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Odeline Billant

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Par

Odeline BILLANT

Freeing the oceans from plastic bag pollution through law: mirage or horizon?

An experiment in numerical comparative law on the shores of the Atlantic Ocean

Thèse présentée et soutenue à Brest, 4 novembre 2022

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L'Université de Bretagne Occidentale n'entend donner aucune approbation ni improbation aux opinions émises dans cette thèse ; ces opinions doivent être considérées comme propres à leurs auteurs.

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List of acronyms

Acronym	Description
ANSES	<i>Autorité Nationale de Sécurité Sanitaire</i>
ANVISA	<i>Agência nacional de vigilância sanitária</i>
BR	Brazil
CCS	Carbon Capture and Storage
CILSS	Permanent Inter-State Committee for the Prevention of Drought in the Sahel
COAHP	<i>Comité Ouest Africain d'Homologation des Pesticides</i>
CONAMA	<i>Conselho Nacional do Meio Ambiente</i>
CPI	Corruption Perception Index
CPIA	Country Policy and Institutional Assessment
CRPU	<i>Comité Régional des Pesticides de l'Union</i>
CV	Cape Verde
DALY	Disability-adjusted life-years
DEFRA	Department of the Environment, Food and Rural Affairs
EA	Environment Agency
ECHA	European Chemicals Agency
ECOWAS	Economic Community of West African Countries
EDI	Environmental Democracy Index
EEA	European Economic Area
EN	England
EPA	Environment Protection Agency
EPI	Environmental Performance Index
EU	European Union
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FL	Florida
FR	France
GDP	Gross Domestic Product

GPA	Global Programme of Action for the protection of the marine environment from land-based activities
HDI	Human Development Index
HDPE	High-density polyethylene
HSE	Health and Safety Executive
IBAMA	<i>Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais</i>
ID	Identification number
IE	Ireland
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
LBP	Land-based pollution
LDPE	Low-density polyethylene
MAA	<i>Ministerio da Agricultura e ambiente</i>
MARPOL	Convention for the Prevention of Pollution from Ships
MEL	Marine environmental law
NA	Non applicable
NGO	Non Governmental Organisation
PE	Pernambouc
RLI	Rule of Law Index
SC	Scotland
SEPA	Scottish Environment Protection Agency
SISNAMA	<i>Sistema Nacional do Meio Ambiente</i>
SLADE	Studies in Law and Development
SN	Senegal
SP	Sao Paulo (state of)
TFEU	Treaty on the Functioning of the European Union
TX	Texas
UCM	Unobserved Components Model
UK	United Kingdom

UN	United Nations Organisation
UNCLOS	United Nations Convention on the Law of the Sea
UNE	United Nations Environment
UNE	United Nations Environment
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
US / USA	United States of America
WAEMU	West African Economic and Monetary Union
WGI	Worldwide Governance Index
WGI	World Governance Index
WTO	World Trade Organisation
WWF	World Wildlife Fund

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*À Marty,
À l'aube de ton grand voyage*

Introduction

“The history of life on earth has been a history of interaction between living things and their surroundings (...). Only within the moment of time represented by the present century has one species – man – acquired significant power to alter the nature of his world”¹. Back in 1962, Rachel Carson, in her now famous *Silent Spring* book, is one of the first to raise the alarm against the danger of man-made chemicals on the environment, but also on human health. Sixty years of hindsight proves her right. In the last decades, the threats posed by human activities on the environment have deepened and expanded through their own intensification².

From time to time, spectacular pollution events such as the wreck of the super tanker Amoco Cadiz³ stir public awareness raising and drive policy making. Many other pollution sources, more discrete and insidious such as pesticides or microplastics, struggle to emerge as central concerns on public agendas.

If the last decades have witnessed the thrive of human threats on ecosystems, it has nonetheless also been marked by unprecedented international and national efforts to protect the environment through law, giving rise to a blooming environmental law.

The hidden potential of a blooming environmental law

The emergence of (marine) environmental law

The progressive integration of environmental stakes in the different fields of law led to the emergence of environmental law as a discipline. ‘Environmental law’, as an expression, “generally refers to a set of legal arrangements deliberately – and sometimes reactively – used or developed to address specific or general problems arising from the impact of human activity

¹ CARSON Rachel, *Silent Spring*, Houghton Mifflin, 1962, 352p., p. 23.

² HALPERN Benjamin S., FRAZIER Melanie, AFFLERBACH Jamie *et al.*, « Recent pace of change in human impact on the world’s ocean », *Scientific Reports*, 9, 2019.

³ On March 16th, 1978 the supertanker Amoco Cadiz grounds on the western coast of Brittany, France. Near to 230 000 tons of crude oil spills out over 360 kilometers of coastline, representing the largest oil spill due to a wreckage. For more information, see for example CEDRE, <http://wwz.cedre.fr/Ressources/Accidentologie/Accidents/Amoco-Cadiz>, accessed 27/06/2022.

on the natural and built environment”⁴. Therefore, environment protection legal frameworks are vast in number and complexity⁵.

Over the last five decades, more than 500 “internationally recognized environmental agreements” have been signed globally⁶, ranging over the protection of the atmosphere, of biodiversity, the regulation of chemicals, hazardous substances or the management of water resources. In addition, legal texts aiming to protect the environment have been adopted nationally and sub nationally.

More specifically, coastal and marine environmental law, which aim is to protect seas and oceans, has been a key issue since the middle of the 20th century. For example, in the 1970s, the International Convention for the Prevention of Pollution from Ships⁷ and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter⁸ are important legal foundations of the protection of seas and oceans. The adoption of the United Nations Convention on the Law of the Sea (UNCLOS)⁹ in 1982, therefore sets a “general obligation to protect and preserve the marine environment”¹⁰. More specifically, UNCLOS provides for an obligation to prevent, reduce and control pollution of the marine environment from land-based sources, from seabed activities subject to national jurisdiction, from activities in the Area, by dumping, from vessels, and from or through the atmosphere¹¹.

Since, oceans, seas and marine resources have been recognized as key features of a sustainable future at several occasions by the European Commission¹² and by the United Nations. Through

⁴ VIÑUALES, Jorge E., Comparative Environmental law: Structuring a Field in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 4.

⁵ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford; New York, Oxford University Press, 2006, 910 p., p. 4.

⁶ AL-ABDULRAZZAK Dalal, GALLAND Grantly R., MCCLLENACHAN Loren *et al.*, « Opportunities for improving global marine conservation through multilateral treaties », *Marine Policy*, 86, 2017, p. 247-252, p. 257.

⁷ International Convention for the Prevention of Pollution from Ships (MARPOL), signed on 2 November 1973 in London, and entered in force on 2 October 1983.

⁸ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, signed in London on December 29th, 1972 and entered into force on August 30th, 1975.

⁹ United Nations Convention on the Law of the Sea, adopted December 10th 1982 in Montego Bay (Jamaica) and entered in force on November 16th 1994.

¹⁰ United Nations Convention on the Law of the Sea, above mentioned, article 192.

¹¹ United Nations Convention on the Law of the Sea, above mentioned, article 207-212.

¹² EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a new approach for a sustainable blue economy in the EU transforming the EU's Blue Economy for a Sustainable Future, COM (2021) 240, Brussels, 17.5.2021; EUROPEAN COMMISSION, Communication from the Commission to the

the launch of the UN decade for Ocean Science for Sustainable Development, the UN recognizes that “the Ocean holds the keys to an equitable and sustainable planet”¹³. The fourteenth United Nations Sustainable Development Goal, dedicated to ocean protection, underlines that “as much as 40 per cent of the ocean is heavily affected by pollution, depleted fisheries, loss of coastal habitats and other human activities”¹⁴. Through their assessment of the health of the global ocean, Halpern *et al.* identify that cumulative human impacts on marine ecosystems are globally increasing and diversifying¹⁵. In echo, the ban of trawl fishing, of deep seabed mining and the protection of biodiversity beyond national jurisdictions have recently been the focus of international negotiations.

The protection of this peculiar environment is nonetheless complex, due to its intrinsic characteristics. First, around two thirds of oceans’ surface remain beyond national jurisdictions. The legal boundaries, set by UNCLOS, additionally remain porous to the diffusion of pollutants or marine species complexifying trackability and the potential identification of polluters. Last, marine ecosystems are particularly wide, vast and interconnected, spanning over two thirds of the Earth. From a legal perspective, UNCLOS provides for a “general obligation to protect and preserve the marine environment”¹⁶. Yet, the sectoralisation of the rules applying to the marine environment addressing the variety of human pressures, combined with the recent expansion of legal frameworks addressing marine environment protection¹⁷ hinders a thorough understanding of protection mechanisms.

European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Innovation in the Blue Economy: realizing the potential of our seas and oceans for jobs and growth, COM (2014) 254 final / 2, Brussels, 13.5.2014.

¹³ OCEAN DECADE, <https://www.oceandecade.org>, accessed 01/08/2022.

¹⁴ UNDP Seoul Policy Centre for Knowledge Exchange through SDG Partnerships, Goal 14: Life Below Water, https://www1.undp.org/content/seoul_policy_center/en/home/sustainable-development-goals.html, accessed 14/06/2022.

¹⁵ HALPERN Benjamin S., FRAZIER Melanie, AFFLERBACH Jamie *et al.*, « Recent pace of change in human impact on the world’s ocean », *Scientific Reports*, 9, 2019.

¹⁶ United Nations Convention on the Law of the Sea, above mentioned, article 192.

¹⁷ AL-ABDULRAZZAK Dalal, GALLAND Grantly R., MCCLENACHAN Loren *et al.*, « Opportunities for improving global marine conservation through multilateral treaties », *Marine Policy*, 86, 2017, p. 247-252, p. 247.

Knowledge gaps left unexplored

As presented by Barnes and Burke, “the social consequences of this intensification of law (...) are unclear”, as “the relationship between law on the books and law on the streets is almost never straightforward”¹⁸. If the function of law is “to direct persons’ actions, their conduct” towards a specific objective¹⁹, there might be, from the start, a gap between the policymakers’ stated intentions and the technical provisions comprised in the text, in regard to their objective. This conception gap can be identified through the analysis of the content of the legal texts. Two other gaps may occur: either between what is provided for in the texts and what is enforced on the ground (*enforcement*²⁰ gap), or between the resulting effects of the text’s enforcement and what would have been needed to resolve the problem at stake (an *effectiveness* gap).

Out of these three gaps, the need to explore the enforcement gap is the most commonly highlighted in legal literature and on the international scene. Enforcement reflects “the act of putting the law into effect”²¹, or “the act or process of compelling *compliance*”²². Therefore, enforcement relates to the process by which legally binding texts exert a force on regulatees²³. Through constraint or credible threat of constraint, enforcement brings regulatees to abide by the law²⁴; therefore ‘enforcement’ can be understood as the ‘enforcement of compliance’²⁵. As it is intended to both deter persons “from violating the regulations and to force violators to return to compliance”²⁶, it is an essential contributor to the protection of the environment

¹⁸ BARNES Jeb et BURKE Thomas F., « The Diffusion of Rights: From Law on the Books to Organizational Rights Practices », *Law & Society Review*, 40, 2006, n° 3, p. 493-524, p. 494.

¹⁹ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, Uppsala, Uppsala University, Department of Law, 2007, 664p., p. 32.

²⁰ Words in bold and italic are specifically defined in the Glossary, see Annex XVIII, at the end of this document.

²¹ LYNTON Jonathan, *Ballentine’s Legal Dictionary/Thesaurus*, 1st edition, Albany: Rochester, N.Y., Cengage Learning, 1994, 736 p., p. 213.

²² GARNER Bryan A., *Black’s Law Dictionary*, 10th edition, St. Paul, MN, Thomson West, 2014, 2052 p., p. 644.

²³ See also the definition proposed by Rose: “Enforcement is ‘the range of procedures and actions employed by a State, its competent authorities and agencies to ensure that organisations or persons, potentially failing to comply with environmental laws or regulations implementing multilateral environmental agreements, can be brought or returned into compliance and/or punished through civil administrative or criminal action’.” » ROSE Gregory L., « Gaps in the Implementation of Environmental Law at the National, Regional and Global Level », Kuala Lumpur, Malaysia, UNEP, 2011, p. 9.

²⁴ RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p.1.

²⁵ ARDIA David S., « Does the Emperor Have No Clothes? Enforcement of International Laws Protecting the Marine Environment », *Michigan Journal of International Law*, 1998, p. 497-567, p. 3.

²⁶ RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p.16.

through law²⁷. To be enforced, law must first be implemented. *Implementation* refers in this context to “the process of bringing any piece of legislation into force”²⁸, requiring the design of successive legal texts precisising the regulation’s scope and setting the tools that will be used to enforce the law.

The need to assess the implementation²⁹ and enforcement of environmental law has been outlined at several occasions on the international scene³⁰. In 2009, the Fourth Montevideo Programs for the Development and Periodic Review of Environmental Law specifically calls for the achievement of “effective implementation of, compliance with, and enforcement of environmental law”³¹. The European Union has also highlighted the need to further implementation, which has been set as a priority action to 2020 in November 2013³², including by developing research to assess the implementation of law, through its Seventh Framework Programme for Research. In addition, the UN highlights that “enforcement of law is perhaps the ultimate expression of state political will and seriousness of purpose, and compliance is the strongest indicator of environmental *rule of law*”³³, but that there are significant data gaps and a need for indicators to measure, track, and report on environmental rule of law performance”³⁴. More specifically related to marine and coastal environments, the current knowledge gap on

²⁷ KRAMER Ludwig, *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p., p. xvi. See also UNE, « Environmental Rule of Law », Nairobi, United Nations Environment, 2019, p. 13.

²⁸ LAW Jonathan, *A Dictionary of Law*, 8th edition, Oxford, United Kingdom, OUP Oxford, 2015, 704 p.

²⁹ Implementation has been qualified as “the greatest challenge of our century” by the Organization of American States’ General Chief of Staff Hugo de Zela on the signing of the Agreement on Environmental Rule of Law and Sustainable Development, 19 November 2014, Wahington, D.C. Cited in MARTIN Paul et KENNEDY Amanda, *Implementing Environmental Law*, Edward Elgar Publishing Limited, 2015, p. 9.

³⁰ As an illustration, the 4th IUCN Academy of Environmental Law Colloquium was dedicated to this issue: Toward More Effective Implementation of Environmental Law: Enforcement and Compliance, October 16-20, 2006, Pace University School of Law. See also PRIEUR Michel, BASTIN Christophe et MEKOUAR Mohamed Ali, « Mesurer l’effectivité du droit de l’environnement. Des indicateurs juridiques au service du développement durable », Brussels, Belgium, Chaire de Normandie pour la Paix, 2021.

³¹ UNITED NATIONS ENVIRONMENT PROGRAMME, Fourth Programme for the Development and Periodic Review of Environmental Law (Montevideo Programme IV), UNEP/Env.Law/2010/1, UNEP, Nairobi, 2010, p. 2.

³² Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 ‘Living well, within the limits of our planet’, published in the Official Journal of the European Union L354/171 on December 28th 2013.

³³ UNE, « Environmental Rule of Law », Nairobi, United Nations Environment, 2019, p. 33.

³⁴ *Ibid.*, p. 16.

enforcement has been underlined in the United Nations' First Global Integrated Marine Assessment³⁵.

Next, an effectiveness gap reveals an inadequacy between the effects of the enforcement of the legal framework, and the desired result³⁶. It can find its sources in the existence of a conception or of an enforcement gap, but also outside of the legal sphere. Non-legal factors, such as the sociological responses to the enforcement of the provisions or an evolution of environmental, sociological or economic contexts can impact the effectiveness of the legal framework.

The investigation of the conception gap is therefore key to determine the extent to which law protects the environment. For example, even a well enforced legal framework could have a limited impact if its scope is uncomprehensive. Its analysis, which is commonly the focus of legal research, requires an access to the legal texts adopted, which is now facilitated by the development of national and international open access legal databases such as Ecolex³⁷. Doing so, it also enables to improve the knowledge of the existence and content of legal texts; in other words, on 'where, when and how' the legislator intends to protect the environment. The analysis of the conception gap may also usefully inform the analysis of the enforcement gap, by highlighting the lack of enforcement provisions such as controls or sanctions.

The investigation of these three gaps represents an important issue to push forward the protection of the environment. Unawareness of the existence and importance of these gaps may hide protection voids, where legal texts have been adopted but are non-protective. It would also highlight the conditions under which law protects the environment, and value law's contribution to the protection of the environment.

These three gaps are nonetheless closely intertwined, and their examination represents a wide field of interdisciplinary research. The focus is here set on the analysis of the conception gap, which represents a prerequisite for an analysis of the existence and consequences of enforcement and effectiveness gaps. Indeed, both of the latter can be impacted by the existence and characteristics of a conception gap. In addition, analysing the conceptual gap highlights the importance of law design and puts forward the differentiated approaches to a single problem.

³⁵ INNISS Lorna et SIMCOCK Alan, « The First Global Integrated Marine Assessment », United Nations General Assembly, 2016, p. 28.

³⁶ The word effectiveness can here be defined as "having the power to produce (...) a desired result". OECD, Glossary of Statistical Terms, accessed <https://stats.oecd.org/glossary/detail.asp?ID=4776> on 10/12/2021.

³⁷ Ecolex, <https://www.ecolex.org>, accessed 14/06/2022.

Once these differentiated approaches mapped out, it is possible to analyse and compare their differentiated or common outputs and outcomes, or in other words enforcement and effectiveness gaps.

The shimmering perspective of legal indicators

Despite the existence of several hundred international treaties related to the protection of the environment and multiple national frameworks, current assessments of the state of the environment³⁸ are only based on ecological, economic or social indicators overlooking international and national law. The dialogue between different disciplines such as biology, ecology, geography & law, essential in the context of the protection of the environment³⁹, has been hindered by the lack of appropriate tools and a shared language, triggering calls for the development of alternative methodologies to the analysis of law, among which the design of legal indicators.

The call for the design of legal indicators and alternative methodologies to the analysis of law

As early as 1992, the Rio Conference called on the states to “develop and identify indicators of sustainable development in order to improve the information basis for decision-making at all levels”⁴⁰, and more recently by the Convention of Parties to the Convention on Biological Diversity⁴¹. This call was reinforced by the European Union: while the Marine Strategy Framework Directive specifically requires Member States to design environmental indicators⁴²,

³⁸ See for example the Ocean Health Index, HALPERN Benjamin S., LONGO Catherine, HARDY Darren *et al.*, « An index to assess the health and benefits of the global ocean », *Nature*, 488, 2012; or the Global Integrated Marine Assessment, INNIS Lorna et SIMCOCK Alan, « The First Global Integrated Marine Assessment », United Nations General Assembly, 2016; and the Global Environment Outlook, UNE, « Global Environmental Outlook », 6th edition, United Nations Environment, 2019.

³⁹ OWEN Dave et NOBLET Caroline, « Interdisciplinary Research and Environmental Law », *Ecology Law Quarterly*, 41, 2014, n° 4, p. 887-938, p. 890.

⁴⁰ UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT, Agenda 21: programme of action for sustainable development, Rio Declaration on Environment and Development, 3-14 June 1992, Rio de Janeiro, Brazil, 294p, Chapter 40.

⁴¹ CONVENTION ON BIOLOGICAL DIVERSITY, Thirteenth meeting of the Conference of the Parties, 4-17 December 2016, Decision XIII/28, Indicators for the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets paragraph 13.

⁴² Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), Official Journal of the European Union L164/19 of 25.06.2008, p. 19-40, Articles 5 and 10.

the Seventh Framework Programme of the European Community for research calls for the design of indicators in the socio-economic sciences and humanities⁴³. The call for the emergence of legal indicators also emerged from the civil society⁴⁴.

If initiatives developing sustainability and environmental indicators have been developed since the 1990s⁴⁵, the development of legal indicators remains scarce, although increasing rapidly⁴⁶. Most initiatives were developed in the fields of finance law, human rights and governance; for now, very few are related to environmental law. For this reason, current environmental assessments are based on numerous indicators to the exclusion of legal indicators, perpetuating the existence of a knowledge gap on law's contribution to the protection of the environment.

The development of legal indicators is closely related to a turn towards empirical and quantitative or numerical approaches to law.

The first relates to a shift in methodological approaches to law, valuing the “objective understanding of empirical phenomena” and the “rejection of subjectivity as the basis for investigations”⁴⁷. To do so, Martin and Kennedy call for the development of scientific methods to the analysis of law which would improve lawyers’ “ability to fruitfully interact with empirical disciplines, and to take the leadership in the development of the knowledge that is necessary for more effective environmental governance”⁴⁸. Therefore, empirical approaches to law can be described as the use of “research methods from the social sciences (...) to examine research questions in the legal sciences in order to study the operative and functional aspects of

⁴³ Decision n° 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013), Official Journal of the European Union L412/1, 30.12.2006, p. 24.

⁴⁴ ABEL Jean-David, CHEVASSUS-AU-LOUIS Bernard, HOSY Christian *et al.*, « Livre Blanc Pour que vive la nature », Collectif de 14 ONG, 2020, objectif 1.1.4, p. 35. See also the motion adopted at the 2020 IUCN World Conservation Congress, « Mesurer l'effectivité du droit de l'environnement grâce à des indicateurs juridiques », <https://www.iucncongress2020.org/fr/motion/060>, accessed 15/06/2022.

⁴⁵ See BÖHRINGER Christoph et JOCHEM Patrick E. P., « Measuring the immeasurable — A survey of sustainability indices », *Ecological Economics*, 63, 2007. See also the table 2 in Annex 5, presenting the key characteristics of indicator-based initiatives in the field of environment or development

⁴⁶ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, « Indicators as a Technology of Global Governance », *Law & Society Review*, 46, 2012.

⁴⁷ MARTIN Paul et KENNEDY Amanda, *Implementing Environmental Law*, Edward Elgar Publishing Limited, 2015, 372p., p. 9.

⁴⁸ *Ibid.*, p. 42.

the law and their effects”⁴⁹. In other words, it “means collecting and analysing data about law”, with aims ranging from the increase of knowledge “on some aspect of law, or to lay the groundwork for reform, or to build a set of generalizations about law”⁵⁰.

Rather than the replacement of traditional doctrinal research, the authors value empirical legal research as a complementary approach⁵¹. In addition, empirical research could be of use to legal theory by revealing “features of law which are not known by common sense and limited experience and which might be of use in identifying and refining theoretical concepts”⁵².

The emergence of quantitative or numerical approaches answers to the same need for alternative methodologies to the analysis of law, although it emerged later than in other fields in the social sciences⁵³. Quantitative approaches to law may, or may not, be related to the use of indicators, as they can also pertain to “count facts about law”⁵⁴, “code law”⁵⁵ or “conduct survey about law”⁵⁶. These kinds of approaches mostly emerged in comparative law, to facilitate and bring a new light to comparisons between the legal systems of different countries. The analysis of the diversity of these law measurement initiatives brought Siems to introduce the term “numerical comparative law”, defined as quantitative approaches to comparative law⁵⁷.

⁴⁹ WULF Alexander J., « The Contribution of Empirical Research to Law », *Journal Jurisprudence*, 29, 2016, p. 29-49, p. 30.

⁵⁰ GALLIGAN Denis J., “Legal Theory and Empirical Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 979.

⁵¹ DAVIES Gareth, « The Relationship between Empirical Legal Studies and Doctrinal Legal Research », *Erasmus Law Review*, 13, 2020, n° 2, p. 3-12, p. 8.

⁵² GALLIGAN Denis J., “Legal Theory and Empirical Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 992.

⁵³ GAZELL James A., « A Stalled Upheaval: A Quantitative Analysis of Legal Research Modes », *New England Law Review*, 8, 1973 1972, n° 1, p. 1-36, p. 6.

⁵⁴ “‘counting facts about law’ refers to information which can simply be counted, for example, how often one court cites one another, or how many laws there are in a particular country”. SIEMS Mathias, *Comparative Law*, 2ème., Cambridge, Cambridge University Press, 2018, 506 p., p. 181.

⁵⁵ “‘coding law’ is based on mechanisms which translate the form or substance of legal rules into numbers. For example, we may code countries that have the death penalty as ‘1’ and those that do not have it as ‘0’”, *ibid.*

⁵⁶ “‘conducting surveys about the law’ can concern different types of information. Surveys can ask socio-legal questions about the law in action (...) but can also be about other topics such as the influence of foreign law (...)”, *ibid.*

⁵⁷ SIEMS Mathias M., « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 521.

Many other initiatives, linking quantitative and computational tools to the analysis of law, have emerged from the development of open-data⁵⁸ concerns and tools such as machine learning and artificial intelligence⁵⁹. The aim of this work is to adapt numerical comparative law methodologies, mainly developed in corporate law⁶⁰, to the analysis of the content of environmental law in regard to the protection of the environment through, *inter alia*, the use of legal indicators. Doing so, it aims to both inform the similarities and differences between countries' legal frameworks, and identify their strengths and weaknesses in regard to the protection of the environment. These two aspects constitute two of the three core topics of numerical comparative law⁶¹.

Defining legal indicators

As the design and use of legal indicators is central to this work, their definition is essential. Etymologically, the word 'indicator' can be traced back to the Latin verb *indicare*, "meaning to disclose or point out, to announce or make publicly known, or to estimate or put a price on"⁶². Therefore, indicators are used to display information on the progress towards a specific goal. Especially in the socio-economic domain, the evolutions of many phenomena cannot be observed through directly measurable variables; "hence the measurement of intensity of the phenomenon in question is not a straightforward task"⁶³. The use of indicators, designed to

⁵⁸ See for example Etalab, a department attached to the French inter-ministerial department for digitalization (DINUM, *direction interministérielle du numérique*), coordinating the public policy for open access of public data. <https://www.etalab.gouv.fr>, accessed 27/06/2022.

⁵⁹ See for example DataJust, a two-year experimental project supported by the French Ministry of Justice based on the analysis of appeal court decisions by an artificial intelligence. The objective is to provide judges, lawyers and litigants with an indicative benchmark for personal injury compensation. <https://www.justice.fr/donnees-personnelles/datajust>, accessed 27/06/2022.

⁶⁰ *Ibid*, p. 522.

⁶¹ SIEMS Mathias, *Comparative Law, op.cit.*, p.180.

⁶² HAMMOND Allen, « Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development », World Resources Institute, 1995, p. 1.

⁶³ OWSIŃSKI Jan W., « Is There Any 'Law of Requisite Variety' in Construction of Indices for Complex Systems? », *Social Indicators Research*, 136, 2018, n° 3, p. 1125-1137, p. 1125.

relate to different aspects of the phenomena, serve as proxies⁶⁴ to observe and compare the phenomena as a whole⁶⁵.

In their Handbook on Constructing Composite Indicators⁶⁶, the OECD and JRC Commission⁶⁷ define an indicator as “a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (*e.g.*, of a country) in a given area”. Based on this definition, there are different aspects to the composition of an indicator.

First, an indicator is a measure of a qualitative or a quantitative nature. In both cases, measuring aims “to discover the exact size or amount of something”⁶⁸. Measuring provides knowledge on the intrinsic properties of an object or subject, at a given time and space, as these properties are not set in stone. One of the benefits of indicators is precisely to compare the measures of a same object or subject across time and space, and therefore to compare countries’ legal frameworks. As such, the components contributing to its definition must remain stable, to allow comparisons whether the measure is qualitative or quantitative.

Second, an indicator is ‘derived from a series of observed facts’, meaning that it is strongly linked to that series of observed facts. Would the series change, the results of the indicator would change as well. The context and constraints encountered in the data selection, collection and analysis phases are key to the interpretation of the indicator. Thus, indicators are tailored to a specific data context, such as the geographic scale of analysis. If it remains possible to compare indicators to one another, this potential bias must be kept in mind.

Last, indicators can provide information on “relative positions (*e.g.*, of a country) in a given area”⁶⁹. Indicators do not pretend to rate and hierarchise elements (*e.g.*, countries) in absolute terms, but rather relatively (compare one another) on a specific subject. Yet, a specific subject

⁶⁴ UNITED NATIONS DEVELOPMENT PROGRAMME, “Why, what and how to measure? A user’s guide to measuring rule of law, justice and security programmes”, New York, United Nations Development Programme, 2014, p. 21.

⁶⁵ BRADLEY Christopher G., « International Organizations and the Production of Indicators », in Davis Kevin E., Kingsbury Benedict et Merry Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 27-74, p. 27.

⁶⁶ OECD et JRC EUROPEAN COMMISSION, « Handbook on Constructing Composite Indicators. Methodology and User guide », Paris, France, Organisation for Economic Co-operation and Development, 2008.

⁶⁷ Organisation for Economic Co-operation and Development, <https://www.oecd.org>

Joint Research Center of the European Commission, ‘the Commission’s science and knowledge service’, <https://ec.europa.eu/info/departments/joint-research-centre>.

⁶⁸ <https://dictionary.cambridge.org/fr/dictionnaire/anglais/measure>, accessed 22/07/2020.

⁶⁹ Here, ‘area’ must be understood as ‘field of knowledge’ rather than as a region.

can be explored from a variety of standpoints with a diversity of underlying motivations. For example, it is unlikely that an environmental NGO and a pro-business think tank would develop indicators relative to environmental regulations with the same prospects. The first will likely put forward the progress towards a better protection of the environment, while the second might set the focus on the barriers to trade raised by environmental law. The actors behind the design of the indicators can therefore provide enlightening hints on the interpretation of the indicators. As such, indicators provide information but knowledge arises from their interpretation.

Davis' definition of indicators provides useful add-ins to the previous one. He defines it as “a named collection of rank-ordered data that purports to represent the past or projected performance of different units. The data are generated through a process that simplifies raw data about a complex social phenomenon. The data, in this simplified and processed form, are capable of being used to compare particular units of analysis”⁷⁰. The temporal component of indicators is here highlighted in their capacity, through interpretation, to explain the past, or predict the future. Additionally, they are here presented as a process “that simplifies raw data about a complex social phenomenon”. As such, indicators do not pretend to provide an exact picture of the phenomenon they represent, but rather a simplification facilitating our understanding of this phenomenon and underlying characteristics. Simplification casts a new light on the phenomenon, under which new analyses will emerge. Trial-and-error methods should gradually lead to a more precise and comprehensive understanding of the analysed phenomenon.

Therefore, there are two different components to indicators. First, they “provide information in more quantitative form than words or pictures alone (...) so its significance is more readily apparent”. Second, they “simplify information about complex phenomena to improve communication”⁷¹ on the basis of a specific methodology. Indicators can be quantitative,

⁷⁰ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p. 4.

⁷¹ HAMMOND Allen, « Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development », World Resources Institute, 1995, p.1.

qualitative, or a mix between the two⁷². Composite or aggregate indicators, such as the country scores of the Rule of Law⁷³ or Corruption Perception Indexes⁷⁴, are compilation of other indicators, to which can be allocated various weights. More specifically, legal indicators “are indicators whose names suggest they measure the performance of some component of one or more legal systems along a particular dimension”⁷⁵.

In other words, indicators are first and foremost an analytical and communicating tool to deal with complexity across time and space. They can facilitate communication between parties on a same subject, summarize multiple data, and tackle complexity. Doing so, they can contribute to transcend disciplinary frontiers by providing a shared language specifically needed in the interactions of environmental law with other disciplines⁷⁶. In addition, by providing “a one-dimensional metric to valuate country specific information”⁷⁷, new research fields could emerge at the intersection between legal indicators and environmental, economic or social indicators. In addition, some authors highlight that the communication of environmental indicators in democratic countries can contribute to “push governments to act on perceived problems”, by facilitating the public’s grasp of the problem⁷⁸.

Therefore, there is a large array of approaches to the development of indicators informing a common complex phenomenon, such as the potential conception, enforcement and

⁷² DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p. 4.

⁷³ World Justice Project, Rule of Law Index, <https://worldjusticeproject.org/rule-of-law-index/>, accessed 17/06/2022.

⁷⁴ Transparency International, <https://www.transparency.org/en/cpi/2021>, accessed 17/06/2022

⁷⁵ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52, p. 39.

⁷⁶ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, Uppsala, Uppsala University, Department of Law, 2007, 664p., p. 56.

⁷⁷ BÖHRINGER Christoph et JOCHEM Patrick E. P., « Measuring the immeasurable — A survey of sustainability indices », *Ecological Economics*, 63, 2007, p. 1.

⁷⁸ HAMMOND Allen, « Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development », World Resources Institute, 1995, p. vii.

See also PRIEUR Michel et MEKOUAR Mohamed Ali, « Measuring the Effectivity of Environmental Law Through Legal Indicators in the Context of Francophone Africa », in *Blazing the trail: Professor Charles Okidi’s enduring legacy in the development of environmental law*, School of Law, University of Nairobi, 2019, p. 241.

effectiveness gaps of a legal system. For example, the Regulation (EU) 2021/2115⁷⁹ provides for an example of a series of indicators integrated to the regulation to monitor and evaluate the common agricultural policy. These indicators, provided for in Annex I of the Regulation, cover impact, result, output and context indicators. Whereas impact and result indicators may inform a potential effectiveness gap, output indicators inform a potential implementation and enforcement gap. Context indicators here inform the countries' sociological and economic context, serving as variables to explain potential variability encountered over impact, result and output indicators.

In the same perspective, indicators relating to law's contribution to the protection of the (marine) environment could distinctively inform the different potential gaps.

The investigation of the conception gap through indicators requires to analyse the legal framework relevant to the specific field of investigation, to identify whether it contains all the necessary elements to be both impactful – through a comprehensive approach to the issue – and enforceable – through for example the provision for controls and sanctions. For example, the indicators should indicate whether a country's environmental law omits to regulate an entire portion of pollutants proved to be harmful to oceans, or omits to provide for sanctions in case of non-compliance with the law.

The identification of implementation and enforcement gaps would require to provide indicators on the implementation and enforcement of law. As regards implementation, the indicators would have to provide answers to the following questions: are all the legal provisions concretely applicable? Do the absence or incompleteness of implementing texts put in danger the enforcement of the legal provisions? The design of indicators of enforcement would require to indicate whether compliers are identified, controls pursued and sanctions imposed for example. Nevertheless, linking these results with the contribution of law to the protection of the environment could be delicate on the interpretation front. For example, should a high number of applied sanctions be an indicator of a well enforced regulation, or of a low level of compliance? To the contrary, a low number of applied sanctions could be interpreted as a high level of compliance, or as an absence of enforcement of the regulation. The investigation of the

⁷⁹ Regulation 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013, published in the Official Journal L 435, 6.12.2021, p. 1-186.

means available for enforcement administrations or the dissuasiveness of the sanctions could provide avenues for such research; ultimately aiming to measure whether violations still occur. These last two elements nonetheless lie outside of the scope of legal research, requiring an interdisciplinary approach.

Likewise, indicators informing the potential effectiveness gap would measure the effects of the enforcement of the regulation on, for example, the level of pollution. The indicators should therefore enable to monitor the level of pollution prior to the enforcement of the regulation, and its evolution, while determining whether the extent to which the legal provisions are responsible for this evolution.

In any case, particular attention must be brought, when working with indicators, to what does the indicator indicate, but also to what the indicator does not indicate. If this work's focus on the conception gap has already been mentioned, further details are needed to explicit the particular focus of this research.

The scope of the present study

An analysis of legal frameworks' potential contribution to the protection of the environment

As presented by Deumier, policy making implies two distinct actions: the choice of a *politique juridique* and the design of a *technique juridique*⁸⁰. The second consists in the operationalisation of the first, which is the formulation of a general policy objective to be reached through law, such as the ban of plastic bags. This distinction between *politique* and *technique* highlights that the *politique juridique* “will miss its purpose if its formulation does not allow it to produce the desired effects”⁸¹, and therefore the importance of an analysis of the content of legal texts regulating, for example, a source of pollution.

The scope of this study is specifically focused on the qualitative and quantitative analysis of the content, or *technique juridique*, of countries' legal frameworks attached to the protection of marine environments. These analyses offer two complementary perspectives. First, they

⁸⁰ DEUMIER Pascale, *Introduction générale au droit*, 4th éd., Issy-les-Moulineaux, LGDJ, Lextenso éditions, 2017, 390 p., p. 64.

⁸¹ Translated by the author. « La politique juridique manquera son but si sa formulation ne lui permet pas de produire les effets recherchés ». *Ibid.*

highlight the diversity and complexity of countries' approaches to similar environmental issues. Second, the specific design of indicators measuring legal frameworks' conception gap informs the potential of protection offered by the legal texts in themselves, prior to their enforcement. In other words, the exploration of the *technique juridique* wielded in the analysed legal systems here serves to identify potential levers to further the protection of the environment. The analysis of the legal framework therefore uncovers what the legal texts provide, and do not provide for, to reveal its potential contribution to the protection of the environment. The provision for legal frameworks aiming to protect the environment being the first link of the chain by which law will contribute to its protection, this work aims to determine the extent to which adopted legal frameworks contains all the necessary requirements to fulfil its mission.

Whereas the analysis of a conception gap directly stems from the analysis of the content of the legal texts adopted, the analysis of enforcement and effectiveness gaps require to reach beyond, by incorporating non-legal elements to the analysis. For example, an analysis of the enforcement gap would require to explore whether the administrations in charge of enforcement have the necessary funding, human resources and tools to carry out their mission. In addition, an analysis of the effectiveness gap would require, for example, to analyse the extent to which the overall emissions of the targeted pollutant have increased or decreased. The analysis of both enforcement and effectiveness gaps will be required to determine the extent to which law protects the environment. The present work is focused on the analysis of the conception gap, excluding the other two, hence the "potential" character of the protection of the environment here measured. As such, this work must be considered as a first step towards the demonstration of where, when and how law effectively protects the ocean.

In the context of this work, the analysed legal framework is composed of the collection of currently in force legal texts adopted by countries' legislative and executive powers at the national, and state levels where relevant in federal countries. Therefore, the adoption of implementing texts relevant to the case-study flows in the analysis of the countries' legal framework. Besides, regulation, understood as "deliberate state influence (...), all state actions that are designed to influence business or social behaviour"⁸², is here used to describe the action undertaken towards the constitution of a legal framework, through the adoption of legal texts.

⁸² BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p, p3.

Case law is not analysed here as part of the legal framework due to technical and time constraints, relative to the important number of analysed countries and the challenge to access to case-law data at distance in some countries⁸³. The technicity of the area of law analysed in this work (*i.e.*, the regulation of plastic bags), leaves a limited room for interpretation, therefore enabling the comparison of civil law and common law countries⁸⁴.

In addition, the analysis of the content of the legal framework requires to dive in the analysis of its different components, and in the relationships between these different components. The regulation of an environmental issue first requires to define the range of situations, behaviours or items to which the regulation applies. This first component is here referred to as the ‘object’ of the regulation. Second, the regulation defines the type of rules which will apply to these objects, here called the policy instrument⁸⁵ – in short, the instrument. Policy instruments can be defined as “the set of techniques by which behavioural change [is triggered] among a particular target group”⁸⁶ by legislative or executive powers. The spectrum of policy instruments used in environmental policy has gradually expanded these last decades, now spanning over traditional regulatory approaches such as command-and-control instruments, or market-based initiatives and awareness-raising⁸⁷. Voluntary tools and measures might also be used to “complement legislative frameworks and to engage stakeholders at different levels”⁸⁸. Whereas some institutions consider policy instruments more broadly than being “designed and implemented

⁸³ Accessing jurisprudence data at distance can be challenging in countries such as Senegal. Originally planned research trips to Senegal had to be abandoned with the outburst of the Covid-19 pandemic. See annex X for the impacts of the Covid-19 pandemic on the thesis.

⁸⁴ This aspect will be further dealt with in Part 1, Title 2.

⁸⁵ Policy instruments must be distinct from legal instruments, commonly understood as “a written legal document that records the formal execution of legally enforceable acts or agreements, and secures their associated legal rights, obligations, and duties”, Legal Information Institute, Cornell Law School, <https://www.law.cornell.edu/wex/instrument>, accessed 15/02/2022.

⁸⁶ LEE Rhiannon, DEN UYL Roos et RUNHAAR Hens, « Assessment of policy instruments for pesticide use reduction in Europe; Learning from a systematic literature review », *Crop Protection*, 126, 2019, p. 104929.

See also BOUWMA I. M., GERRITSEN A. I., KAMPHORST D. A. *et al.*, « Policy instruments and modes of governance in environmental policies of the European Union: past, present and future », Wageningen, Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), 2015.

⁸⁷ European Environment Agency, <https://www.eea.europa.eu/themes/policy/intro>, accessed 15/02/2022.

⁸⁸ DECISION No 1386/2013/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 November 2013 on a General Union Environment Action Programme to 2020 ‘Living well, within the limits of our planet’, Recital 3. The European Union also continuously refers to policy instruments with the same meaning in the European Commission’s *Better Regulation Toolbox*, EUROPEAN COMMISSION, « Better Regulation Toolbox », Brussels, European Commission, 2021, see especially pp. 120-129.

by public authorities only” such as the IPBES⁸⁹, for the purposes of this analysis, policy instruments endorsed by legislative or regulatory powers through the adoption of a legal text will solely be considered. The last two analysed components are the provision for controls and sanctions, required to enforce the regulation. The interactions between these different components will also be analysed, as for example the sanctions provided for can be applicable to an instrument but not to another. The development of computational tools, such as a tailored relational database, will facilitate these analyses.

The analysis of legal frameworks’ potential contribution to the protection of the environment, based on the analysis of the content of legal texts, prior to their enforcement, could serve a diversity of purposes. First, the identification of a potential conception gap has already mentioned as a useful precondition to the analysis of law’s enforcement and effectiveness, both decisive to guarantee law’s contribution to the protection of the environment. In addition, it would enable to highlight both the strengths and weaknesses of currently in force law in regard to the protection of the environment, offer a snapshot of the current state of environmental legal frameworks and monitor the evolutions of environmental law. The complexity and variety of legal frameworks around the world nonetheless hinder the progress of such analyses. The design and development of quantitative tools, such as legal indicators, and computational tools, such as a relational database, could facilitate such analyses and access to legal data to non-lawyers.

This work precisely aims to experiment the development of such tools to analyse marine environmental legal frameworks’ potential contribution to the protection of the environment.

An experiment on plastic pollution on the shores of the Atlantic Ocean

Threats to marine environments are wide-ranging, from land-based pollution to fisheries passing by maritime traffic, coastal artificialisation, exploitation of natural resources and marine pollution⁹⁰. Therefore, the exploratory nature of this work required to settle both a thematic and geographical case-study.

⁸⁹ Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), <https://ipbes.net/policy-instruments>, accessed 15/02/2022.

⁹⁰ INNISS Lorna et SIMCOCK Alan, « The First Global Integrated Marine Assessment », United Nations General Assembly, 2016, Part V.

A focus on plastic pollution, as a primary source of land-based pollution

Out of the many threats to the marine environment, land-based pollution has been chosen as the overarching focus of this work. It is estimated that land-based pollution represents 80% of pollution at sea⁹¹ and is responsible for a range of impacts on ecosystems human health and livelihoods. Just like there are no boundaries at sea, land-based pollution is a global, transboundary issue. As land-based pollution finds its source on land and drifts away at sea washed up by rains and rivers, countries have a large latitude to regulate its sources both through national law and international law, through cooperation mechanisms.

In 1995, 108 governments and the European Commission gathered to adopt the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA)⁹². It “works to identify the sources of land-based pollution or harmful activities, and prepares priority action programmes of measures to reduce them”⁹³. Since 2012, three components of land-based pollution have been identified by the GPA as priority sources: marine litter (mainly composed of plastics), pesticides and sewage⁹⁴. There are nonetheless a wide variety of land-based pollution sources spanning over chemical wastes, sediments, cleaning agents, petroleum products or pharmaceutical products.

These three priority sources are significantly different on a variety of aspects, but closely interlinked. To start with, sewage is a technology designed to filter and purify used water before releasing it back into rivers or directly into the ocean. Contrary to the other two priority sources, it is the absence or defect of sewage which is harmful to ocean health. The type and variety of targeted contaminants widely depend on the prior use of the discharged water, be it domestic, industrial, or rainwater. Sewage can target organic material (among which we could find

⁹¹ UNITED NATIONS ENVIRONMENT, “Land-based pollution” <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution>, accessed 10/06/2020. Other sources of pollution at sea are vessel based, issued from seabed activities, from dumping at sea and from or through the atmosphere. See United Nations Convention on the Law of the Sea, above mentioned, articles 208 to 212.

⁹² The GPA is an intergovernmental mechanism adopted by 108 Governments and the European Commission issued from the Washington Declaration on Protection of the Marine Environment from Land-Based Activities, adopted on November 3rd 1995 in Washington, United States of America.

⁹³ UNITED NATIONS ENVIRONMENT, “Land-based pollution”, *op. cit.*, accessed 21/06/2022

⁹⁴ § 5 of the Manila Declaration on Furthering the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities adopted by the Intergovernmental Review Meeting on the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, January 2012

nutrients) heavy metals, chemicals (among which we could find pesticides), and solid waste (among which we could find plastic). Performant sewage technologies could prevent some plastics and pesticides from entering into the ocean. Nonetheless, few sewage plants are currently in capacity to filter micro-plastics, and pesticides most often enter the environment outside of sewage installations.

Plastic is an artificial, man-made material “that can be shaped when soft into many different forms and has many different uses”⁹⁵. For long considered as a miraculous material, the characteristics that made it so popular and ubiquitous ended up being a major threat to ecosystems. Contrary to pesticides, one could argue that plastic is not aimed at being harmful to the living. The raised health and environmental issues are rather due to our uses, capability to reuse or recycle, and available discarding means leading it to end up into the environment where it has diverse impacts.

Pesticides are chemicals specifically designed and used for their capacity to harm the living⁹⁶. By their very definition, their presence in ecosystems is intentional. Human-beings and societies choose to spray pesticides on crops, insects, fungus or mammals as we consider that the existence of the latter is more harmful than the mean to get rid of it. The pesticides found in the environment are residues⁹⁷; but just like plastic, the chemical components can take years to degrade into a primitive form, a stack of ‘CHON’⁹⁸ components. Pesticides are known to be used in agriculture, but not only. Domestic and public uses represent a significant proportion of the pesticides used⁹⁹.

The use of pesticides, consumption and discard of plastic, and need for or performance of sewage plants is tightly interrelated to the functioning of societies and consumption patterns. As such, these issues are also tightly entangled with cultural, social, economic factors and individual choices. Fighting land-based pollution requires a holistic approach questioning not

⁹⁵ <https://dictionary.cambridge.org/fr/dictionnaire/anglais/plastic> accessed 15/07/2020

⁹⁶ “The term pesticide refers to any substance used in the control of pests as defined by humans”, HOUGH Peter, *The Global Politics of Pesticides: Forging consensus from conflicting interests*, London, Routledge, 2014, 244 p., p. 4.

⁹⁷ “The part that is left after the main part has gone or been taken away, or a substance that remains after a chemical process such as evaporation”, <https://dictionary.cambridge.org/fr/dictionnaire/anglais/residue>, accessed the 15/07/2020

⁹⁸ A chemical is considered as degraded once it is reduced to carbon, hydrogen, oxygen, and nitrogen components, referred to as CHON.

⁹⁹ For example, in France, the national railway company (“SNCF”) is often referred to as the main glyphosate user.

only how poisonous substances end up in the environment, but why and what can be done to reverse the current trend. The point of this work is not to push forward the debate whether to cut or untangle the Gordian knot; but rather to critically analyse how environmental law seeks to fight such pollution sources, in a comparative perspective. The experiment of the use of quantitative tools to the analysis of legal frameworks' potential contribution to the protection of the environment nonetheless requires a much more restricted focus, which has been set on the regulation of plastic bags, as a contributor to marine litter.

Plastic has revolutionized industry and consumers' behaviour these last decades, becoming central to consumption patterns throughout the world¹⁰⁰. Lightweight, cheap and resistant, these once promising characteristics are now the drivers of a globalized pollution¹⁰¹ accumulating in the environment and even in the most remote places of the world¹⁰². It is estimated that “11 million metric tons of plastic entered the ocean from land in 2016 adding to the estimated 150 million metric tons of plastic already in the ocean” whereas “the cumulative amount of plastic stock in the ocean could grow by 450 million metric tons in the next 20 years”¹⁰³.

Under the action of waves, wind and ultraviolet light, plastic is fragmented into smaller parts, namely micro and nano plastics¹⁰⁴. Plastic has been found in marine species spanning from whales¹⁰⁵ to commercially sold shellfish¹⁰⁶. In particular, the absorption of microplastic raises

¹⁰⁰ AZOULAY David, VILLA Priscillia, ARELLANO Yvette *et al.*, « Plastic Threatens Human Health at a Global Scale - New Report », Center for International Environmental Law (CIEL), 2019, p. 51.

See also WORM Boris, BARBIER Edward B., BEAUMONT Nicola *et al.*, « Impacts of Biodiversity Loss on Ocean Ecosystem Services », *Science*, 314, 2006 and ZHU Jingkun et WANG Can, « Biodegradable plastics: Green hope or greenwashing? », *Marine Pollution Bulletin*, 161, 2020, p. 111774.

¹⁰¹ Proposal for a Directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags COM(2013) 761 final.

¹⁰² For example, a plastic bag has been found in the Mariana trench: CHIBA Sanae, SAITO Hideaki, FLETCHER Ruth *et al.*, « Human footprint in the abyss: 30-year records of deep-sea plastic debris », *Marine Policy*, 96, 2018, p. 204-212.

¹⁰³ PEW CHARITABLE TRUSTS et SYSTEMIQ, « Breaking the Plastic Wave: a Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution », Pew Charitable Trust and Systemiq, 2020, p. 25, citing JAMBECK Jenna R., GEYER Roland, WILCOX Chris *et al.*, « Plastic waste inputs from land into the ocean », *Science*, 347, 2015.

¹⁰⁴ AZOULAY David, VILLA Priscillia, ARELLANO Yvette *et al.*, *op. cit.*

¹⁰⁵ UNGER Bianca, REBOLLEDO Elisa L. Bravo, DEAVILLE Rob *et al.*, « Large amounts of marine debris found in sperm whales stranded along the North Sea coast in early 2016 », *Marine Pollution Bulletin*, 112, 2016.

¹⁰⁶ SANTILLO David, MILLER Kathryn et JOHNSTON Paul, « Microplastics as contaminants in commercially important seafood species », *Integrated Environmental Assessment Management*, 13, 2017.

particular concerns to human health, as they can penetrate deep in the organism while both attracting and releasing additives or contaminants¹⁰⁷. Larger plastics are also a threat to wildlife, through entanglement or blockages of digestive systems. In addition, they can transport invasive species¹⁰⁸ or bacteria¹⁰⁹. More broadly still, the presence of (biodegradable) plastic in the oceans could impact marine carbon storage, with consequences on climate security¹¹⁰. More specifically, plastics branded biodegradable can also represent a threat to ecosystems¹¹¹.

Therefore, the ubiquity of plastic in natural environments has major environmental, socio-economic and health direct and indirect effects¹¹². As highlighted by Amara, seafood represents one of the last sources of wild food on the planet¹¹³ and a major source of proteins for populations of the Global south¹¹⁴. Contaminated seafood or depleting natural resources therefore represents a major sanitary and economic stake. In the environment, pollution can impact individuals or populations, directly or indirectly. Direct impacts alter the health of the fauna or flora, through pathologies for example¹¹⁵; indirect effects alter “their interactions with

¹⁰⁷ CARBERY Maddison, O’CONNOR Wayne et PALANISAMI Thavamani, « Trophic transfer of microplastics and mixed contaminants in the marine food web and implications for human health », *Environment International*, 115, 2018.

¹⁰⁸ LAMB Joleah B., WILLIS Bette L., FIORENZA Evan A. *et al.*, « Plastic waste associated with disease on coral reefs », *Science*, 359, 2018; p. 360.

¹⁰⁹ KIRSTEIN Inga V., KIRMIZI Sidika, WICHELS Antje *et al.*, « Dangerous hitchhikers? », *Marine Environmental Research*, 120, 2016.

¹¹⁰ SANZ-LÁZARO Carlos, CASADO-COY Nuria et BELTRÁN-SANAHUJA Ana, « Biodegradable plastics can alter carbon and nitrogen cycles to a greater extent than conventional plastics in marine sediment », *Science of The Total Environment*, 756, 2021, p. 143978.

In a broader perspective, see CARBERY Maddison, O’CONNOR Wayne et PALANISAMI Thavamani, « Trophic transfer of microplastics and mixed contaminants in the marine food web and implications for human health », *Environment International*, 115, 2018.

¹¹¹ See for example ZHU Jingkun et WANG Can, « Biodegradable plastics: Green hope or greenwashing? », *Marine Pollution Bulletin*, 161, 2020, p. 111774 or NAZARETH Monick, MARQUES Mônica R. C., LEITE Marcia C. A. *et al.*, « Commercial plastics claiming biodegradable status: Is this also accurate for marine environments? », *Journal of Hazardous Materials*, 366, 2019, p. 714-722.

¹¹² NEWMAN Stephanie, WATKINS Emma, FARMER Andrew *et al.*, « The Economics of Marine Litter », in BERGMANN Melanie, GUTOW Lars, KLAGES Michael, *Marine Anthropogenic Litter*, Springer International Publishing, 2015, 447p., pp. 367-394, p. 381.

¹¹³ AMARA Rachid, « Impact de l’anthropisation sur la biodiversité et le fonctionnement des écosystèmes marins. Exemple de la Manche-mer du nord », *VertigO - La revue électronique en sciences de l’environnement*, 2010, Hors-série 8, p.3.

¹¹⁴ FAO, « The State of World Fisheries and Aquaculture: sustainability in action », Food and Agriculture Organisation, 2020, p. 160.

¹¹⁵ BROWN Christopher J., JUPITER Stacy D., ALBERT Simon *et al.*, « A guide to modelling priorities for managing land-based impacts on coastal ecosystems », *Journal of Applied Ecology*, 56, 2018, n° 5, p. 7, citing SCHLACHER Thomas A., MONDON Julie A. et CONNOLLY Rod M., « Estuarine fish health assessment », *Marine Pollution Bulletin*, 54, 2007.

other organisms and their habitats”¹¹⁶. These impacts come at a cost. In a report on the costs of plastic to the environment, the society and the economy, the World Wildlife Fund (WWF) estimates that “the cost of the plastic produced in 2019 will be at least US\$3.7 trillion (+/-US\$1 trillion) over its estimated lifetime”¹¹⁷.

A diversity of plastics, including single use, find their way to the ocean. Based on coastal clean-ups run globally in 2020, Ocean Conservancy finds that the top ten items collected are cigarette butts, plastic beverage bottles, food wrappers, bottle caps, plastic grocery bags, straws, food containers, beverage cans and glass beverage bottles¹¹⁸. Out of these objects, plastic bags were the first to be regulated nationally, since the 2000s. As numbered by UNE, “as of July 2018, one hundred and twenty-seven (127) out of 192 countries reviewed (about 66%) have adopted some form of legislation to regulate plastic bags”¹¹⁹. The analysis of plastic bag regulation therefore offers an interesting ground for comparative analyses. For these reasons, it was chosen as a focus for this research.

There are three different strategies aiming to mitigate plastic pollution at sea. In the fight against plastic pollution, initiatives aiming to collect plastic on the shores or at sea have been largely mediated. To be a viable solution, the pace of secondary collection would nonetheless need to override the pace at which plastic enters the ocean. For Europe only, Bishop *et al.* estimate that an average 83 187 thousand tons entered the ocean in 2017 only¹²⁰. At a global scale, in 2010, Jambeck *et al.* estimate that 4.8 to 12.7 million metric tons of plastic entered the ocean¹²¹.

¹¹⁶ BROWN Christopher J., JUPITER Stacy D., ALBERT Simon *et al.*, « A guide to modelling priorities for managing land-based impacts on coastal ecosystems », *Journal of Applied Ecology*, 56, 2018, n° 5, citing BROWN Christopher J., JUPITER Stacy D., LIN Hsien-Yung *et al.*, « Habitat change mediates the response of coral reef fish populations to terrestrial run-off », *Marine Ecology Progress Series*, 576, 2017.

¹¹⁷ DALBERG CONSULTING FIRM, « Plastics: the costs to society, the environment and the economy », WWF, 2021, p. 15.

¹¹⁸ OCEAN CONSERVANCY et INTERNATIONAL COASTAL CLEANUP, « We Clean On: 2021 Report », Ocean Conservancy, 2021, p. 17.

¹¹⁹ UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », United Nations Environment, 2018, p. 10.

¹²⁰ Fig 2, BISHOP George, STYLES David et LENS Piet N. L., « Recycling of European plastic is a pathway for plastic debris in the ocean », *Environment International*, 142, 2020, p. 105893.

¹²¹ JAMBECK Jenna R., GEYER Roland, WILCOX Chris *et al.*, « Plastic waste inputs from land into the ocean », *Science*, 347, 2015, p. 770.

Retrospective collection can be a way to reduce the impacts of continued plastic leakages, but is unlikely to be a solution of plastic pollution¹²².

Developing or improving primary collection and recycling of plastic just after use is another avenue to reduce plastic leakages in the environment, as it is estimated that 75% of plastic entering the ocean from land-based sources comes from uncollected waste¹²³. Nonetheless, this strategy has a number of setbacks. First, based on the precedent figure, 25% of waste entering the ocean comes from collected waste, meaning that collection does not prevent leakages. Second, the production of single-use plastic in itself has high polluting impacts, and the end of life of plastic doesn't coincide with the end of impacts¹²⁴. Last, recycling infrastructures have operating and maintenance costs and require collection systems that some countries, especially developing countries, can encounter challenges covering. Just as retrospective collection, primary collection and treatment can be considered as a necessary but non-sufficient solution to tackle plastic pollution.

The regulation of plastic usages is what is considered of greatest interest here. Dealing with a water leakage, no plumber would base her long-term strategy on buckets (primary collection) or towels (retrospective collection). Rather, the plumber's wisdom leads her to cut off the tap first. If less plastic is produced or used, less energy will be needed to recycle the waste or recover it in the environment¹²⁵. From an environmental-protection standpoint, this solution looks as the most effective and straightforward of all three¹²⁶. Therefore, the analysis developed here focuses on strategies developed by countries to cut off plastic pollution at the source, upstream from its production or use rather than downstream of its usages. Arguing on the fact

¹²² VINCE J. et HARDESTY B.D., « Governance solutions to the tragedy of the commons that marine plastics have become », *Frontiers in Marine Science*, 5, 2018, p. 221.

¹²³ MCKINSEY COMPANY et OCEAN CONSERVANCY, « Stemming the Tide: Land-based strategies for a plastic-free ocean », McKinsey Company, 2015, p. 7.

This issue is addressed by the Directive 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (Text with EEA relevance), Official Journal L 155, 12/06/2019 p. 1-19.

In France, the *Stratégie 3R* adopted by the Décret n° 2022-549 du 14 avril 2022 relatif à la stratégie nationale pour la réduction, la réutilisation, le réemploi et le recyclage des emballages en plastique à usage unique, JORF n°0089 du 15 avril 2022, aims to promote the reuse and recycling of plastics to put an end to single-use plastics by 2040.

¹²⁴ KISTLER Amanda et MUFFETT Carol, « Plastic & Climate: the hidden costs of a plastic planet », Center for International Environmental Law (CIEL), 2019, p. 15 and p. 55.

¹²⁵ This idea ties up with the zero-waste movement's adage saying that the best waste is the one that isn't produced. In French « *Le meilleur déchet est celui que l'on ne produit pas* »

¹²⁶ PEW CHARITABLE TRUSTS et SYSTEMIQ, « Breaking the Plastic Wave: a Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution », Pew Charitable Trusts and Systemiq, 2020, p. 9.

that only upstream strategies are liable to protect the environment from pollution, the methodology developed here analyses the regulatory instruments preventing the pollution from happening in the first place.

The international frameworks regulating plastic pollution

Given its transboundary nature, mitigating plastic pollution requires a global coordinated action¹²⁷. To date, there are no international legal framework specific to plastic pollution. Several international treaties and regional seas conventions are nonetheless relevant to the regulation of land-based pollution or plastic pollution.

As above-mentioned, the United Nations Convention on the Law of the Sea (UNCLOS) settles a “legal order for the seas and oceans” with the aim to “promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment”¹²⁸. As such, it provides a definition of “pollution of the marine environment”¹²⁹ and of the four sources of pollution at sea, among which we find land-based pollution¹³⁰. Protecting and preserving the marine environment is a general obligation set at the article 192 of the Convention, requiring “measures to prevent, reduce and control pollution of the marine environment” set at the article 194. The article 207 addresses more precisely land-based pollution, by encouraging states to adopt “laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources” and to “harmonize their policies in this connection at the appropriate regional level”.

Several authors nonetheless highlight the limitations of the UNCLOS framework in the context of plastic pollution. Kirk highlights that the article 207, addressing land-based pollution, is “normatively weak, as there is no timeline by which States must adopt measures, nor is there

¹²⁷ The EU’s right to act on the matter of plastic pollution is justified by the European Commission in the above mentioned COM(2013) 761 final as follows: “The EU’s right to act stems from the fact that the high consumption rates of plastic carrier bags represent both a common and a trans-boundary challenge, and an EU- wide initiative is necessary to tackle the problem in a more coherent and effective way”, with article 114 of the Treaty on the Functioning of the European Union as legal basis.

¹²⁸ Preamble to the Convention, signed on the 10th of December 1982 by 157 signatories, and entered into force on the 16th of November

¹²⁹ UNCLOS, above mentioned, article 1.4 “introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.”

¹³⁰ UNCLOS, above mentioned, article 194, 3, a “the release of toxic, harmful or noxious substances, especially those which are persistent, from land-based sources, from or through the atmosphere or by dumping”.

an actual obligation to give effect to the agreed rules, standards, and recommended practices and procedures in national legislation, nor is there any clarity as to which agreements, rules, etc. are captured by the phrase ‘internationally agreed rules, standards, and recommended practices and procedures’ or which international organizations are deemed competent to adopt such rules, standards, etc.¹³¹”. Even though UNCLOS remains vague in its obligations, this convention acts as a framework from which other binding and non-binding legal instruments will emerge in the following years and decades. In 2016, the focus of the seventeenth meeting of the UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea (ICP-17) was set on ‘Marine debris, plastics and microplastics,’ highlighting the importance of this threat to ocean and human health¹³².

Several international conventions partially applicable to the plastic pollution issue have been adopted, from the production of plastic to their disposal.

The objective of the Stockholm Convention on Persistent Organic Pollutants “is to protect human health and the environment from persistent organic pollutants”¹³³, which are certain chemicals recognized as dangerous. As such, it is the only international binding agreement addressing the production phase of plastics by regulating some additives or chemicals that cannot be used, listed in Annex A of the Convention. According to Simon *et al.*, Annex A of the Convention “includes a limited set of prohibited chemicals that may no longer be used as additives” to produce plastic, even though about 1500 of chemicals “have been identified as chemicals of concern in plastics”¹³⁴. Therefore, for the time being, the Stockholm Convention plays a limited role in the regulation of the production of plastics.

¹³¹ KIRK Elizabeth A. et POPATTANACHAI Naporn, « Marine plastics: Fragmentation, effectiveness and legitimacy in international lawmaking », *Review of European Comparative & International Environmental Law*, 27, 2018, n° 3, p. 222-233, p. 223.

On the ambiguity of article 207, see also NAIDOO Ruchir, *Should Seas Have Standing? A Critical Study Of Plastic Marine Debris And Pollution Laws In International And South African Law*, Master thesis, University of Kwa-Zulu Natal, 2015, 106 p., p. 53.

¹³² Seventeenth meeting of the UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea (ICP-17), 13-17 June 2016, UN Headquarters, New York.

¹³³ The Stockholm Convention on Persistent Organic Pollutants, signed in Stockholm on the 22nd of May 2001, and entered in force on the 17th of May 2004.

¹³⁴ SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47, p. 43, citing AURISANO Nicolò, WEBER Roland et FANTKE Peter, « Enabling a circular economy for chemicals in plastics », *Current Opinion in Green and Sustainable Chemistry*, 31, 2021.

Down the road, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal¹³⁵ could play a role in regulating the international trade of plastic waste. Hazardous waste is defined as “wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III”¹³⁶. Annexes VIII and IX additionally lists waste respectively “characterized as hazardous under Article 1” and “wastes (..) [which] will not be wastes covered by Article 1, paragraph 1 (a), of this Convention unless they contain Annex I material to an extent causing them to exhibit an Annex III characteristic”. Under article 4, Parties to the Convention can exercise “their right to prohibit the import of hazardous wastes or other wastes for disposal” and Parties shall not export hazardous waste or other waste to “the Parties which have prohibited the import of such wastes” and “if the State of import does not consent in writing to the specific import, in the case where that State of import has not prohibited the import of such wastes”. The latter is known as the Prior Informed Consent procedure (PIC). In 2019, the fourteenth meeting of the Conference of the Parties to the Basel Convention adopted amendments to Annexes II, VIII and IX to the Convention to clarify the scope of the Convention applying to plastic waste presumed, or not presumed to be hazardous¹³⁷. In other words, “only clean, sorted plastic waste effectively destined for recycling can be freely traded, whereas mixed, contaminated, or hazardous plastic waste requires the prior informed consent of the importing country”¹³⁸. Therefore, the contribution of the Basel convention to the mitigation of plastic pollution is indirect, by regulating “the trade of land-based wastes that risk ending up in the ocean as marine debris if not properly managed”¹³⁹.

Last, two conventions prevent marine litter by preventing plastic pollution from ships. The Annex V of the International Convention for the Prevention of Pollution from Ships

¹³⁵ Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, signed on 22 March 1989 in Basel, Switzerland, and entered in force on 5 May 1992.

¹³⁶ Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, above mentioned, article 1.

¹³⁷ BC-14/12: Amendments to Annexes II, VIII and IX to the Basel Convention, entered in force on 1 January 2021.

¹³⁸ SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47, p. 44.

¹³⁹ FRANSSON Lovisa Norine, *Wasting our future by wasting the sea -How to combat marine pollution from land-based sources on international and regional level*, Master thesis, Uppsala University, 2020, p. 32.

(MARPOL)¹⁴⁰, which forbids ships from dumping garbage overboard has been revised in 2013 and 2018 to specifically address the disposal of plastic in the ocean. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter¹⁴¹ also addresses plastic pollution by generally prohibiting all dumping at sea, as provided by article 4. A list of exceptions is provided by Annex I. By focusing on marine sources of plastic pollution, these two treaties nonetheless do not address land-based pollution.

In parallel to these international efforts to protect marine environments, the United Nations Environmental Programme (UNEP) launched regional cooperation and binding mechanisms to protect oceans through Regional Seas Conventions in the 1970s. The Barcelona Convention for the Mediterranean Sea¹⁴² is the first of these Regional Seas Convention, adopted in 1976 prior to the UNCLOS convention. In the following decades, a number of other Regional Seas Conventions have been adopted and complemented by Protocols addressing land-based pollution, among which marine litter is one of the identified sources¹⁴³.

This PhD research project is focused on seven countries bordering the Atlantic Ocean which is protected through three of these conventions and their land-based pollution protocols¹⁴⁴. These

¹⁴⁰ International Convention for the Prevention of Pollution from Ships (MARPOL), signed on 2 November 1973 in London, and entered in force on 2 October 1983.

¹⁴¹ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, signed in London on December 29th, 1972 and entered into force on August 30th, 1975.

¹⁴² Convention for the Protection of the Mediterranean Sea Against Pollution, adopted on 16 February 1976 in Barcelona and entered into force on 15 April 1978.

¹⁴³ See Annex I, Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities, adopted on 17 May 1980 by the Conference of Plenipotentiaries of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea Against Pollution from Land-based Sources, held in Athens, and entered into force on 17 June 1983.

¹⁴⁴ As will be described below, these case-study countries are Brazil, Cape Verde, France, Ireland, the United Kingdom, the United States of America and Senegal.

Relevant regional sea conventions are:

- Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, signed in Cartagena on March 24, 1983 and entered into force on October 11, 1986 and the Protocol concerning Pollution from Land-Based sources and activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, signed in Oranjestad on October 6, 1999 and entered into force on August 13, 2010;
- Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region signed in Abidjan on March 23, 1981 and entered into force on August 5, 1984 and the Protocole additionnel à la Convention d'Abidjan relatif à la coopération en matière de protection du milieu marin et côtier de la région de l'Afrique occidentale, centrale et australe contre la pollution due aux sources et activités terrestres, adopté le 22 juin 2012 à Grand-Bassam (Côte d'Ivoire) ;
- Convention for the Protection of the Marine Environment of the North-East Atlantic signed in Paris on September 22, 1992 and entered into force on March 25, 1998.

frameworks nonetheless provide limited targets and measures to provide for a regulation, at the source, of plastic pollution¹⁴⁵.

Last, additional incentives and non-binding agreements have emerged. In 1985, the United Nations Environment Programme (UNEP) drafts the Montreal Guidelines for the Protection of the Marine Environment against Pollution from Land-based Sources. Its objective is to facilitate the adoption of regional, multilateral, bilateral, or national legal texts to tackle land-based pollution. In 1992, the duty of states in the protection of the (marine) environment is reaffirmed by the Rio Declaration on Environment and Development¹⁴⁶ and in Agenda 21, the non-binding action plan of the United Nations for sustainable development. The Chapter 17 of the latter is dedicated to “protection of the oceans (and) all kinds of seas” with a particular focus on sewage; marine litter and pesticides are also highlighted as major threats.

Following the afore-mentioned launch of the Global Programme of Action for the protection of the marine environment from land-based activities (GPA) in 1995 and the 2012 Manila Declaration on three priority sources, three global partnerships corresponding to the three identified sources have been launched in between 2009 and 2012¹⁴⁷. Just like the GPA, these programmes are frameworks for cooperation and propose guidelines to states willing to tackle one or several of the three major land-based pollution sources identified. The Honolulu Strategy on Marine Litter is an additional framework proposing strategies to tackle plastic pollution and room for cooperation. It is considered as one of the outputs of the GPA.

On the other hand, even if “the number of international initiatives to fight plastic pollution has more than doubled in the last five years”, and “the number of news and media articles covering plastic sustainability initiatives has increased eightfold in the past four years”¹⁴⁸, existing international frameworks are insufficient to tackle the plastic pollution issue holistically. Many

¹⁴⁵ KIRK Elizabeth A. et POPATTANACHAI Naporn, « Marine plastics: Fragmentation, effectiveness and legitimacy in international law-making », *Review of European Comparative & International Environmental Law*, 27, 2018, n° 3, p. 222-233, p. 225.

¹⁴⁶ Rio Declaration on Environment and Development, Rio de Janeiro, 3-14 June 1992.

¹⁴⁷ Global Partnership on Marine Litter (GPML): <https://gpmarinelitter.org> in 2012 ; Global Wastewater Initiative (GW2I) ; Global Partnership on Nutrient Management (GPNM) <http://www.nutrientchallenge.org/> in 2009.

¹⁴⁸ WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020, p. 11.

voices raised these last years to call for the adoption of a binding treaty on plastic pollution from academia¹⁴⁹, but also from the civil society¹⁵⁰, arguing that current frameworks are too fragmented and insufficient to mitigate plastic pollution.

The current international governance frameworks of plastic pollution are diverse, spanning over 20 global and 34 regional binding and voluntary instruments, spreading over the regulation of pollution, the protection of biodiversity and species, and the regulation of chemicals and waste¹⁵¹. The authors nonetheless find this governance landscape insufficient to address marine plastic pollution¹⁵². The main challenges identified are the lack of *comprehensiveness*¹⁵³ of the current governance, mainly restricted to marine litter and sea-based sources rather than applicable to land-based sources¹⁵⁴, even though “it is now evident that most litter entering the seas comes from land-based sources”¹⁵⁵. Second, the current global governance landscape does not “provide a comprehensive approach to managing the lifecycle of plastics”¹⁵⁶, and notably upstream stages such as design, production and use which have a direct influence on potential pollution levels. Third, “the presence of a legal obligation [through the adoption of a legally binding international treaty] can increase the cost of violation and, therefore, improve the chances of successful cooperation”¹⁵⁷. Last, the current network of Regional Conventions leaves geographic gaps where no convention has been adopted. WWF *et al.* additionally highlight the lack of scale of voluntary initiatives, which “cannot drive the system change

¹⁴⁹ See for example SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47; DAUVERGNE Peter, « Why is the global governance of plastic failing the oceans? », *Global Environmental Change*, 51, 2018, p. 22-31 ; or BORRELLE Stephanie B., ROCHMAN Chelsea M., LIBOIRON Max *et al.*, « Why we need an international agreement on marine plastic pollution », *Proceedings of the National Academy of Sciences*, 114, Proceedings of the National Academy of Sciences, 2017, n° 38, p. 9994-9997.

¹⁵⁰ See for example the Business Statement for a Legally Binding UN Treaty on Plastic Pollution, <https://www.plasticpollutiontreaty.org>, accessed 13/05/2022.

¹⁵¹ RAUBENHEIMER Karen, ORAL Nilüfer et MCILGORM Alistair, « Combating marine plastic litter and microplastics: an assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches », Nairobi, United Nations Environment Programme, 2017, p. 23.

¹⁵² *Ibid.*, p. 105.

¹⁵³ See the Glossary, Annex XVIII, for a definition.

¹⁵⁴ SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47, p. 43.

¹⁵⁵ FERRARO Gianluca et FAILLER Pierre, « Governing plastic pollution in the oceans: Institutional challenges and areas for action », *Environmental Science & Policy*, 112, 2020, p. 453-460, p. 454.

¹⁵⁶ RAUBENHEIMER Karen, ORAL Nilüfer et MCILGORM Alistair, « Combating marine plastic litter and microplastics: an assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches », Nairobi, United Nations Environment Programme, 2017, p. 105.

¹⁵⁷ FERRARO Gianluca et FAILLER Pierre, *op. cit.*

required”¹⁵⁸. This UNEP report therefore recommends the adoption of “a new global architecture with a multi-layered governance approach”¹⁵⁹.

The adoption of an international treaty on plastic pollution could address these current gaps and obstacles to a holistic mitigation of plastic pollution. First, this treaty would have to address the entire life-cycle of plastic, “from the extraction of raw materials to legacy plastic pollution”¹⁶⁰, covering current pollution due to past mismanagement of plastic. Therefore, the treaty should be in capacity to “eliminate the impacts of current amounts of plastic pollution and mitigate impacts of the projected increase in production in a business-as-usual scenario”¹⁶¹. The three goals of the treaty could therefore be to promote reduce, reuse and removal of plastic in the environment.

Second, this treaty should recognise the land root-causes of plastic pollution, extending the current frameworks applicable to marine litter to all plastic, and therefore gaining in comprehensiveness¹⁶².

Third, this treaty could facilitate the adoption of national policies through the provision of assistance to countries or the provisions of tools to regulate domestic markets¹⁶³. The adoption of common definitions and standards, as recommended by the Technical Barriers to Trade (TBT) Agreement of the World Trade Organisation (WTO) would reduce the risk of disputes under the WTO. In addition, it would enable to develop “plastic sustainability criteria at the global level”¹⁶⁴. WWF argues that addressing the current heterogeneous legislative landscape both between and within countries by adopting common definitions and standards would be

¹⁵⁸ WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020, p. 12.

¹⁵⁹ RAUBENHEIMER Karen, ORAL Nilüfer et MCILGORM Alistair, « Combating marine plastic litter and microplastics », United Nations Environment Programme, 2017, p. 120.

¹⁶⁰ SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47, p. 43.

¹⁶¹ *Ibid.*

¹⁶² NORDIC COUNCIL OF MINISTERS, « Possible elements of a new global agreement to prevent plastic pollution », Copenhagen, Nordic Council of Ministers, 2020, p. 25.

¹⁶³ *Ibid.*, p. 22.

¹⁶⁴ *Ibid.*, p. 26.

beneficial to businesses, which must currently cope with a complex legislative ecosystem¹⁶⁵. Doing so, the new treaty would address current gaps in the governance framework, while “build[ing] upon and complement [ing] existing regional and global frameworks, allowing them to contribute within their core competences”¹⁶⁶.

The adoption of such a wide-ranging international agreement is a lengthy process, which has recently taken an important step forward. On March 2nd 2022, the Fifth session of the United Nations Environment Assembly of the United Nations Environment Programme ended by the adoption of the resolution “End plastic pollution: Towards an international legally binding instrument”¹⁶⁷ by 193 UN Member States, paving the road for the adoption of an international agreement. This resolution, initially drafted by Rwanda and Peru, “requests the Executive Director to convene an intergovernmental negotiating committee, commencing its work during the second half of 2022, with the ambition of completing its work by the end of 2024”. This committee will have to specify the objectives of this instrument, which could “include both binding and voluntary approaches”¹⁶⁸.

On the one hand, this resolution positively answers to the calls for a full life-cycle approach to plastic pollution¹⁶⁹, while aiming “the long-term elimination of plastic pollution, in marine and other environments” and underlining the importance to reuse, remanufacture or recycle.

On the other hand, a certain flexibility in some provisions “could allow countries discretion in implementation of their commitments taking into account the national circumstances”¹⁷⁰, and capacity building, technical and financial assistance is to be provided to developing countries and countries with economies in transition, leading Contracting States to apply a wide range of approaches, spanning from voluntary to binding rules.

¹⁶⁵ WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020; pp. 14-23.

¹⁶⁶ ENVIRONMENTAL INVESTIGATION AGENCY, CENTER FOR INTERNATIONAL ENVIRONMENTAL LAW et GLOBAL ALLIANCE FOR INCINERATOR ALTERNATIVE, « Convention on Plastic Pollution: toward a new global agreement to address plastic pollution », Washington DC, Environmental Investigation Agency, 2020, p. 3.

¹⁶⁷ United Nations Environment Assembly of the United Nations Environment Programme, “End plastic pollution: Towards an international legally binding instrument”, UNEP/EA.5/L.23/Rev.1, 02/03/2022.

¹⁶⁸ *Ibid*, paragraph 3.

¹⁶⁹ *Ibid*, paragraph 3, a.

¹⁷⁰ *Ibid*, paragraph 4, c.

Many aspects of this future agreement on plastic pollution are still to be clarified. If the intergovernmental negotiating committee is expected to end its work by the end of 2024, the entry into force of the agreement could require a few more years, the time for countries to ratify the treaty. Implementation of the treaty and the achievements of its first results could also require additional time¹⁷¹. This timeframe, put in perspective with the urgency to tackle plastic pollution, highlights the importance of current national efforts analysed in this work.

Seven case-study countries on the shores of the Atlantic Ocean

The fragmented international governance of plastic pollution and its land-based sources led some countries to take the lead. Awareness of the potential damages to health and the environment of this new source of pollution was raised and transformed into regulations across the world. Since the 2000s, countries around the world - including several African countries - adopted regulations to tackle plastic issue, and more precisely plastic shopping bags upstream from their usages. A global agenda would be particularly useful to fight this global issue, giving states incentives and tools to move down that road. At the same time, the land-based characteristic of this pollution calls for state-based legislation tailored to local contexts, actors and usages. The objective here is to showcase different legal approaches that can be used to cut down this source of pollution, and to both qualify and quantify how protective they are likely to be in themselves, prior to their enforcement.

The geographic focus of this research will be specifically set on the analysis of the regulations adopted by a set of countries.

This research project is based on the analysis of the legal frameworks of seven case-study countries bordering the Atlantic Ocean. These countries are organised in three clusters: European (France, Ireland, United Kingdom and the relevant rules of the European Union), African (Senegal, Cabo Verde) and American (United States, Brazil)¹⁷². These countries have

¹⁷¹ SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47, p. 47.

¹⁷² This research must be seen as a pilot study aiming to clear the field for a wider, more ambitious and longer research project aiming at developing the method across time and space. The restricted time and resources allocated to this PhD thesis did not allow a wider focus, and an expansion of the number of countries to include countries of Asian, Russian, or Scandinavian legal traditions, and across the global ocean.

been chosen as voluntarily diverse to test the developed method in different contexts. On the one hand they diverge on a number of geographical¹⁷³, political, economic and social contexts¹⁷⁴, summarised in country factsheets (see Annex II). The diversity of case-study countries provides room to analyse both the diversity of regulatory answers, and test the developed method's capacity to capture the potential of protection provided by these texts. On the legal front, two legal traditions are represented in the set of studied countries: the common law and the civil law traditions. Often antagonized, the developed methodology addresses the question as to how comparison across countries belonging to these two legal traditions can occur.

On the other, they share an ocean and the challenges to protect it despite being spread across the North, South, West and East coasts of the Atlantic Ocean. The diffusion of pollution is rarely deterred by a border, be it maritime or terrestrial. At sea, the dispersal of pollution is enhanced by marine currents, and the absence of natural or man-made obstacles. If the ocean is, to some extent, a shared resource, pollution at sea is a shared challenge and a shared threat.

In the context of empirical approaches to legal research, Epstein and Martin highlight that methodologies are most often strictly attached to the analysis of a particular area, requiring the adaptation of existing methods or the development of new methods for the analysis of new datasets¹⁷⁵. Therefore, through the development of a specific methodology tailored to the analysis of the content of legal frameworks in regard to the protection of the environment, this work aims to answer more specifically to two overarching questions;

What is the added value of using quantitative tools and indicators to analyse the content of the law?

¹⁷³ Spread across three continents, their population and size expand from the 4000km² Cape Verdean archipelago and its 540 thousand people to the United States of America, third largest country worldwide with near to 10 000km² and third most populated country with around 300 million people. The single city of Sao Paulo in Brazil is near as populated as Senegal. See Annex II country factsheets for more details.

¹⁷⁴ On the economic and social front, the comparison of the Gross Domestic Product (GDP) and of the Human Development Index are illustrate the discrepancy of the economic and social contexts of the seven case study countries. See Annex II country factsheets

¹⁷⁵ EPSTEIN Lee and MARTIN Andrew D., "Quantitative Approaches to Empirical Legal Research", in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 902.

Under which conditions can a method based on numerical and computational analyses of legal frameworks contribute to a better understanding of the quality of ocean protection provided by legal frameworks?

The answer to these questions will be provided in three steps. The first provides a guidance throughout the maze of quantitative approaches to the analysis of law, by delving both into the past approaches to the measure of law and the conceptual and technical ground for the development of a tailored methodology (Part I). The second sets the method in motion, by applying it to the analysis of plastic bag legal frameworks (Part II). The last casts a critical eye on the latter, discussing both the inputs and limits of the proposed approach (Part III).

The application of the methodology to the analysis of plastic bag regulations in seven case-study countries therefore enables to further explore and compare their regulatory characteristics and potential of protection. Doing so, it enables to question the extent to which the protection of the ocean from plastic bag pollution is a mirage emerging from protection voids left by legal frameworks, or a horizon that could be reached, notwithstanding a long journey.

Part I. Getting through the maze: the design of a new methodology

As highlighted by Webley, “research design is a fundamentally important factor in any research project”, be it qualitative or quantitative studies¹⁷⁶. The requirement to publish and discuss research methodologies is of particular importance in this research project, which not only intends to mix qualitative and quantitative methods, but also develop a new methodological framework to explore the potential contribution of law to the protection of the environment. Whereas methods relate to the “procedure or process for attaining an object”, relying on “a body of skills or techniques”¹⁷⁷, methodologies are “a system of methods used in a particular area of study or activity”¹⁷⁸. If methods are the tools used in a certain perspective, methodologies are their overarching justification.

Research methods are sometimes differentiated based on their inductive or deductive nature. Whereas the first uses “a particular set of facts or ideas to form a general principle”¹⁷⁹, the second “employs deduction in reasoning”¹⁸⁰, “based on the inference of particular instances from a general law”¹⁸¹. The research design developed here is based on an inductive approach. Starting from the development of a new analytical and numerical framework to measure the potential contribution of law to the protection of the environment based on the case study of plastic bag regulation in seven countries, the aim of this research is to explore the potentialities and limits of this methodology. More, its capacity to be used to open the analysis to other sources of land-based pollution, and other countries will be discussed. The methodology is also developed in an iterative way, testing, learning and correcting errors.

There are several guiding principles to the development of this methodology. The first is to limit to the maximum the subjectivity of the research framework. Attention is therefore given to be as precise as possible, as objectivity stems from precision. The second is to fill the gap

¹⁷⁶ WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 932.

¹⁷⁷ Merriam-Webster dictionary, <https://www.merriam-webster.com/dictionary/method>, accessed 28/02/2022.

¹⁷⁸ Lexico, Oxford dictionary, <https://www.lexico.com/definition/methodology>, accessed 28/02/2022.

¹⁷⁹ Cambridge dictionary, <https://dictionary.cambridge.org/fr/dictionnaire/anglais/inductive>, accessed 28/02/2022.

¹⁸⁰ Merriam-Webster dictionary, <https://www.merriam-webster.com/dictionary/deductive>, accessed 28/02/2022.

¹⁸¹ Lexico, Oxford dictionary, <https://www.lexico.com/definition/law>, accessed 28/02/2022.

between measures of the existence of law and measures of its effects, by analysing its content in the light of the objective pursued. The third is to consider legal indicators and measures of law as a tool rather than as an end in itself, valuing the combined inputs of quantitative and qualitative methods.

The design of this methodology follows three major steps. The first builds on past experiences of law measuring, highlighting the flaws, successes and challenges raised by authors who have developed quantitative approaches to law (Title 1). The second sets the bases for comparability across case-study countries, through the development of a functional approach (Title 2). The third displays the numerical and analytical frameworks of analysis, empowered by the specifically conceived relational database (Title 3).

Title 1. Building on past experiences of law measuring

The development of measures of the law and performance indicators for the legal system is a relatively novel field of inquiry¹⁸². Nonetheless, a large array of approaches has been developed so far, each measurement enterprise tackling the practical challenge of choosing what to measure¹⁸³ in regard to its own objectives. The measured characteristics of law and defined indicators therefore vary greatly from an experiment to another (Chapter 1). Besides, the criticisms addressed to these newly-designed methodologies set the bases for the need and the contours of a new and tailored methodology, adapted to the objectives of this research (Chapter 2).

This review of past experiments involving the development of legal indicators and / or quantitative approaches to law highlights the flaws, successes and challenges raised by the authors. It also presents how the development of quantitative approaches to law is closely related to business law and economics, illustrating the originality and challenges of our approach. As the measuring methodologies are closely related to the objectives of law

¹⁸² DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23.

¹⁸³ REILING Dory, HAMMERGREN Linn et DI GIOVANNI Adrian, « Law & Justice Institutions - Justice Sector Assessment Handbook: Carrying out a Justice Sector Diagnostic », *American Society of International Law and the International Judicial Academy*, 2, 2007, n° 2, 100p., p. 14.

measurement, these experiments were based on methodologies which aren't suitable, justifying the need to develop and test a new methodology.

The focus of this state of the art is set on initiatives analysing national law through quantitative measures¹⁸⁴. Rather than attempting an exhaustive review of literature on quantitative research in law, this section provides representative examples of past and current initiatives. Indicators of the state of the environment, or frameworks and tools designed to favour law implementation and enforcement will not be addressed here¹⁸⁵.

Chapter 1. Exploring the entry-point: measured characteristics of law

From a methodological standpoint, the greatest challenge is choosing what to measure¹⁸⁶. Therefore, the focus is here set on the respective choices of entry points to the measure of law. The choice of 'what' to measure is closely related to the objectives of law measurement. Out of the set of analysed experiments of law measurement, three approaches emerge: those pertaining to the measure of the existence of law, to the functioning of a legal system or to the effects of law. In other terms, legal indicators relate to measures of inputs, outputs and outcomes of the legal system¹⁸⁷. An input is defined as "something such as energy, money, or information that is put into a system, organization, or machine so that it can operate"¹⁸⁸. In a legal system, measures of inputs would be related to the existence of law and the adoption of specific provisions (section 1). Outputs¹⁸⁹ are the resulting products of the system. In a legal system, measures of outputs could be measures of the enforcement of law, or interactions with the social system (section 2). Last, measures of outcomes are measures of the consequences of the latter¹⁹⁰ - in a legal system, outcomes are the effects attributed to the enforcement of law (section 3).

¹⁸⁴ Measures of international law will not be addressed here, for several reasons. As international law organizes international relations among states, it does not have the same characteristics as national law, especially in terms of its binding character. This study is based on the analysis of national law; illustrations of law measurement initiatives in international law could be confusing, as certain terms do not have the same signification in national and international law.

¹⁸⁵ Tables providing examples of such initiatives are published in annex IV.

¹⁸⁶ REILING Dory, HAMMERGREN Linn et DI GIOVANNI Adrian, « Law & Justice Institutions - Justice Sector Assessment Handbook: Carrying out a Justice Sector Diagnostic », *American Society of International Law and the International Judicial Academy*, 2, 2007, n° 2, 100p., p. 14.

¹⁸⁷ RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *The Journal of Legal Pluralism and Unofficial Law*, 47, 2015, n° 1, p. 9-21, p. 17.

¹⁸⁸ Cambridge dictionary, <https://dictionary.cambridge.org/dictionary/english/input>, accessed 28/02/2022.

¹⁸⁹ Collins dictionary, <https://www.collinsdictionary.com/dictionary/english/output>, accessed 28/02/2022.

¹⁹⁰ Merriam-Webster dictionary, <https://www.merriam-webster.com/dictionary/outcome>, accessed 28/02/2022.

These initiatives have been conducted by a wide array of actors¹⁹¹, in a diversity of objectives. Analysis of this contextual background to the measure of law will be discussed separately¹⁹².

Section 1) The existence of law: an assessment of the inputs

Gathering information on the existence of legal texts is one of the entry points to the measure of law. Distinct law measurement enterprises developed a numerical approach to account for the existence of law in both a comparative and monitoring perspective. Two distinct conceptions of the measure of existence of law can be observed. The first measure the existence of constituents of law (a) whereas the second focus on measuring the content of law (b).

a. Law as the sum of its parts: measuring constituents of law

The existence of legal texts or of specific legal provisions is commonly searched for and measured to serve as a proxy to determine what issues are considered as dealt with in a specific country.

At a national level, in France as an example, *Légifrance*¹⁹³ publishes twice a year a report on the implementation of national law¹⁹⁴. An implementation rate is measured from the number of provisions calling for the adoption of a *décret d'application* and the number of provisions which have received a *décret d'application*. Taking as a reference the seventh biannual review of the laws of the XVth Legislature¹⁹⁵, the implementation rate of laws promulgated between July 1st 2017 and December 31st 2020 and calling for implementing decrees is 88%.

The French government is also developing indicators to yearly monitor the activity of legislative and regulatory bodies. These indicators are based on the number of enacted and drafted *lois*, *décrets* and *ordonnances*. Further indicators provide information on a range of topics such as the number of articles included in the draft text compared to the number of

¹⁹¹ Actors such as international organisations, non-governmental organisations, research groups and private companies have developed law measurement initiatives.

¹⁹² See B. 2) a. Actors and objectives behind law measurement.

¹⁹³ *Légifrance* is the French public online portal providing open access to legislative, regulatory and case law texts. <https://www.legifrance.gouv.fr>.

¹⁹⁴ *Bilan semestriel de l'application des lois*, published June 30rd or December 31th each year since 2008. Available at <https://www.legifrance.gouv.fr/contenu/menu/autour-de-la-loi/legislatif-et-reglementaire/application-des-lois/bilans-semestriels>, accessed 28/02/2022.

¹⁹⁵ *Bilan semestriel au 30 juin 2021*, published on June 30th, 2021 and available online <https://www.legifrance.gouv.fr/contenu/menu/autour-de-la-loi/legislatif-et-reglementaire/application-des-lois/bilans-semestriels/bilan-semestriel-au-30-juin-2021>, accessed 28/02/2022.

articles in the enacted text, the yearly comparison of the number of texts and words comprised in enacted texts or the number of applying provisions voted in relation to the number of these provisions called for in primary texts¹⁹⁶.

These measurement initiatives provide useful information to monitor the existence of legal voids due to the absence of legal texts. Nevertheless, the provided information is relatively poor as it provides no qualitative or quantitative indication on the content or the completeness of the provisions adopted, and thus on the potential of protection they provide. The simple fact that these legal provisions have been adopted doesn't automatically imply that they deal with the issue appropriately. First, the same exercise should be made with the adopted provisions: are they calling for the adoption of further texts to be fully implemented? Second, the qualitative relevancy and completeness of the adopted provisions should also be searched for. Rather than a measure of the *application* of national law as suggested, the initiative developed by *Légifrance* and launched by the Prime Minister¹⁹⁷ could be considered as a tool to monitor the activity of legislative and regulatory bodies, complementary to the tool developed by the French government. These indicators inform the activity of the legislative and regulatory bodies rather than the quality of the law enforced.

Other actors, such as research groups, also have an interest in measures of the existence of law or of its characteristics. Siems¹⁹⁸ presents a diversity of comparative methodologies used to measure the co-existence and resemblance of law, provisions or concepts in different countries based on the existence of law, of legal provisions or of specific characteristics of legal texts. These methodologies aim to highlight similarities or divergence across countries.

At a European level, Cooter and Ginsburg¹⁹⁹ measure the length of statutes implementing EU directives using the number of words as a proxy to compare the level of detail to illustrate

¹⁹⁶ SECRÉTARIAT GÉNÉRAL DU GOUVERNEMENT, « Indicateurs de suivi de l'activité normative », Paris, 2021. The *Conseil d'Etat* adopted a similar approach in CONSEIL D'ETAT, « Mesurer l'inflation législative », Paris, France, Conseil d'Etat, 2018. Courts may also provide annual indicators on their activity. For example, the *Cour de Cassation* publishes each year, since 2003, statistics on the activity of the Court. See COUR DE CASSATION, « Rapport Annuel 2020 », Paris, Cour de Cassation, 2021.

¹⁹⁷ Circulaire du 29 février 2008 relative à l'application des lois, JORF n°0057 du 7 mars 2008, point 2.

¹⁹⁸ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136.

¹⁹⁹ COOTER Robert D. et GINSBURG Tom, « Leximetrics: Why the Same Laws are Longer in Some Countries than Others », Rochester, NY, Social Science Research Network, 2003.

differentiated implementation of EU law across countries. In the same logic, Schäffer and Racz²⁰⁰ compare quantitatively the sources of law and the number of binding acts in five Western and Eastern European Countries in terms of pages. Their quantitative analyses are supplemented by qualitative analyses based on questionnaires.

In order to compare corporate law in the United States (US) and in the European Union (EU), Carney²⁰¹ searched US law for similar provisions as those found in EU Directives. From the analyses of convergence and divergence of certain provisions, he draws conclusions on the differing influence of interest groups. This work has been criticised as implicit benchmarking, rather than as a contribution to the analysis of power distribution of interest groups in the EU and the US²⁰².

These early initiatives are recognised as “the starting point for further analyses”²⁰³. Their analytical potential is nonetheless rather poor, given the choice of proxies to measure complex phenomenon. Additionally, they provide no information on the substance of the texts, causal relationships, the relevance of the text or of its enforcement. Other initiatives made a step further, by focusing on a qualitative analysis of the content of law.

b. The content of law: measuring quality rather than quantity

The qualitative deficiencies of the above-mentioned measuring initiatives can be addressed quantitatively, through the measure of the quality of in force law, rather than its quantity. This is the objective pursued through the Environmental Democracy Index (EDI), developed through a joint initiative by the World Resources Institute and the Access Initiative. The Index was first released in 2015 for 70 countries²⁰⁴. The initial ambition was to update the Index biannually,

²⁰⁰ SCHÄFFER Heinz, RÁCZ Attila, RHODE Barbara *et al.* (dir.), *Quantitative analyses of law: a comparative empirical study: sources of law in Eastern and Western Europe*, Budapest, Akadémiai Kiadó, 1990, 404 p.

²⁰¹ CARNEY William J., « The Political Economy of Competition for Corporate Charters », *The Journal of Legal Studies*, 26, 1997, n° 1, p. 303-329.

²⁰² SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136, p. 121.

²⁰³ *Ibid.*, p. 120.

²⁰⁴ See the archived website to access data and resources, <https://www.environmentaldemocracyindex.org>, accessed on 26/10/2021. Out of the seven case study countries, only 3 countries are included in this assessment: Ireland, the United Kingdom, and the United States of America.

the index hasn't been updated since 2015²⁰⁵. Nevertheless, this initiative is interesting on many aspects, and represents the closest law measurement framework to the present work.

The challenge the EDI aims to address, is to inform the legal and institutional gaps between principles of environmental democracy²⁰⁶ “endorsed in broad terms at international fora”²⁰⁷ and the national legal foundations of environmental democracy. To do so, the EDI's focus is to systematically measure the “extent to which the laws of a country establish and recognize environmental democracy rights”, and therefore the quality of procedural rights on the basis of in force law and regulations²⁰⁸.

“Measuring the extent” requires to go beyond the simple account of existing law, the focus being rather set on the “breadth of their coverage across the range of environmental decision-making processes and how proactively they address barriers and constraints to the public's fulfilling these rights”²⁰⁹. Therefore, there are two types of legal indicators: those testing the extent of provisions, and those testing the “strength of a given provision in providing an enforceable legal right for the public”²¹⁰. Both types of indicators are based on the Bali Guidelines²¹¹ on environmental democracy, each guideline being transposed into several measurable indicators. Each indicator is given a score between 0 and 3, 0 meaning that the law is “either silent or prohibits some aspect of procedural rights”, and 3 means that the “respective provision exemplifies accepted good practice”²¹². The originality of this approach is to add

²⁰⁵ See the archived website of the Environmental Democracy Index, <https://www.environmentaldemocracyindex.org/index.html>, frequently asked questions. Accessed 28/02/2022.

²⁰⁶ Such as “information accessibility and quality, full participation of marginalized groups, and access to adequate remedies”, WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015, p.1.

²⁰⁷ Such as in the principle 10 of the 1992 Rio Declaration on Environment and Development ; the 1998 Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, or in the Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters, *Adopted by the Governing Council of the United Nations Environment Programme in decision SS.XI/5, part A of 26 February 2010* (known as the Bali Guidelines)

²⁰⁸ WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015, p.3.

²⁰⁹ *Ibid*, p.3.

²¹⁰ *Ibid*, pp.5-6.

²¹¹ Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters, above mentioned.

²¹² WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015, p.6.

another set of practice indicators on the manifestation of these rights in practice. Indicators are then aggregated in an index per country, following a methodology that will be studied below²¹³.

The World Bank Doing Business initiative is another attempt to develop indicators on the quality of the law in regard to a specific objective. Here, law must contribute to facilitating freedom to do business. Legal indicators thus measure investor protections and legal rights for borrowers and lenders. Non-legal indicators are also incorporated to measure the complexity and duration of business creation processes. Both types of indicators are dispatched into ten topics²¹⁴. The methodology followed to set the “best regulatory performance” from which the country indicators will be scored changes from an indicator to the other. All indicators are then aggregated in a country score²¹⁵.

On the specific field of carbon capture and storage (CCS), the Global CCS Institute examines and assesses the national legal and regulatory framework in 55 countries, looking for factors “likely to be critical for the regulation of the technology”²¹⁶. The CCS Legal and Regulatory Indicator covers the clarity and *efficiency* of administrative processes, the comprehensiveness of the legal framework, the provision of adequate environmental impact assessment and siting processes, stakeholder and public consultation, and liability in case of closure or accidental releases of stored CO₂. Sub criteria have been selected for each of these five themes. Their respect is qualitatively appreciated on a 3 levels score, then computed to reach a country score²¹⁷. In addition to this legal score, the Institute has also developed indicators to assess global geological resources available for storage (Global Storage Readiness Assessment CCS-SI) and policy support for the technology (CCS Policy Indicator CCS-PI).

It is therefore possible to study the existence of law quantitatively, without being bound to quantitative only analyses. Law’s richness and diversity is also expressed through qualitative

²¹³ See Title 3, B., 2), c. An aggregate indicator of the potential of protection.

²¹⁴ These topics are starting a business, dealing with construction permits, getting electricity, registering property, getting a credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency. <https://www.doingbusiness.org/en/methodology>, accessed 26/10/2021.

²¹⁵ See Chapter 6 “Ease of doing business score and ease of doing business ranking”, WORLD BANK GROUP, « Doing Business 2020 », Washington DC, World Bank, 2020.

²¹⁶ HAVERCROFT Ian, « CCS Legal and Regulatory Indicator (CCS-LRI) », Melbourne, Australia, Global CCS Institute, 2018, p. 4.

²¹⁷ HAVERCROFT Ian, « CCS Legal and Regulatory Indicator (CCS-LRI) », Melbourne, Australia, Global CCS Institute, 2018, Appendix II.

analyses. Measures of the existence of law, of the occurrence of specific provisions or of the quality of in force law in regard to a specific objective could be compared to the measure of an input, seen as “information that is put into a system so that it can operate”²¹⁸. These measures enable to document the flow, density variety and quality of legal data entering the legal system. Another entry point to the measure of the law is the focus on the functioning of legal systems, including in a comparative perspective.

Section 2) The functioning of a legal system: an assessment of the outputs

As above-mentioned, outputs²¹⁹ are the resulting products of the system, fed by its inputs (here the adoption of legal provisions). In a legal system, measures of the outputs of law can focus on the degree of enforcement of law (a), or on the interactions of the legal and social systems (b). Both aspects inform the functioning of the legal system.

a. The degree of enforcement of law

Through constraint or credible threat of constraint, enforcement brings regulatees to abide by the law²²⁰. “Enforcement” is in fact the enforcement of compliance²²¹. It is intended to both deter persons “from violating the regulations and to force violators to return to compliance”²²². As such, it is a “complex social and political process”²²³ that nonetheless draw its sources from law. The available means for enforcement (*e.g.*, controls and sanctions) are provided for in legislation or regulation. Several initiatives attempt to measure various expressions of enforcement.

The Law and Finance study developed by La Porta *et al.* in the 1990s is often considered as a “pioneering” and “seminal”²²⁴ work in quantitative legal studies, and in particular in business law. The aim of this study is to measure how laws protecting investors differ across 49

²¹⁸ <https://dictionary.cambridge.org/dictionary/english/input> consulted on 18/02/2020

²¹⁹ Collins dictionary, <https://www.collinsdictionary.com/dictionary/english/output>, accessed 28/02/2022.

²²⁰ KRAMER Ludwig, *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p., p. xvi.

²²¹ ARDIA David S., « Does the Emperor Have No Clothes? Enforcement of International Laws Protecting the Marine Environment », *Michigan Journal of International Law*, 1998, p. 497-567, p. 500.

²²² RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p. 16.

²²³ SULLIVAN Larry E. et SIMONETTI ROSEN Marie (dir.), *Encyclopaedia of Law Enforcement*, vol. 1, Thousand Oaks, United States, Sage Publications, 2004, 1729 p., p. 522.

²²⁴ SARKAR Prabirjit et SINGH Ajit, « Law, finance and development: further analyses of longitudinal data », *Cambridge Journal of Economics*, 34, 2009, n° 2, p. 325-346, p.325.

countries, the variations of the quality of enforcement and the correlation of these variations with corporate ownerships patterns around the world²²⁵. They nevertheless use proxies to measure the quality of enforcement that could be disputable. These proxies are measures of the efficiency of the judicial system, rule of law, corruption, risk of expropriation by the government and likelihood of contract repudiation by the government²²⁶. Whereas the first two are closely related to law enforcement at large, they are not specific to the studied provisions. The last three are more generally related to the government's stance towards business. This study has been criticized as implicit benchmarking, measuring "how similar legal systems are to the US one" rather than the quality of the legal system in itself²²⁷, and for the limited set of criteria used²²⁸.

A successive study, conducted by Djankov *et al.* (including La Porta) and published in 2008 attempts to assess and study the enforcement of the regulation of self-dealing using a complementary approach. The same case is presented to law firms across the world through a questionnaire. Semi-quantitative variables are extracted from these questionnaires to quantitatively compare theoretical enforcement of law across 72 countries²²⁹. Questionnaires and semi-quantitative variables are also at the centre of the initiative developed by Michel Prieur these last few years, aiming to measure the degree to which environmental law is implemented and enforced²³⁰. To the difference of the Djankov *et al.* study, experts interviewed are directly asked to answer a set of questions determining the level of implementation and enforcement of a particular question in a given country. This methodology questions the underlying subjectivity of the study, which is dependent upon the number, the positions and opinions of the people interviewed. Some actors, like government officials, could have an

²²⁵ LA PORTA Rafael, LOPEZ-DE-SILANES Florencio, SHLEIFER Andrei *et al.*, « Law and Finance », *Journal of Political Economy*, 106, 1998, n° 6, p. 1113-1155, p. 1115.

²²⁶ *Ibid.*, p. 1140.

²²⁷ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136, p. 121.

²²⁸ SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 528.

²²⁹ DJANKOV Simeon, LA PORTA Rafael, LOPEZ-DE-SILANES Florencio *et al.*, « The law and economics of self-dealing », *Journal of Financial Economics*, 88, 2008, n° 3, p. 430-465.

²³⁰ PRIEUR Michel, BASTIN Christophe et MEKOUAR Mohamed Ali, « Mesurer l'effectivité du droit de l'environnement. Des indicateurs juridiques au service du développement durable », Brussels, Belgium, Chaire de Normandie pour la Paix, 2021.

interest in over-estimating the implementation and enforcement status of the law, whereas the representant of a Non-Governmental Organization (NGO) to minimize it.

Last, in an original article published in 2019, de Redon measures the different answers of the courts to environmental offences compared to other offences. Based on the statistical analysis of crime data publicly available on the website of the French Ministry of Justice, he shows that in proportion fewer environmental offences are condemned and that they are less severe than for other types of equivalent offences²³¹.

b. Measuring interactions between the legal and the social system

Another avenue for to explore the functioning of a legal system is to measure interactions between the legal system and other systems, such as the social system.

The SLADE programme is one of the first research programme known to leverage legal indicators, in the early 1970s. Its aim was to “acquire systematic, comparable information about law and social change from the documented experiences of six nations in Latin America and Mediterranean Europe in the decades following the end of World War II”²³². *In fine*, the programme intended to measure the interactions and mutual influences of the social and legal systems in six countries over a two-decade period. To do so, they relied on the measurement of twenty-six quantitative indicators of both the social system and the legal system. Qualitative information is used as an aid to the understanding and interpretation of quantitative information. Due to funding reasons, the project had to stop after a data collection period of three years. Therefore, collected data have been sparsely analysed²³³, and little information is available on the methodology. One of the founders of the initiative nonetheless published the memoirs of this project, which provide interesting insights into the ambition and difficulties of this pioneering project.

He underlines the difficulty to define legal indicators, contrary to indicators of social change for which there was a “strong tradition of empirical social research, and a sophisticated methodology, all of which expressed a large area of consensus”²³⁴. He underlines that legal scholarship was in the 1970s, just like in the 2000s, “primarily concerned with doctrine; it was

²³¹ DE REDON Louis, « Climat judiciaire et protection de l’environnement : pas de risque de surchauffe », *Droit Pénal*, 2, 2019, p. 17-25, p. 22.

²³² MERRYMAN John Henry, « Law and Development Memoirs II: SLADE », *The American Journal of Comparative Law*, 48, 2000, n° 4, p. 713-727, p. 713.

²³³ *Ibid*, p. 724.

²³⁴ *Ibid*, p. 717.

qualitative and practical or philosophical and normative” and that quantitative methods in law were poorly developed “due more to the traditions of legal scholarship than to any inherent difficulty in measuring legal system components and processes”²³⁵. In no way does he apprehend legal measures as a substitute to traditional measures, but rather as “a useful addition to them”.

To measure evolutions of the legal system, they look at institutions, actors, processes and resources consumed across legislative, administrative, judicial, private ordering, law enforcement, legal education and legal professions²³⁶. These measures are crossed with measures of the evolution of the social system in time-series, to track evolutionary correlations. The amount of collected data due to the breadth of the scope of the project is one hypothesis formulated by Merryman to explain the abandon of the project.

These measures document the interactions between law and society, irrespectively of the objective of the text. As for SLADE, the project’s aim is to document co-evolutions of law and society at large, not of specific provisions. As such, these initiatives can be associated to measures of the outputs of the legal system.

A last set of measures relate to measures of outcomes or to the effects of law on the issue it addresses.

Section 3) The effects of law: an assessment of the outcome

Legal texts are drafted and enacted with the ambition to tackle a challenge, to address an objective. Indicators monitoring the effects of such texts are common. The measure of the effects of law provides information on the supposed outcomes of the text: are the effects in line with the objectives comprised in the legal text? Have the objectives been achieved? Did the initial text have unforeseen perverse effects? Multiple law measurement enterprises aim to measure these effects using different methodologies ranging from measures of perception (a) to measures of the effects of national policies (b).

a. The perception of the effects of law

Measuring the perception of the effects of law has become a common approach in the rule of law or governance scholarship, driven by its use in three emblematic indicator initiatives. The

²³⁵ *Ibid*, pp. 717-719.

²³⁶ *Ibid*, p. 718.

World Justice Project “Rule of Law Index” (RLI) measures how the rule of law is experienced and perceived by the general public (households and experts)²³⁷, the World Bank supported Worldwide Governance Index (WGI) “combine the views of a large number of enterprise, citizen and expert survey respondents in industrial and developing countries”²³⁸ and the Corruption Perceptions Index (CPI) ranks countries “by their perceived levels of public sector corruption according to experts and business people”²³⁹. Although these three initiatives look very similar, they do not measure the same outcome, and refer to perceptions of different actors²⁴⁰.

While the WGI measures the perception of governance, the RLI measures the perception of rule of law and the CPI corruption, which are all close but different concepts. As such, perceptions of corruption and rule of law are two of the six dimensions²⁴¹ measured by WGI. Corruption is also one of the eight factors measured by the RLI²⁴². It should also be noted, as far as corruption is concerned, that the WGI measures the “Control of corruption” and the RLI the “Absence of corruption”. Additionally, the CPI only measures public corruption and excludes all other forms of corruption, unlike the WGI and RLI. Despite measuring outcomes looking at first very similar, the WGI, RLI and CPI are based on different methodologies, approaches and definitions of sometimes the same concepts. These differences must be made clear to the user to dismantle analysis biases. Another line of difference between these three initiatives is the type of sources the analysis is based on.

The comparison of these three approaches is also impeded by the fact that all are based on differing perception sources. The WGI is based on 31 different data sources²⁴³ ranging from

²³⁷ WORLD JUSTICE PROJECT, “Rule of Law Index 2021”, Washington DC, World Justice Project, 2021, p. 9.

²³⁸ World Bank, <https://info.worldbank.org/governance/wgi/>, accessed 19/02/2020. The WGI is produced by Daniel Kaufmann (Natural Resource Governance Institute (NRGI) and Brookings Institution) and Aart Kraay, (World Bank Development Research Group). See KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, « The Worldwide Governance Indicators: Methodology and Analytical Issues », *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246.

²³⁹ Transparency International, <https://www.transparency.org/cpi2019>, accessed 19/02/2020.

²⁴⁰ The United Nations intended to develop rule of law indicators in 2011 (see UNITED NATIONS, « The United Nations Rule of Law Indicators: Implementation Guide and Project Tools », New York, United Nations, 2011). As the project doesn't seem to have followed suit, it will not be specifically analysed here.

²⁴¹ Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.

²⁴² The eight factors measured by the RLI are constraints on government powers, absence of corruption, open government, fundamental rights, order and security, regulatory enforcement, civil justice, and criminal justice.

²⁴³ KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, “The Worldwide Governance Indicators: Methodology and Analytical Issues”, *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246, p. 222. The methodology used to score the WGI hasn't changed since 2011.

surveys of firms and households to public, private, and NGO sector experts worldwide. As such, the WGI relies both on primary data collected by and for the project means and secondary data collected by public, private and NGO sector experts. The WGI spans over household, business and both public and private perceptions of governance. The RLI is based on 138 000 household and 4 200 expert surveys²⁴⁴, and no secondary sources of data (*i.e.*, data not collected specifically for this purpose). On the contrary, the CPI entirely relies on 13 secondary sources, including the RLI expert survey as one of the sources²⁴⁵. All of these sources measure the perception of public corruption solely.

All three initiatives value perception as the best proxy to measure rule of law, corruption or governance. As expressed by the CPI, “corruption generally comprises illegal activities, which are deliberately hidden and only come to light through scandals, investigations or prosecutions”, with no indicator to date measuring “objective national levels of corruption directly and exhaustively”²⁴⁶. Kaufmann *et al.* speaking on behalf of the WGI highlight the particular value of perceptions in the measure of governance as “perceptions matter because agents base their actions on their perceptions, impression, and views” while there are few data relevant alternatives in that field of study²⁴⁷. Nevertheless, perception-based data is sensitive to bias and aggregation methods, which can stymie comparison between different initiatives²⁴⁸. Perception-based measures have thus developed specific methodologies to limit the risks and critics to this special way of measuring law.

Last, two initiatives propose an approach in between measures of perception and measures of the effects of national policies. First, the Ibrahim Index of African Governance assesses 54 African countries over security & rule of law; participation, rights & inclusion; foundations for economic opportunity; human development and public perception of overall governance. Each pillar is documented through different indicators. No raw data is directly collected by the Mo Ibrahim foundation to do so, as all indicators are sourced in other indices or public international

²⁴⁴ WORLD JUSTICE PROJECT, “Rule of Law Index 2021”, Washington DC, World Justice Project, 2021, p. 9.

²⁴⁵ TRANSPARENCY INTERNATIONAL, “Corruption Perception Index 2020: Full Source Description”, Berlin, Transparency International, 2020, p. 1.

²⁴⁶ *Ibid.*

²⁴⁷ Kaufmann *et al.* underline to justify the use of perceptions that “even when objective or fact based data are available, often such data may capture the *de jure* notion of laws “on the books”, which often differs substantially from the *de facto* reality that exists “on the ground””. KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, “The Worldwide Governance Indicators: Methodology and Analytical Issues”, *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246, p. 238.)

²⁴⁸ See below B., 2), b. Methodological ground for debate.

organisations' databases, among which some have been described here²⁴⁹. Second, United Nations Environment currently develops an indicator framework to measure environmental rule of law globally, based on existing indicator measures, such as the above-mentioned Environment Democracy Index, the Environmental Performance Index²⁵⁰, the Freedom in the World Index²⁵¹ or the above-mentioned Rule of Law index²⁵². This proposed indicator framework, which has not been tested yet, aims to measure six dimensions: contextual factors, laws and institutions, implementation, civic engagement, dispute resolution and access to justice, environmental outcomes and current status²⁵³.

Besides, further initiatives took a step back from the measure of law or its perception, by measuring the effects of national policies.

b. The effects of national policies: an indirect measure of the effects of law

Last, some initiatives intend to measure countries' status and trend on specific areas of policy-making, such as environment protection, political and civil rights, human rights or even policy-making at large in a context of development.

To measure the state and trend of sustainability around the world, the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network of Columbia University launched the Environmental Performance Index in 2006. Updated every two years, the 2020 report ranks 180 countries on two policy objectives - environmental health and ecosystem vitality - using 32 performance indicators across 11 issue categories²⁵⁴. The data used to construct indicators comes from secondary data sources such as international organisations, non-governmental organisations or academic research centres. For each indicator, a single proxy is used. For example, unsafe sanitation is measured by “using the number of age-standardized disability- adjusted life-years lost per 100,000 persons (DALY

²⁴⁹ MO IBRAHIM FOUNDATION, « 2020 Ibrahim Index of African Governance - Index Report », London, United Kingdom, Mo Ibrahim Foundation, 2021, pp. 142-149. Sources of the Ibrahim Index of African Governance described here are the indices developed by the Freedom House and the World Justice Project.

²⁵⁰ See b. the effects of of national policies: an indirect measure of the effects of law.

²⁵¹ See b. the effects of of national policies: an indirect measure of the effects of law.

²⁵² UNE, « Environmental Rule of Law », Nairobi, United Nations Environment, 2019, p. 238.

²⁵³ *Ibid.*, p. 235.

²⁵⁴ These 11 issues are air quality, sanitation & drinking water, heavy metals, waste management, biodiversity & habitat, ecosystem services, fisheries, climate change, pollution emissions, water resources, and agriculture.

WENDLING Zachary. A., EMERSON John W., DE SHERBININ Alex *et al.*, « Environment Performance Index 2020 », New Haven, CT, Yale Center for Environmental Law and Policy, 2020, p.1.

rate) due to their exposure to inadequate sanitation facilities”²⁵⁵. The reliance secondary data and on a single proxy poses risks highlighted by the EPI report such as the importation of measurement biases and a limited scope of each indicator. The report goes through each indicator choice and limitations, offering to readers a full disclosure of the limits of the index.

No indicator is directly related to law adoption or enforcement. The indicators measure outcomes such as air quality, biodiversity & habitats or waste management, but no link is made with the adoption of any regulation. By focusing measures on the state and evolution of environmental health and ecosystem vitality, the aim is to assess how well countries perform on sustainability issues. Therefore, it is an indirect measure of environmental policy performance, which is influenced by the content, implementation and enforcement of law. Indirectly, the EPI provides a measure of the effects of enacted law, but these effects cannot be discriminated from other effects, as the role of law is not made explicit. For example, unsafe sanitation is measured regardless of whether this matter is regulated in the country.

On the theme of Human rights, two initiatives measuring the effects of law are of interest here. Freedom in the World is an initiative developed by the non-governmental organisation Freedom House, mixing numerical ratings and qualitative descriptions of political rights and liberties in 195 countries and 15 territories in the 2021 edition. The methodology was launched in 1972, and has been regularly reviewed since. The assessment is based on 10 political rights indicators and 15 civil liberties indicators taking the forms of questions to which experts are asked to answer through a 0 to 4 score (the greatest the score, the greatest the degree of freedom). Indicator scores are then summed up to reach a score out of 100. The indicators are mainly centred on “on-the-ground fulfilment of these rights”²⁵⁶ than on the content of legal texts. Indicator guidance sub-questions encourage the respondents to question the implementation of law, such as anti-corruption law.

Whereas the objectives of the Human Rights Indicators are close to those of Freedom in the World on the theme of human rights, the scope of the assessment is much larger as it expands over countries’ commitments, efforts and results in the realisation of human rights. The commitment is measured through structural indicators, reflecting “the ratification and adoption

²⁵⁵ *Ibid*, pp. 56-63.

²⁵⁶ FREEDOM HOUSE, « Freedom in the World 2021 Methodology », Washington DC, Freedom House, 2021, p2.

of legal instruments and the existence as well as the creation of basic institutional mechanisms deemed necessary for the promotion and protection of human rights”²⁵⁷. Structural indicators therefore relate closely to indicators of the content of law, above-mentioned. Process indicators measure ongoing efforts to transform indicators into results. These indicators reflect for example resources allocated and the coverage of targeted population groups rather than legal aspects. Last, outcome indicators reflect the results, “the state of enjoyment of human rights in a given context”²⁵⁸. The evolution of outcome indicators, such as mortality rates, is slow moving and could be due to a multiplicity of causes. Causality is not searched for; the set of indicators are descriptive rather than predictive.

Two other initiatives focus on the analysis of business law through an effect-oriented approach. The World Bank has developed a Country Policy and Institutional Assessment (CPIA) framework, on which is partly based resource allocation. The CPIA rates countries on a set of 16 criteria covering economic management, structural policies, policies for social inclusion and equity, and public sector management and institutions. As such, it is a wide-ranging policy assessment tool meant to balance “the capture of the key factors that foster growth and poverty reduction”²⁵⁹. Some of the criteria are closely related to effects of law. The “business regulatory environment rating” for example assesses “the extent to which the legal, regulatory, and policy environments help or hinder private businesses in investing, creating jobs, and becoming more productive”, and the “policy institutions for environmental sustainability rating” assesses the extent “to which the legal, regulatory, and policy environments help or hinder private businesses in investing, creating jobs, and becoming more productive”²⁶⁰. To do so, the CPIA leans on secondary data sources such as the Doing Business indicators, the World Governance Indicators or the Environment Performance Indicators.

Last, a project of the Centre for Business Research of the University of Cambridge (UK) called Law, Finance and Development claims to measure the causality link between the adoption of legal provisions protecting shareholder rights and stock market development based on 60

²⁵⁷ UNITED NATIONS HUMAN RIGHTS, « Human Rights Indicators: A guide to Measurement and Implementation », New York, United Nations, 2012, 188p., p. 34.

²⁵⁸ *Ibid.*, p. 37.

²⁵⁹ The World Bank, Country Policy and Institutional Assessment, <https://datacatalog.worldbank.org/search/dataset/0038988>, accessed 28/10/2021.

²⁶⁰ WORLD BANK, « CPIA Criteria 2017 », Washington DC, World Bank Group, 2018.

variables measuring shareholder protection in legislation, regulation and case law between 1970 and 2005, in four countries²⁶¹. Causality is measured statistically. Nevertheless, the legal indicators of shareholder protection are mainly based on the analysis of legal provisions, leaving aside the questions of law implementation and enforcement. The results are inconclusive as to causality between shareholder protection and stock market development, with cases of reverse causation or mutual causation. The influence of other factors on both shareholder protection and stock market development could be an explanation, such as the Gross Domestic Product per capita.

These initiatives take a step back from the measure of law, as their aim is first and foremost to assess the extent to which environment protection or political rights are guaranteed on the ground. The advance or decline of countries on these themes could therefore find their roots in causes overriding law's scope. There could be a plethora of other positive drivers of change other than law in a society or ecosystem. None of these initiatives intend to isolate the pure effect of law all things equal elsewhere. The ambition to do so would require an assessment of the content of the texts, of its enforceability and enforcement. Even so, the proof of correlation and causality between the texts' adoption and observation of change should still be researched. So long as implementation is not searched for prior to measuring the effects, it will not be possible to showcase the impact of law. Effects are presupposed, whereas impacts are demonstrated. Therefore, measures of the outcomes of law is still in its early ages.

Despite the variety of initiatives pertaining to law measurement, common critiques can be identified. The identification of these critiques paves the way towards the design of a new methodology.

²⁶¹ SARKAR Prabirjit et SINGH Ajit, « Law, finance and development: further analyses of longitudinal data », *Cambridge Journal of Economics*, 34, 2009, n° 2, p. 325-346.

Chapter 2. Crystallizing critiques: a way out of methodological deadlocks

The development of measures of the law and of legal indicators has been preceded and accompanied by criticisms of different kinds. The fact that the legal scholarship is traditionally unfamiliar or averse with quantitative and empirical approaches to law²⁶², and the fact that developed methodologies have built-in limitations and biases are two sources of the rise of these criticisms. Critics revolve around three main ideas: law is immeasurable (section 1), measuring the law is not objective (section 2) and indicators are instrumentalised (section 3).

In other words, validity and reliability are at the crossroads of indicator criticism. Validity questions whether “the indicators measure the concepts their names suggest they measure” – and their reliability “the extent to which those measurements contain errors”²⁶³.

Section 1) Law is intrinsically immeasurable

The first, often made critic to law measurement initiatives, is that law is by nature immeasurable. This critic is founded on two types of obstacles to law measurement: theoretical obstacles (a) and technical obstacles (b).

a. Theoretical obstacles

Theoretical obstacles to law measuring oppose the measure of law as a method to analyse law as such, or in a comparative perspective.

The first critic to measures of law as a method stresses the fundamental differences between law and science, impeding the reduction of law to numbers. The interests, objectives and operating modes of law and science would be irreconcilable. For example, whereas science would be descriptive and based on data, law would be prescriptive and based on values²⁶⁴. This criticism, by opposing science and law, seems to mingle law, as a system of rules made by a government in a limited area, and the study of law as an organized body of knowledge acquired through observation and experiment. Whereas law prescribes, the study of law (or legal science)

²⁶² MERRYMAN John Henry, « Law and Development Memoirs II: SLADE », *The American Journal of Comparative Law*, 48, 2000, n° 4, p. 713-727, p. 713. See also SUPIOT Alain, *La gouvernance par les nombres : cours au Collège de France, 2012-2014*, Paris, Fayard, 2015, 520 p.

²⁶³ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52, p. 41.

²⁶⁴ SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 530.

describes and analyses. Additionally, law is not entirely foreign to data and measures. Many legal provisions lean on numerical thresholds to draw the limit between what is authorised and what is forbidden, for example by setting thickness requirements for plastic bags, or speed limits for cars. Even though the context around these numerical thresholds can vary from a country to another, characteristics of these thresholds can be compared just like “you can compare apple and oranges numerically” through their characteristics such as size and weight²⁶⁵. Besides, Siems adds that other social sciences, have relied on statistical evidence in a widely accepted way for a long time now, such as in psychology, sociology and political science. Therefore, the use of indicators in the study of law could provide similar benefits as to their use in other sciences, including social sciences.

Law measurement is also criticized as a method of comparative law. Analysing the diversity of law measurement initiatives in comparative law, Siems introduces the term “numerical comparative law” to refer to this emerging approach to comparative law²⁶⁶. He finds three main theoretical criticisms to the spread of numerical comparative law as a method.

The first denounces numerical comparative law as a “reductionist methodology”, seeking to reduce complexity instead of accepting it. By breaking a complicated system into simpler parts, “it does not lead to a deeper understanding of interactions, irregularities and disorder, but remains on the surface”²⁶⁷. Ruhl later acknowledges that reductionism may be a powerful to explain 90% of theorems, “but left powerless to unravel the 10%”²⁶⁸. These criticisms are not specific to legal science, but are general to the use of metrics, indicators and proxies in any science²⁶⁹. No methodology is fit for all purpose, all contain limitations, biases, blind spots or shortcomings. This may not be a problem as such, as long as these weaknesses in the methodology design are made explicit, in order to be consolidated by other initiatives. This

²⁶⁵ SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 535.

²⁶⁶ *Ibid*, p. 522.

²⁶⁷ RUHL J.B., « Complexity Theory as a Paradigm for the Dynamical Law-and-Society System: a Wake-Up Call for Legal Reductionism and the Modern Administrative State », *Duke Law Journal*, 45, 1996, n° 5, pp. 849-928, pp. 893-894.

²⁶⁸ *Ibid*, p. 900.

²⁶⁹ See for example LYYTIMÄKI Jari, SALO Hanna, LEPENIES Robert *et al.*, « Risks of producing and using indicators of sustainable development goals », *Sustainable Development*, 28, 2020, n° 6, p. 1528-1538 and RIJCKE Sarah de, WOUTERS Paul F., RUSHFORTH Alex D. *et al.*, « Evaluation practices and effects of indicator use—a literature review », *Research Evaluation*, 25, Oxford University Press, 2016, n° 2, p. 161-169.

critic is also the occasion to highlight that methods are closely related to their object, and that the numerical methodology of natural sciences cannot be simply copied or mimicked by the social sciences – just like methodologies in physics cannot be copied and pasted in biological research. In this perspective, Barondes raises three flaws he finds common in quantitative legal research: “deceptive reliance on metaphor, use of quantitative terminology in framing a legal question to preordain the conclusion, and extension of an analysis beyond the boundaries of its assumptions”²⁷⁰. While the first two might be symptoms of early attempts lacking the confidence to design proper methodologies, the third is a risk looming over any research and might be particularly tempting in quantitative research.

A second critic of numerical comparative law is based on the incommensurability of legal systems, the fact that they have no common measure²⁷¹. This critic concerns measures such as enforcement, effectiveness or convergence / divergence as “the rule’s application depends on the structure of the legal system as a whole” even if the provisions are the same²⁷². The rule’s application is nonetheless one of the components of a legal system. For example, comparing the legal answers to a common source of pollution provided by different countries can provide useful information in the perspective of the adoption of an international treaty. Whereas this critic highlights the importance to make a clear case of the limits of the designed methodology, it should not prevent any measuring attempt *a priori*. To be comparable, measures of enforcement or effectiveness would have to take into account the structure and functioning of the legal system; measures of convergence / divergence would either remain theoretical, either take into account the enforcement of and compliance to the analysed provisions.

The last critic questions the functionality²⁷³ of numerical comparative law. Functionality is a central concern in comparative law, due to potential linguistic, terminological, cultural and legal differences between legal systems. The use of statistics and metrics can tend to erase these

²⁷⁰ BARONDES Royce de R., « The Limits of Quantitative Legal Analyses: Chaos in Legal Scholarship and FDIC v. W.R. Grace & Co. », *Rutgers University Law Review*, 1995, no 161, p. 161-226, p. 224.

²⁷¹ GLENN H. Patrick, « Are Legal Traditions Incommensurable? », *The American Journal of Comparative Law*, 49, American Society of Comparative Law, 2001, n° 1, p. 133-145.

²⁷² SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 531.

²⁷³ About the functional method: “According to the functional method, the law of different countries can be compared by locating a common social problem, rooted in the demands and needs of societies and expressed in terms abstracted from the intricacies of the law, and then identifying the various legal solutions to the problem in the different jurisdictions”, BIGNAMI Francesca, « Formal Versus Functional Method in Comparative Constitutional Law », *Osgoode Hall Law Journal*, 53, 2016, n° 2, p. 442-471, p. 449.

See section on functionality Title 2, B., 1), The functional approach, an established comparative law methodology.

specificities, disregarding the variety of functional equivalents²⁷⁴ while the comparative lawyer's mission is to evaluate the legal answer in regard to its specific social background (historic, social, cultural, economic)²⁷⁵.

Taken together, these three critics evolve around the same warning, summarised by Barondes: “The lesson is neither that quantitative and quasi-quantitative legal analyses are inevitably erroneous, nor that substantial simplifying assumptions used to make a legal issue receptive to quantitative analysis are necessarily improper. Instead, the value of simplicity in an analysis must be weighed in light of its effect on the accuracy of the results”²⁷⁶. It could be added to this statement that the value of an analysis is to be aware and to expose its own limitations. Statistics, just as indicators, must be seen as analytical tools, which, just as any tool, can be used for some but not all usages. They do not replace but rather complement the limitations of other existing tools used to further legal knowledge²⁷⁷.

The developed methodology will therefore specifically address each one of these criticisms. First, as regards the reductionism criticism, the methodology will be based on the coalescence of qualitative and quantitative analyses. The first will expose the full complexity of the texts analysed, whereas the second, rather than reducing complexity, will require the development of tools to better handle it. Second, in regard to incommensurability, attention will be driven to the themes of study, to guarantee that the targeted source of pollution is common to all the case studies. Therefore, the methodology will be based on the comparison of provided answers to a commonly identified issue. Last, functionality will be specifically addressed below²⁷⁸. The recourse to indicators here specifically enables to compare the regulatory strategies of countries as they are not compared *per se*, but in regard to a common source of pollution.

²⁷⁴ *i.e.*, “other legal [or non-legal] solutions whose effect is similar, but the way of achieving that solution is different”, SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *ibid*, p. 532.

²⁷⁵ MERRYMAN John Henry, *The Loneliness of the Comparative Lawyer and Other Essays in Foreign and Comparative Law*, The Hague; Boston, Kluwer Law International, 1999, 541 p., p. 7.

²⁷⁶ BARONDES Royce de R., « The Limits of Quantitative Legal Analyses: Chaos in Legal Scholarship and FDIC v. W.R. Grace & Co. », *Rutgers University Law Review*, 1995, n° 161, p. 161-226, p. 224.

²⁷⁷ MERRYMAN John Henry, « Law and Development Memoirs II: SLADE », *The American Journal of Comparative Law*, 48, 2000, n° 4, p. 713-727, p. 716 ; RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *The Journal of Legal Pluralism and Unofficial Law*, 47, 2015, n° 1, p. 9-21, p. 11.

²⁷⁸ See Title 2, Chapter 2.

b. *Technical obstacles*

In addition to the theoretical obstacles to the measure of law, there are technical obstacles common to all law measurement initiatives.

The first of these challenges is closely related to access to data. As exposed by Restrepo Amariles, “contrary to phenomena in the natural world, such as weight or length, most dimensions of the social institution we call law are not readily quantifiable”²⁷⁹. The challenge is therefore to choose what to measure *i.e.* which indicators or proxies for complex, hidden or un-observable phenomenon, and these choices are often food for criticism. For example, analysing three distinct measures of the rule of law, Versteeg and Ginsburg highlight that convergence between these indices could be fuelled by the reliance on experts’ perceptions, even though the initiatives purport to capture different aspects of the rule of law²⁸⁰. Access to data might also be a challenge for directly measurable variables when such data is classified or not measured by local statistic agencies.

McGrath emphasize another challenge in the measure of effectiveness of environmental law. The combined complexity of the environment on the one hand and law on the second requires a multi-disciplinary approach and “the integration of environmental science and law”, representing “a Herculean task”²⁸¹. The “mathematical turn in legal thinking”²⁸² law measurement requires is therefore a key technical challenge. The introduction of indicators to legal scholarship “convey a mathematization of the legal concepts they measure” and the introduction of “mathematical and statistical techniques”²⁸³ to extract from the data collected empirically variables intended to measure a concept. Restrepo Amariles describes this process as composed of three stages: the definition of sub-variables of the concept which is to be measured, then the quantification of each variable through indicators, and last the computation of these variables. Thus, legal indicators lead to an increasing use of statistical and mathematic techniques to “describe, explain, assess and prescribe human and institutional behaviour of

²⁷⁹ RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *The Journal of Legal Pluralism and Unofficial Law*, 47, 2015, n° 1, p. 9-21, p. 17.

²⁸⁰ VERSTEEG Mila et GINSBURG Tom, « Measuring the Rule of Law: A Comparison of Indicators », *Law & Social Inquiry*, 42, 2017, n° 1, p. 100-137, p. 124.

²⁸¹ MCGRATH Chris, *Does environmental law work? how to evaluate the effectiveness of an environmental legal system*, Saarbrücken, Lambert Academic Publishing, 2010, 251 p., p.9.

²⁸² RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *op. cit.*

²⁸³ RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development », in FORTES Pedro, BORATTI Larissa, PALACIOS Andres, et al. (éd.), *Law and Policy in Latin America: Transforming Courts, Institutions, and Rights.*, London, Palgrave Macmillan, 2016, p. 95-111, p. 106.

legal relevance”²⁸⁴. The resort to statistical and mathematical techniques in legal academia complement rather than replace traditional analytical and qualitative techniques. One of the technical obstacles to the rise of law measurement initiatives is the lack of legal scholars comfortable with mathematical techniques.

Therefore, the question of human resources is a central obstacle to law measuring’s development, both in term of cost and in term of competencies. The treatment of data required time and therefore a human cost that funders were not keen to supply, triggering the abandonment of the SLADE programme. Merryman adds that “our data-gathering reach exceeded our interpretive grasp. Interpretation was no small undertaking; it could be expected to take years of multidisciplinary effort, and the potential payoff was both uncertain and remote”²⁸⁵. This citation grasps several technical obstacles: the gap between ambition and capacity, the multidisciplinary skills needed, the cost of these initiatives, and uncertainty about results. These obstacles have two consequences, as analysed by Restrepo Amariles: the rareness of initiatives as ambitious as the SLADE programme, and the “lack of conceptual sophistication of most existing legal indicators”²⁸⁶.

The objectivity of law measurement initiatives composes the second often-made criticism.

Section 2) Measuring the law is not objective

The second often made criticism to law measurement initiatives is that these measures are not objective. There are two main aspects to this critic. The first, is that the actors behind law measurement initiatives are not neutral, their underlying objectives influencing the developed indicator (a). The second, is that the methodologies developed to measure the law have built in biases (b).

²⁸⁴ RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *Ibid*, p.15.

²⁸⁵ MERRYMAN John Henry, “Law and Development Memoirs II: SLADE”, *The American Journal of Comparative Law*, 48, 2000, n° 4, p. 713-727, p. 726.

²⁸⁶ RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *The Journal of Legal Pluralism and Unofficial Law*, 47, 2015, n° 1, p. 9-21, p. 11.

a. *Actors and objectives behind law measurement: a Trojan horse?*

As summarised by Davis *et al.*, “Indicators are made by, in, and for organisations and these have their own reasons for using indicators”²⁸⁷. As “a form of knowledge”²⁸⁸, they are a tool designed for a specific purpose, a demonstration or an analysis. As such, the institutions behind law measurement initiatives have the control on the theoretical orientation and the conceptual framework of the indicators. Therefore, it is important to keep in mind who are the actors behind law measurement initiatives, and what is their interest in as this information could shape the sources, methods and indicators chosen as bases for the measure²⁸⁹.

Bradley identifies four distinct motivations of indicator producers, among which only one is related to a contribution to the expansion of knowledge on a specific issue or region. The three others are indirect or direct financial profit, reputation and ideology²⁹⁰. Reputation is related to the branding and visibility associated with indicator development, and to the facilitation of other projects. Ideology leads to promote, through the indicator, preferred policy outcomes. As such, indicator development is not only a source of knowledge enhancement, but also “a political as well as an economic process”, as they are also a way to attract attention to specific causes. As highlighted by Davis, this kind of “noneconomic motivations readily explain why many organisations distribute their indicators free of charge”²⁹¹. In any case, Bradley adds that “the motivations of a producer will affect indicator’s design, implementation and promulgation”.

The source of funding is another avenue for proven or perceived neutrality of the indicator. For example, Freedom House’s Freedom in the World indicator has been criticized internally and externally as potentially, at least indirectly influenced by the institution’s biggest donor, the United States government²⁹². In a larger perspective, Davis *et al.* analyse influences on the

²⁸⁷ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 323.

²⁸⁸ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p.1.

²⁸⁹ BRADLEY Christopher G., « International Organizations and the Production of Indicators », in Davis Kevin E., Kingsbury Benedict et Merry Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 27-74, p. 57.

²⁹⁰ *Ibid.*, pp. 28-29.

²⁹¹ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52, p. 40.

²⁹² BRADLEY Christopher G., « International Organizations and the Production of Indicators », *op.cit.*, p. 43.

conceptualization of indicators “under four headings: actors and institutions, expertise, temporality and resources”²⁹³.

The identity of the actors behind law measurement initiatives is central to better delineate potential biases inherent to the methodology, as they “determine which concepts are being deployed, for what purposes, and with which theoretical orientation”²⁹⁴. Their identity can be analysed along three lines: the types of actors, the regions from which they are originated and the field of study.

Out of the initiatives presented in the review of literature above, this study enabled to identify five types of actors: international organisations, states, non-profit organizations, think tanks and academics. Most often, these types mingle: NGOs and international organizations need technical support from academics to develop measurement initiatives and academics need financial support and institutional endorsement to achieve impact. Nonetheless, analysing the type of actor at the origin of the law measurement initiatives provides an interesting insight into the identity of legal indicators providers (figure I.1).

²⁹³ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, pp. 11-12.

²⁹⁴ *Ibid*, p. 11.

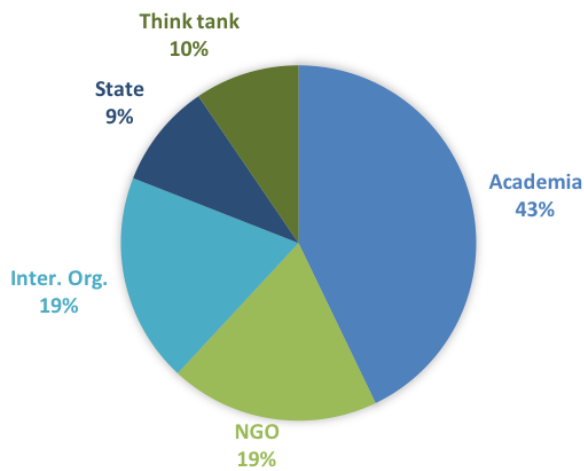


Figure I.1 Actors per share of law measurement initiatives

Data collected by the author. Main actor taken into account.

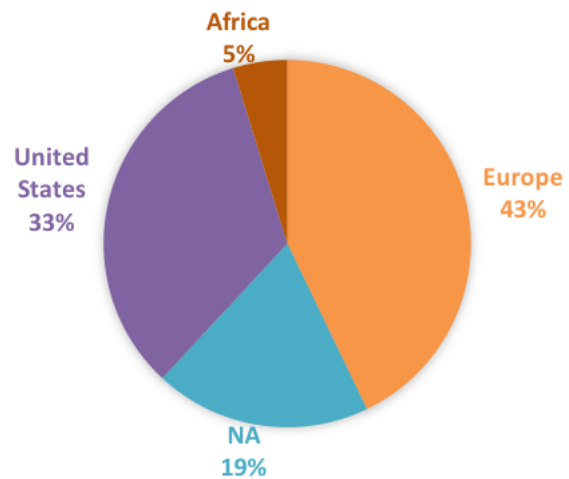


Figure I.2 Areas per share of law measurement initiatives

Data collected by the author. The location of the headquarters of the initiative is taken into account.



Figure I.3 Field of study per share of law measurement initiatives

Data collected by the author. Main area taken into account.

Figure I.1 shows that academia is the main legal indicators provider out of the initiatives studied here. Not-for-profit organisations account for 19% of initiatives, whereas think tanks account for 10% of initiatives. International organisations (19%) and States (9%) complete the landscape.

As for the geography of the law measurement initiatives analysed here, their epicentre would be located somewhere over the Atlantic Ocean, with a large predominance of European and United States based initiatives (see figure I.2). “NA” initiatives correspond to initiatives of the United Nations or of the World Bank, to which it was not possible to assign a location. For the

other initiatives, the country in which the university, NGO or think tank is settled is the one used for the diagram.

Whereas the predominance of United States and European based initiatives is due to a home bias or reflects the geography of the production of legal indicators is uncertain. In any case, most of these indices' ambition is to assess legal systems across the world. Some critics are based on the fact that the measured "apparently universal categories" such as "rule of law or good governance" are "based on a particular local or national model which define certain social forms as indicators (...) [and] are often based on the political and economic theories of those who create the indicators"²⁹⁵.

The third dimension of the identity of legal indicator producers, is the field of study (figure I.3). Unsurprisingly, Siems²⁹⁶ finds that numerical comparative law is a popular approach in corporate law. As such, most law measures are related to crime, corruption, governance and business, fields in which performance metrics are highly valued.

Krever²⁹⁷ goes a step further by linking the development of numerical approaches of law to the diffusion of neo-liberalism. He considers that two of the main legal quantification projects – the World Bank's Worldwide Governance Indicators (WGI) and Doing Business – serve economic development. The link with business is explicit as far as the Doing Business index is concerned. The WGI's link is more subtle, as the indicator explicitly aims to provide information on the perception of governance, defined as "the traditions and institutions by which authority in a country is exercised". This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them"²⁹⁸. There is no mention of a private sector bias here. Nonetheless, the definition of one of the six dimensions of governance measured to construct the index is explicitly business-oriented: regulatory quality is defined as

²⁹⁵ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p. 17.

²⁹⁶ SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 522.

²⁹⁷ KREVER Tor, « Quantifying Law: Legal Indicator Projects and the Reproduction of Neoliberal Common Sense », *Third World Quarterly*, 34, 2013, no 1, p. 131-150.

²⁹⁸ KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, « The Worldwide Governance Indicators: Methodology and Analytical Issues », *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246, p.4.

“capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development”²⁹⁹. Social welfare and environmental protection are thus unaccounted for in the measure of regulatory quality by the WGI. The World Bank’s “neoliberal, economic-based frame of reference and theory of growth”³⁰⁰ bias in its use and promotion of indicators is also put forward by Davis *et al.*

The figure I.3 doesn’t confirm, quantitatively, the predominance of business-oriented indicators which rank at the third place in rate, behind implementation measures (24%) and governance & rule of law measures (19%). These figures are nonetheless insufficient to serve as a counter argument to the potential link between indicators and the diffusion of neoliberalism as the present analysis is neither comprehensive, nor qualitative to take into account the respective impacts of different law measurement initiatives. Environment is nonetheless poorly represented, even though its protection is one of the challenges to come.

The fact that the identity and objectives of actors at the origin of law measurement initiatives may influence the choice of variables is both logical and problematic. It is logical to choose indicators that reflect and answer to the objectives of the research. It is nonetheless problematic that indicators, under an appearance of neutrality and scientificity may be used as tools to pursue political goals. Under these conditions, the lack of objectivity could transform indicators into trojan horses. The methodological biases of indicator measurement and the propensity of indicators to be instrumentalised are further avenues to explore criticisms addressed to legal indicators, and the risk of metamorphosis into trojan horses. The importance of methodology in the design of indicators is not specific to the field of law, as it finds more its sources in the fabrication of indicators than in their application to law.

b. *Methodological ground for debate*

Analysing ‘how’ law measurement initiatives are driven is essential to appreciate the potential flaws of the measurement. Indeed, methodological choices constitute a cornerstone of criticism on the potential for non-objectivity of (legal) indicators. Indicators’ methodological ground is based on two pillars, corresponding to two successive steps in the indicator-creation process. The first step consists in the definition of the data-indicator relationship, from the choice of the

²⁹⁹KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, « The Worldwide Governance Indicators: Methodology and Analytical Issues », *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246, p.4.

³⁰⁰ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p. 7.

data sources to the methodology used to transform the data into indicators (i). The second step corresponds to the methodological choices spanning from the aggregation of the individual indicators to a country score, and the interpretation of that score (ii).

i. Indicator-data relationships: from sources of data, to data transformation

The purpose of indicators is to provide information on a certain area. Few indicators are directly measurable, requiring to organise the transformation of data into indicators. The way to do so is therefore a methodological choice.

The relationship between indicators and data sources can articulate in two different ways. Indicators can either be linked to the data deductively “by operationalizing a theory of what data need to be looked for so as to provide evidence for the phenomena” or inductively “working from already existing data or bodies of statistics”³⁰¹.

Deductive approaches to indicator-data relationships can rely on different sources of data, which have an influence on the perceived objectivity of the indicators. These different sources are perceptions, expert views and observations.

Perceptions is a data source commonly used in law-measurement initiatives³⁰². Perception based-methodologies raise a number of concerns, such as possible bias due to the limited number of people interviewed or the risk of a score manipulation. For example, Versteeg and Ginsburg found that the convergence of four indicators of the rule of law using different conceptual backgrounds and methodologies is at 92% due to their reliance on experts, who appear to all rely on the same sources or on precedent scores of the indicator³⁰³. Davis *et al.* also highlight the inherent subjectivity of perception-based methodologies by underlining experts’ potential incentives to under or to over-report³⁰⁴. For example, “participants may be reluctant to disclose participation in illegal behaviour such as corruption”³⁰⁵. In a similar

³⁰¹ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 318.

³⁰² See A. 3) a. on perception-based methodologies

³⁰³ VERSTEEG Mila et GINSBURG Tom, « Measuring the Rule of Law: A Comparison of Indicators », *Law & Social Inquiry*, 42, 2017, n° 1, p. 100-137, p. 121.

³⁰⁴ MERRY Sally Engle, DAVIS Kevin E. et KINGSBURY Benedict (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, 353 p., p. 13.

³⁰⁵ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136, p. 129.

perspective, Hawken and Munck showed that the strictness of corruption perception indicators varies significantly whether the evaluator is a household or an expert³⁰⁶. In addition, they found that scores of perception always follow the same pattern depending on the category of evaluator³⁰⁷.

There are nonetheless advantages to the reliance on perception to assess matters such as the rule of law. As defended by Urueña, it is more difficult for countries to “game the score” by adopting paper reforms, which will be never enforced, as the score reflects what is perceived by the general public and experts³⁰⁸. Kaufmann also defend the choice to rely on perceptions, for three reasons. First, because “agents base their actions on perceptions”; second, because governance is difficultly measurable through other means than perception; third, perceptions are a way to measure “*de facto* reality that exists “on the ground”” to the contrary of *de jure* notions³⁰⁹.

Thoroughly criticised, perception as a source of law measurement is commonly used by influential initiatives such as the World Governance Indicators or the World Bank Rule of Law Index. Rather than being fully dismissed, perception-based initiatives deserve to be recognised as one method, out of others, of demonstration. They require nonetheless a careful handling and a robust methodology to handle the inherent subjectivity if this kind of sources.

Expert views are another source of deductive data sourcing for indicators. Close to perceptions, they nonetheless differ through the fact that experts are not asked for their perception of a phenomenon, but for their insights on objective questions. For example, the Environmental Democracy Index relies on such data sources. National researchers are asked to fill a questionnaire providing data for each indicator. For example, one of the indicators measures the extent to which “law provides for timely access to environmental information”. The national researchers choose between four options, leading to four different indicator scores, ranging

³⁰⁶ Hawken and Munck distinguish five types of evaluators: i) expert ratings by a commercial risk assessment agency, ii) expert ratings by an NGO, iii) expert ratings by a multilateral development bank (MDB), iv) surveys of business executives, and v) surveys of the mass public. See HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », Rochester, NY, Social Science Research Network, 2011, p. 4.

³⁰⁷ In descending order of strictness, they found the following pattern: in descending order of strictness: Expert Commercial > Expert NGO > Business Survey > Expert MDB = Mass Survey. HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », *Ibid*, p. 5.

³⁰⁸ URUEÑA René, « Indicators and the Law. A Case study of the Rule of Law Index », in DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 75-102, p. 86.

³⁰⁹ KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, “The Worldwide Governance Indicators: Methodology and Analytical Issues”, *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246, p. 238.

from 30 days or less to an absence of provision in the law for that matter, passing by a provision for a 30-60 days delay and a more than 60 days delay³¹⁰. The answers of the national researchers are then reviewed by a national reviewer and a secretariat reviewer, before going back to the researcher and reviewer. The secretariat has the final say. Last, the governments are provided with the results and a summary analysis, and asked to review the scoring. The latter can be altered after a last discussion with the national lawyer and reviewer. This complex review setting aims to increase the objectivity of the evaluation process. Freedom in the World follows a similar methodology, national analysts score countries and these scores are discussed with expert advisers and Freedom House staff. Freedom House recognises an unavoidable element of subjectivity but asserts that “the ratings process emphasizes methodological consistency, intellectual rigor, and balanced and unbiased judgments”³¹¹. In both cases the data process and multiple reviews aim to minimise error possibilities, bias and subjectivity by ensuring that results are issued from a collective work, rather than from a single person’s opinion.

The last deductive data source is direct observations ran by the developers of the indicator themselves. This type of data-sourcing is privileged when authors want to keep the control on the way data is collected, to minimise the risk of unforeseen biases due to the measure of perception or the recourse to experts. It has nevertheless the disadvantage of requiring an important investment from the indicator developers, who have to collect the data themselves. The ambitious SLADE program relied on primary data collection. Collection of some kinds of desired data was abandoned due to inaccessibility, and relied on publications and newspapers to collect data from the past³¹². Primary collection of data is nonetheless time and resource intensive³¹³.

The main qualities of deductive data sourcing are closely related to its advantages. On the one hand it enables to tailor type and sources of data to the objectives of the measurement initiative. On the other hand, it may require a high level of human, technical and financial resources too burdensome to maintain. Limited resources or difficulty to access data may thus necessitate the

³¹⁰ WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015.

³¹¹ FREEDOM HOUSE, « Freedom in the World 2021 Methodology », Washington DC, Freedom House, 2021, p.2.

³¹² MERRYMAN John Henry, « Law and Development Memoirs II: SLADE », *The American Journal of Comparative Law*, 48, 2000, n° 4, p. 713-727, pp. 719-723.

³¹³ In the case of the SLADE programme, the time the data was collected, the developers ran out of funding and had to abandon the programme. See A. 2) b. Measuring interactions between the legal and the social system.

use of proxies, recourse to a limited number of experts or methodological shortcuts detrimental to the objectivity of the results.

Inductive approaches are seldomly used in law measuring initiatives. They consist in working with existing bodies of statistics to construct the indicators. This could be due to the fact that law measurement initiatives are rather recent and poorly developed, leading to a restricted variety of readily usable statistics. Inductive data-sourcing in law measurement initiatives nonetheless exist, and are used mainly for outputs or outcomes measured, such as enforcement of the effects of the law. For example, the Environmental Performance Index relies on “best available data” on the state of the environment to produce the score³¹⁴. Data most often comes from international organisations, research institutions, academia and government agencies³¹⁵. The main issue in inductive approaches is to find relevant existing data for the specific purpose of measurement. Most often, this requires the use of proxies, indirect measures of the targeted concept or reality. The choice of proxies and necessity to settle for existing indicators can introduce subjectivity and bias in the analysis. For example, in the EPI unsafe sanitation and unsafe drinking water is measured “using the number of age-standardized disability- adjusted life-years lost per 100,000 persons (DALY rate) due to their exposure to inadequate sanitation facilities [or unsafe drinking water]”³¹⁶. The EPI itself recognises that this measure entails several limitations. First, the DALY rate is an indirect, non-comprehensive measure of unsafe sanitation as it does not directly measure water quality in ecosystems and the quality or use of sanitation facilities; nor does it measure the prevalence of chemical contaminants in drinking water. Second, the DALY rate himself is impeded by gaps in the literature, which are important sources of uncertainty in the estimates. In this case, the EPI seems rather aware of the limitations and uncertainties related to their choice of proxy³¹⁷. Their report provides an extensive review of both for all chosen indicators. Nonetheless, the risk with the import of proxies developed by other parties is the invisibility of biases and limitations, which can be hidden by the sources of data themselves. However, inductive data-sourcing have benefits, such as the access to standard

³¹⁴ WENDLING Zachary. A., EMERSON John W., DE SHERBININ Alex *et al.*, « Environment Performance Index 2020 », New Haven, CT, Yale Center for Environmental Law and Policy, 2020, p.168.

³¹⁵ *Ibid.*, p.169.

³¹⁶ *Ibid.*, p.56. The DALY rate is developed by the Global Burden of Disease project of the Institute for Health Metrics and Evaluation.

³¹⁷ On the importation of data-sourced biases into corruption indicators, see HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », Rochester, NY, Social Science Research Network, 2011.

metrics and a certain efficiency in the use of resources and competences as indicators are reused instead of being produced once more.

Whether the link between indicators and the data is deductive or inductive is directly related to subjectivity mitigation strategies. To reduce subjectivity, a deductive approach requires to detail how, why and what type of data would be needed to provide evidence for the phenomena; an inductive approach requires to highlight explicitly to what extent existing data is relevant for the current purpose, and biases inherent to these indicators. A type of data-sourcing is nonetheless not intrinsically more objective than the other. Objectivity – or the reduction of subjectivity – is first and foremost inherent to the choices made, their justification and the disclosure of potential biases and limitations. In addition, the disclosure of raw data enable validity and reliability testing by other researchers.

ii. From aggregation to interpretation: a fragile equilibrium

Consequent to data collection and indicator construction, indicators' aggregation into a single index and its interpretation constitute steps prone to a reintroduction of subjectivity.

Analysing corruption indices, Hawken and Munck raise the concern that measurement errors of indicators, far from being reduced, are carried over to the index or exacerbated³¹⁸. This phenomenon can find its source either in the weighting of indicators to produce the index, or because of the aggregation of errors in the indicators which can be systemic and independent across sources. The question of the weight to be given to the indicators to produce the aggregated index is a litigious. In the context of the Law, finance and development index, Sarkar and Singh have used “the un-weighted sum of all variables as an aggregated index of shareholder protection”, as much of the literature does. They nonetheless highlight that the assumption that “all variables are equally important (...) is of course unlikely to be true but assigning unequal weights risks the [becomes] too arbitrary³¹⁹. The choice of the aggregation procedure, including the implicit or explicit weight given to each indicator (the choice to assign, or not to assign variable weights to indicators) is thus an avenue for biases and subjectivity³²⁰.

³¹⁸ HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », Rochester, NY, Social Science Research Network, 2011, p. 9.

³¹⁹ SARKAR Prabirjit et SINGH Ajit, « Law, finance and development: further analyses of longitudinal data », *Cambridge Journal of Economics*, 34, 2009, n° 2, p. 325-346., p. 331.

³²⁰ HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », *Ibid*, p.12.

The World Governance Indicators deploy a specific methodology aimed to reduce uncertainty related to the measures and aggregation. As described by Kaufmann *et al.*, sub-indicators of corruption “should be viewed as noisy or imperfect proxies for corruption”³²¹ and combination of these individual sources would lead to a closer measure of the real, unobserved governance. Yet, because individual indicators describe governance at different scales, with different criteria and for a different set of countries, combining individual sources is challenging. The Unobserved Components Model (UCM) used by the WGI enables to standardize the data into comparable units, aggregate and weigh the individual sources according to their precision while constructing margins of error³²². The weighing of indicators is thus data-driven rather than theory-driven. As the aggregate measures remain imperfect, the WGI explicitly reports the standard errors and confidence intervals generated by the UCM to avoid users “over interpreting small differences between countries and over time in the indicators that are unlikely to be statistically—or practically—significant”³²³. The chosen confidence interval for the WGI is 90%, meaning that the authors are “90 percent confident that the true, but unobserved, level of governance for the countries lies in this range”³²⁴. The CPI also considers statistical significance using a 90% confidence interval, but this information is not as explicitly disclosed than for the WGI. Hawken nonetheless highlights that the UCM measures consensus rather than truth. Doing so, there is a confusion between validity testing (the results are true) rather than reliability testing (the results reflect agreement between different sources)³²⁵.

Even though an explicit display of methodological choices is necessary to reduce subjectivity, it remains insufficient to guarantee objectivity. The production of indicators is a matter of endless compromise between the ambition of the initiatives and the technical feasibility, between precision and relevancy across jurisdictions. Objectivity is one of the variables entering in account when finding a compromise. The “desire to cover the largest number of

³²¹ KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, “The Worldwide Governance Indicators: Methodology and Analytical Issues”, *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246, p. 236.

³²² “In other words, sources that provide a more informative signal of governance receive higher weight.”

KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, *ibid.*, p. 231.

³²³ *Ibid.*, p. 222.

³²⁴ *Ibid.*, p. 231.

³²⁵ HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », Rochester, NY, Social Science Research Network, 2011, p. 14.

countries possible” may also be done at the expense of methodological considerations, jeopardizing the usefulness and reliability of the developed indicators³²⁶.

The question remains whether the lack of objectivity of law measurement initiatives is prohibitive or not. As defended by Hawken and Munck, “it is always worth remembering that having some data, even if of poor quality, is a less grave problem than having no data at all”³²⁷. Maybe it should be added “so long as the limitations and biases of the data are made clear to all”. Subjectivity may be limited and explicated, but its disappearance is above the ambitions of this work.

Section 3) Indicators can be instrumentalised

The third range of criticisms of legal indicators evolve around their propension to be instrumentalised. The fact that “the actors and institutions who develop an indicator determine which concepts are being deployed, for what purposes, and with which theoretical orientation”³²⁸, answers to a form of logic. This fact nonetheless becomes an issue when the apparent neutrality of indicators hides biases, benchmarking or ideology.

This issue becomes a risk when indicators override their informative power to become prescriptive, “a technology for governance”³²⁹ which drives policy making. Therefore, attention shall be paid to the production process of indicators and to underlying objectives or values, as “the production of indicators is itself a political process, shaped by the power to categorize, count, analyse and promote a system of knowledge that has effects beyond the producers”.

For example, teams of *Doing Business* keep track of regulatory and legal reform associated with the indicators. Since 2005, they count the implementation of more that 3800 business regulatory reforms across 190 countries³³⁰. There is more to it. Restrepo Amariles reports that “more than 50 economies have formed ‘Reform Committees’ around the results of *Doing*

³²⁶ HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », Rochester, NY, Social Science Research Network, 2011, p.17.

³²⁷ *Ibid*, p.19.

³²⁸ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p. 11.

³²⁹ *Ibid*, p. 1.

³³⁰ Doing Business, <https://www.doingbusiness.org/en/reforms>, accessed 15/11/2021.

Business indicators, most often at the inter-ministerial level or reporting directly to the president or prime minister”³³¹, meaning that these countries base regulatory priorities on the *Doing Business* indicators. This role is assumed by the organisation, claiming the indicators to be “actionable”³³², meaning that it is simple for countries to improve their rate through the adoption of reform. In this perspective, countries are given access to a database of good practices and benchmarks worldwide, are provided with an evaluation of success or failure of past reform and guided in their reform by a simulator of the score of the indicator depending on the adopted reform. With concern, Restrepo Amariles highlights that “the combination of the above tools renders national law reformers not only dependent from development agencies’ data, but also accountable vis-à-vis the reform agenda set at an international level”³³³. The *Doing Business* indicators are thus an indirect medium for the World Bank to influence reform in national legal systems, which it couldn’t undergo directly as it cannot statutorily enter into political considerations³³⁴. Further, the political power of indicators reinforces implicitly the stance that there is just one model linking business, development and law. The *Doing Business* indicators is just an example of the capacity or propensity of indicators to transform facts into norms; to be prescriptive or normative rather than descriptive³³⁵. In other ways, they implicitly determine the path that has to be followed to comply with standards, which are decided by the indicator developers themselves. As developed in the previous section, indicators are far from being unbiased as they mirror the views and objectives of their developers³³⁶.

³³¹ RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development », in FORTES Pedro, BORATTI Larissa, PALACIOS Andres, et al. (éd.), *Law and Policy in Latin America: Transforming Courts, Institutions, and Rights.*, London, Palgrave Macmillan, 2016, p. 95-111, p. 95.

³³² WORLD BANK GROUP, « Doing Business 2020 », Washington DC, World Bank, 2020, p. 25.

³³³ RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development », *op. cit.*, p. 104.

³³⁴ RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development, *ibid.*, p. 102.

³³⁵ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 319.

³³⁶ On the biases of the *Doing Business* indicators in favour of deregulation and market economy, see for example RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development, *op. cit.*, p. 105.

Implicit benchmarking is another potential manipulation of indicators, misleading the reader on what is measured. Rather than measuring the quality of legal rules, implicit benchmarking in reality measures “how much countries deviate from a particular legal model”³³⁷.

Additionally, the way indicators interact with data and concepts is most often unclear to users, and might appear as a mysterious black box. Indicators are most often developed to provide an easy access representation of a complex reality such as rule of law, governance or corruption. It requires to strike a balance between universality and precision, and between the reality and measurement possibilities. Even though methodological choices such as the selection of proxies or the aggregation method are most often exposed, indicator consumers may not have the time, the will or the capacity to dive deep into methodological perspectives, and consider the indicators’ results as an intangible, mathematic, truth, “in a way that private opinions are not”³³⁸. Thus, Nelken links the use of indicators as tools typical of new systems of post war governance, shaping behaviours at a distance³³⁹.

Therefore, the mathematization of law is a double-edged sword. On the one hand it “opens up new horizons for the governance of legal systems and analysis of law”, enabling for example to establish relations with other quantified economic, social or environmental variables, or to “track patterns and trajectories of legal systems over time”³⁴⁰. On the second hand, the mathematical treatment of law necessarily strips legal analysis away from its context and potentially of its complexity.

³³⁷ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136, p. 122.

³³⁸ MERRY Sally Engle, « Measuring the World: Indicators, Human Rights, and Global Governance: with CA comment by John M. Conley », *Current Anthropology*, 52, The University of Chicago Press, 2011, n° S3, p. S83-S95, p. S84.

³³⁹ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 319.

³⁴⁰ RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development », in FORTES Pedro, BORATTI Larissa, PALACIOS Andres, *et al.* (éd.), *Law and Policy in Latin America: Transforming Courts, Institutions, and Rights.*, London, Palgrave Macmillan, 2016, p. 95-111, p. 107.

Conclusion of Title 1

This review of literature brings to light that quantitative measures of law have been emerging in the 1970s, but really developed in the 2000s. Figure I.4 shows the cumulated number and types of law measurement initiatives described above, by year of creation. It shows the rapid increase of law measurement initiatives in the 2000s, along with their progressive diversification. Initiatives measuring interactions of law with the social system were the first to appear, but didn't develop further. Constituents of law were the second area of law to be measured in the beginning of the 1990s, and were continued to be developed throughout the years, just like perceptions of law, enforcement of law, and the content of law. Measures of the effects of law were the last to appear in 2005, but the number of initiatives grew rapidly, as it is now the type of law measurement initiative most represented in our sample.

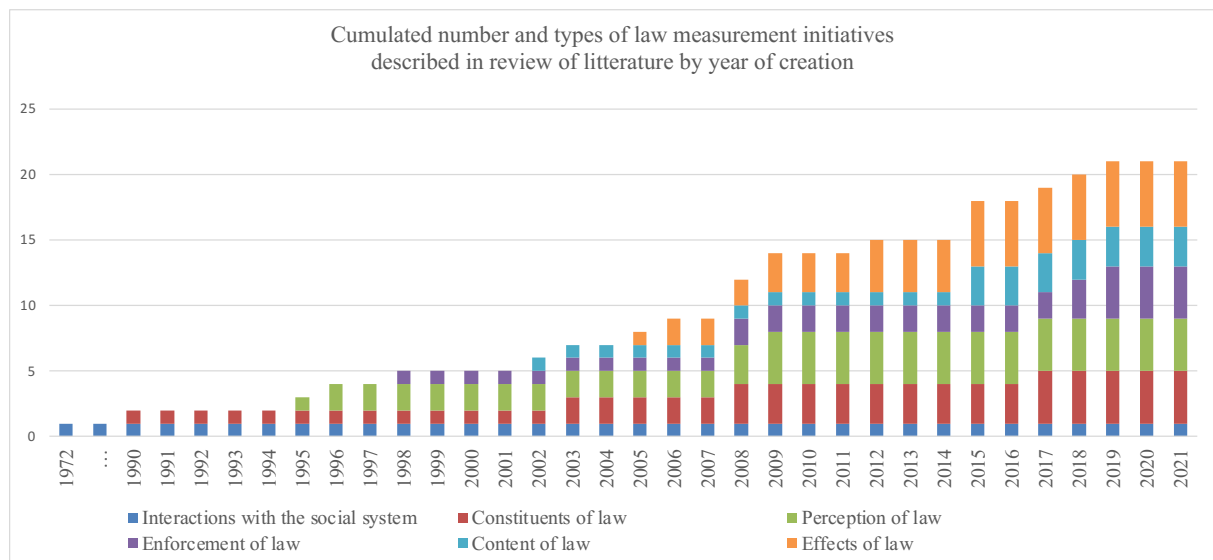


Figure I.4 Cumulated number and types of law measurement initiatives described in the review of literature by year of creation.

NB: the recorded year is the one of the first known published report or the year of the start of the data collection, when known.

All of these initiatives use quantitative descriptors of law, often called indicators. Nevertheless, none of these 21 initiatives provide a clear definition of the meaning of the expression 'legal indicator'. Concomitantly, law measurement initiatives have been criticized by both indicator producers and detractors. The identification of these critiques is essential in preparation to the development of a new methodology.

These criticisms put forward the need for the development of a methodology tailored to the particular context and objectives of this research, which aim is to be independent from expert-views and perceptions.

Indicators are first and foremost tools, among others, to analyse legal systems. Like any tool, it has specific usages for which it has been designed, and usages for which it cannot be used. Every indicator has its scope of interpretability, influenced by the indicator methodology design, for example.

Under certain conditions, indicators can have positive outcomes, such as creating “a hinge between communities” through the creation of a common language³⁴¹ or by producing readily accessible and standardized forms of knowledge that is able to convert complicated contextually and variable phenomena into unambiguous, clear and impersonal measures”³⁴².

These positive outcomes can be achieved with caution. All stages in the development and use of legal indicators require a perpetual pursuit of balance, from choosing what to measure to the disclosure of the results, passing by the formulation of the methodology.

In the choice of the indicators, the use of a criteria-grid enables to rationalize the choice made³⁴³. The specific design of a method to answer a particular question has also been underlined as “the most fruitful approach”³⁴⁴. In more specific terms, Siems proposes six guidelines in using numerical comparative law: *necessity* “to find a new way of dealing with pieces of information”; *methodical awareness* as “the world of statistics is slippery and its results may be less clear than they appear”; *transparency* as “it must be clear how the data is collected, and exactly what the figures mean”, *comparability* as “if there are manifested social, economic and cultural differences, a statistical comparison of the law is less valuable”; *functional equivalents* as “without this, a comparative study might get a strong home bias and might be regarded as “hidden benchmarking” because the legal measures with which one is familiar might not exist in other countries”; and *reflections* to “consider which conclusions can be accurately drawn

³⁴¹ URUEÑA René, « Indicators and the Law. A Case study of the Rule of Law Index », in DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 75-102, p. 91.

³⁴² NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 324.

³⁴³ The Environmental Performance Index uses the following inclusion criteria for data: relevance, performance orientation, established methodology, verification, spatial completeness, temporal completeness, recency, open source. WENDLING Zachary. A., EMERSON John W., DE SHERBININ Alex *et al.*, « Environment Performance Index 2020 », New Haven, CT, Yale Center for Environmental Law and Policy, 2020, p. 168.

³⁴⁴ SIEMS Mathias, *Comparative Law*, 2ème., Cambridge, Cambridge University Press, 2018, 506 p., p. 39.

from statistics”³⁴⁵. These guidelines, in addition to the cautionary remarks analysed above, will provide the bases for the development of indicators in this work. The first issue to address is here the comparability of the legal frameworks adopted in the case study countries.

³⁴⁵ SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, pp. 539-540.

Title 2. Guaranteeing comparability: a functional approach in a comparative perspective

In response to past experiments and in pursuit of the objectives of this research, the design of a new numerical comparative law methodology is required. The first methodological concern driving the development of this framework is to guarantee comparability across jurisdictions with different legal, social, political and economic characteristics. The power to regulate and environmental competencies are first mapped in the seven case study countries, to identify similarities and differences (Chapter 1). This analysis highlights the diversity of power to regulate settings in environmental law at large, but also on the regulation of plastic bags, questioning the comparability of their regulations. The analysis of the regulations through the functional methodology appears as a solution to mitigate this comparative imbroglio (Chapter 2).

Chapter 1. A comparative imbroglio: environmental competences in case study countries

Regulating in the field of the environment is highly technical, environmental protection laws being vast in numbers and complex³⁴⁶. If debates remain around the boundaries of environmental law and its distinctiveness³⁴⁷, the concern of law makers to regulate the impacts of human activities on natural ecosystems or resources is ancient³⁴⁸.

The question of ‘who’ or ‘which institutions’ have the power to regulate on environmental matters is central to analyse ‘what’ rules exist and ‘how’ they intend to protect the environment. The power to regulate and share of competencies is specific to each country, closely related to its constitutional history and to its level of or type of integration into supranational organisations. As such, three different settings emerge from the analysis of the distribution of competences in the seven case study countries.

³⁴⁶ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p., p. 4.

³⁴⁷ *Ibid*, p. 5.

³⁴⁸ LANGE Bettina., Command and Control Standards and Cross-jurisdictional Harmonization, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p.855.

A country-to-country analysis of the power to regulate is required to picture both the complexity and diversity of legal and political arrangements in the regulation of the environment across the case study countries³⁴⁹. The share of competence not only varies across countries, but also across subjects in a same country³⁵⁰.

As far as environmental competence is concerned in the fields of plastic, two main criteria allow to regroup countries around similarities: the distribution of environmental competences inside a federal (or devolved) state, and the share of competences with a supranational organisation³⁵¹. The correspondence, or non-correspondence, of each country to these two criteria enables to group countries by degrees of resemblance. First, for each country and each criterium, a binary variable is attributed whether the country corresponds (1) or does not correspond (0) to each criterium. Answers are compiled in the table I.1.

	Federal or devolved	Share of comp. with supranational org.
USA	1	0
BR	1	0
SN	0	0
CV	0	0
FR	0	1
IE	0	1
UK	1	1

Table I.1 Case-study countries and environmental competence distribution along 2 criteria: plastic

Clustering countries doesn't mean that two countries in the same cluster are identical, but rather that they have more in common than with other countries. Here, three groups emerge: the USA and Brazil, representing two practices of a federal state along with the United Kingdom, a particular case characterized by devolution and Brexit (section 1); France and Ireland, both unitary states integrated in the European Union (section 2); and Senegal and Cape Verde, both unitary states with no peculiar delegation of competence to a supranational organisation in the field of plastic bag regulation (section 3).

³⁴⁹ See annex II for case-study factsheets for contextual socioeconomic and political data in each of the countries.

³⁵⁰ See Part 3, Title 3 for examples of how the power to regulate settings in the case-study countries are different for pesticides and sewage.

³⁵¹ The case study countries regroup both common law and civil law countries. As the belonging to civil law or to common law traditions doesn't directly impacts the share of competence in environment regulation, this variable has been excluded from the dendrogram analysis. The comparability of common law and civil law countries in the context of this research will be addressed in B.1), b., Answering to critiques raised against the functional approach.

Section 1) The United States of America and Brazil: two practices of a federal state... the United Kingdom, a devolution exception

The USA and Brazil are both federal states articulating environmental competence at both the federal and state level. As far as plastic bag regulation is concerned, neither share or delegate competence to a supranational organization. These characteristics induce that on these aspects the USA (a) and Brazil (b) are statistically closer to another than to other case-study countries. They remain nonetheless different on many aspects³⁵². Devolution, or the transfer of power “from a central government to a local government”³⁵³ brings the United Kingdom closer to the functioning of a federal state (c).

a. The United States of America: a state competence, a federal pre-emption exception

The Constitution of the United States of America (USA), in force since March 4th 1789, is the Supreme law of the USA. Through its seven articles and twenty-seven amendments, it sets fundamental rights and acts as the basis to the power to regulate in the USA.

In international relations, article 1(8) provides that “no state shall enter into any treaty”, leaving international matters to the federal government. In respect to environmental protection, this means that the federal government is competent to sign environmental treaties and liable to comply.

In domestic law, the Constitution dictates the relationships among the executive, legislative and judiciary branches, “as well as the relative powers between the federal and state governments”³⁵⁴. On the one hand, the Constitution provides for enumerated federal powers, especially in article 1, sections 8 and 10 and article 4, section 1. On the other hand, the power to legislate of the states is set by the Tenth amendment, from which emerged the “universally-recognized state police power”³⁵⁵ in the fields of health, education and welfare. The “Supremacy Clause”, set by Article VI of the Constitution, provides that in case of conflict

³⁵² Here only competence distribution and power to regulate will be addressed. Country factsheets in annex II provide complementary sociological, geographic, economic and political information on each country.

³⁵³ Cambridge dictionary, <https://dictionary.cambridge.org/fr/dictionnaire/anglais/devolution>, accessed 02/03/2022.

³⁵⁴ SALZMAN James, United States of America, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 375.

³⁵⁵ Vassallo & Salazar, P.C. law firm, <https://www.vslawyers.com/federal-preemption-of-state-environmental-law/>, accessed 02/03/2022.

between state and federal legislation, state legislation is pre-empted by federal legislation³⁵⁶. States may also pre-empt local authorities' regulations. Therefore, specific limitations to the legislative powers of the states may be provided for by federal acts, as for example in pesticide regulation, by the Federal Insecticide, Fungicide and Rodenticide Act³⁵⁷; otherwise, states have the power to regulate environmental matters.

The legislative powers of the federal government are held by the Congress, composed of the House of Representatives and of the Senate. Each state also retains legislative powers, exercised by state congress³⁵⁸. On environmental issues, the executive branch at the federal level is the Environmental Protection Agency (EPA), created in 1970, along with other departments with environmental competencies³⁵⁹. The EPA retains large enforcement powers. It develops and enforces environmental regulations, helps formulate environmental law to be discussed and adopted by the Congress, and has the power to issue sanctions and levy fines³⁶⁰. The EPA is assisted by ten regional offices throughout the country. There are no specific courts to judge environmental matters, which are judged by the Supreme Court and common courts.

As seen previously, states may regulate environmental matters so long as the subject hasn't been pre-empted by the federal government. To date, even if several federal acts have been adopted to fight marine litter³⁶¹, no federal act regulates the production, importation,

³⁵⁶ As defined by Bermann and Nicolaidis, pre-emption occurs when the “federal law bars the adoption or application of any State law on a subject, it ‘occupies the entire field’, no matter how consonant with federal policy such State law may appear to—or even actually—be”. BERMANN George A. et NICOLAIDIS Kalypso, « Appendix Basic Principles for the Allocation of Competence in the United States and the European Union », in Nicolaidis Kalypso et Howse Robert (éd.), *The Federal Vision: Legitimacy and Levels of Governance in the United States and the European Union*, Oxford, Oxford Scholarship Online, 2001, 556p., p.489.

³⁵⁷ See Part III, Title 3, Chapter 1, section 2, a.

³⁵⁸ SALZMAN James, United States of America, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 375.

³⁵⁹ Such as the Council of Environmental Quality for environmental impact statements, the Department of Agriculture for soil conservation and forestry; the Department of Commerce for oceanic and atmospheric monitoring; the Department of Energy for energy policy and petroleum allocation; the Department of Health and Human Services for human health issues; the Department of the Interior for endangered species, energy, minerals, national parks and public lands; the Department of Labour for occupational health; the Department of State for international treaties dealing with the environment; the department of Transportation for Mass transit, roads, oil spills, and airplane noise; the Office of Management and Budget, for Agency coordination and budget. From VICARIO Lorenzo et OHLINGER Tina, « The United States Environmental Policy », Brussels, Belgium, POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICIES, 2015, p.13.

³⁶⁰ SALZMAN James, United States of America, *ibid.*, p. 389.

³⁶¹ See for example the Marine Debris Act as amended in 2018, the Save Our Seas 2.0 Act, the Microbead Free Waters Act of 2015, NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE, « Reckoning with the U.S. Role in Global Ocean Plastic Waste », The National Academies Press, 2021, p. 167.

exportation, distribution, commercialisation or use of plastic bags. As such, states have the power to do so, under state police power. As a reminder, the two states chosen as case-studies for the United States are the states of Texas and Florida. Local authorities may also adopt plastic bags regulations³⁶².

b. Brazil: an intricate power to regulate

Brazil is a federal country, with a share of competence between the federal government and States. The two main sources of environmental law in Brazil are the Constitution adopted in 1988³⁶³ and the National Environmental Policy³⁶⁴.

The 1988 Constitution, still in force, is the first Brazilian constitution to provide directly for the environment's protection through nine articles³⁶⁵. In Brazil, the federal government, the states and the municipalities hold administrative (executive) and legislative competences³⁶⁶. Under article 23(VI) of the Constitution, states and the federal government should cooperate on environmental matters for administrative (executive) competences³⁶⁷. On legislative matters, under article 24, the Federal government, Federal District and states detain competing competences on environmental matters³⁶⁸. Potential conflicts of competence are ruled by the same article: the Federal government can only adopt general legal texts for national or regional territories. States and the federal district can precise or complement federal law. For local

³⁶² Local authorities are out of the geographical scope of this study. For more information on local authorities and plastic regulation in the USA, see for example WAGNER Travis P., « Reducing single-use plastic shopping bags in the USA », *Waste Management (New York, N.Y.)*, 70, 2017, p. 3-12.

³⁶³ BRASIL. Constituição Federal. *Constituição da República Federativa do Brasil de 1988*, Brasília, DF, 05 Outubro 1988.

³⁶⁴ BRASIL. Lei nº 6.938, de 31 de agosto de 1981. *Dispõe sobre a Política Nacional do Meio Ambiente, seus fins e mecanismos de formulação e aplicação, e dá outras providências*, Brasília, DF, 31 ago 1981.

³⁶⁵ *Ibid*, p. 219. E.g., article 225 qualifies the environment of 'public good' ("bem de uso comum do povo").

³⁶⁶ BENJAMIN Antonio Herman and BRYNER Nicholas, Brazil, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 84.

³⁶⁷ "Article 23. The union, the states, the federal district and the municipalities, in common, have the power: (CA No. 53, 2006) (...) VI – to protect the environment and to fight pollution in any of its forms" Constitution of the Federative Republic of Brazil, Constitutional text of October 5, 1988, with the alterations introduced by Constitutional Amendments No. 1/1992 through 64/2010 and by Revision Constitutional Amendments No. 1/1994 through 6/1994, Documentation and information Center, Publishing Coordination, Brasília, 2010.

³⁶⁸ "Article 24. The union, the states and the federal district have the power to legislate concurrently on: (...) VI – forests, hunting, fishing, fauna, preservation of nature, defense of the soil and natural resources, protection of the environment and control of pollution". Constitution of the Federative Republic of Brazil, Constitutional text of October 5, 1988, with the alterations introduced by Constitutional Amendments No. 1/1992 through 64/2010 and by Revision Constitutional Amendments No. 1/1994 through 6/1994, Documentation and information Center, Publishing Coordination, Brasília, 2010.

matters, municipalities also detain competing competencies on environmental matters, consistently defended by the Constitutional Court (*Supremo Tribunal Federal*)³⁶⁹. As Costa de Oliveira highlights, “from here stems the risks of conflicting competencies in Brazil”³⁷⁰.

The National Environmental Policy³⁷¹, which entered into force prior to the adoption of the current Constitution, details the main concepts, objectives and instruments to be implemented by the competent institutions to protect the environment³⁷². This text also creates the *SISNAMA* (national environmental system), an agency whose role is to distribute environmental competences among institutions. The 6th article of the *lei* details which are the competent levels for environmental law adoption: the federal government (*União*), the states, the federal district and municipalities. Added to these administrations, the National Environmental Council (*CONAMA*) is in charge of providing advice to the Government on environmental matters and the Brazilian Institute of Environment and Natural Renewable Resources (*IBAMA*), is a federal executive administration.

On the matter of plastic bags, no text has been adopted to date at the federal level to restrict their use. Therefore, the default environmental share of competence developed above apply. The power to regulate in the field of plastic is a shared competence between the Federal governments, the states and municipalities³⁷³. States and municipalities can thus regulate plastic bags. For example, the state of Pernambuco adopted a *lei* offering a preferential service to

³⁶⁹ BENJAMIN Antonio Herman and BRYNER Nicholas, Brazil, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 85., citing S.T.F., RE No 633, 548 AgR/GO, 2d Panel, Relator: Min. Edson Fachin, DJe 11 April 2017. See also Lei Complementar No. 140, Art. 9; Estatuto da Cidade, Lei No. 10.257, de 10 de julho de 2001.

³⁷⁰ Translated. COSTA DE OLIVEIRA Carina, « B) En droit brésilien : « des sources aux principes » », *Revue juridique de l'Environnement*, 40, Persée - Portail des revues scientifiques en SHS, 2015, n° 2, p. 218-222, p. 220.

³⁷¹ BRASIL. Lei n° 6.938, de 31 de agosto de 1981, above mentioned.

³⁷² COSTA DE OLIVEIRA Carina, « B) En droit brésilien : « des sources aux principes » », *Revue juridique de l'Environnement*, 40, 2015, n° 2, pp. 218-222, p.218.

³⁷³ Legal texts adopted at the municipal level are out of the scope of this study. For examples of municipal texts on plastic bags, see for example *Lei n° 15.374 DE 18 de Maio de 2011 Dispõe sobre a proibição da distribuição gratuita ou venda de sacolas plásticas a consumidores em todos os estabelecimentos comerciais do Município de São Paulo, e dá outras providências, Diário Oficial da Cidade de 19/05/2011, p. 1* for the city of Sao Paulo or *Lei n° 17.733/2011 obriga os hipermercados, supermercados, mercados e estabelecimentos congêneres a disponibilizar caixa preferencial aos consumidores que utilizarem sacolas retornáveis* for the city of Recife.

customers bringing reusable bags³⁷⁴. The State of Sao Paulo hasn't, for the time being, adopted any plastic-bag state-wide regulation. Both are the two states chosen as case-studies for Brazil.

c. United Kingdom: a devolution and Brexit specificity

The United Kingdom (UK) is a special case in a number of respects. First, it joined the European Union on January 1st 1973. Fearing a complete European integration, it chose to opt-out from several symbolic integration steps, such as the inclusion in the Schengen area and in the euro zone. A referendum conducted in June 2016 triggered the UK's departure from the EU, officially since December 31st, 2020³⁷⁵.

Second, a crucial notion to the understanding of UK politics and power to regulate is devolution. If the United Kingdom is an independent state from an international law perspective, it isn't a nation³⁷⁶. The UK is composed of several 'countries' united under the UK banner, namely Scotland, Wales, North Ireland and England. Devolution is an asymmetric process of transfer of competences to national elected parliaments and executive institutions³⁷⁷. 'Asymmetric', because the transfer of competence from the Westminster parliament to national parliaments is decreasingly advanced in Scotland, North Ireland, and Wales³⁷⁸. A 'process' as devolution was initiated in 1998 in the three countries³⁷⁹, and evolved since with the adoption of further devolution acts³⁸⁰. 'A transfer of competence' as legislative and executive powers on a set of matters are no longer exerted by Westminster and Whitehall³⁸¹ but by nationally elected parliaments and governments. Therefore, a distinction is made between 'reserved matters' and

³⁷⁴ *Lei n° 16559 de 15/01/2019 Institui o Código Estadual de Defesa do Consumidor de Pernambuco, publicado no DOE - PE em 16 jan 2019*

³⁷⁵ See Annex II for the United Kingdom factsheet for more information on implications of Brexit on environmental law in the United Kingdom.

³⁷⁶ ANTOINE Aurélien, *Droit constitutionnel britannique*, 2ème édition., Issy-les-Moulineaux, LGDJ Lextenso éditions, 2018, 206 p, p. 173.

³⁷⁷ *Ibid*, p. 176.

³⁷⁸ Scotland is the country with the most devolved matters and Wales the least. *Ibid*, p. 176.

³⁷⁹ Devolution started in Scotland with the adoption of the Scotland Act 1998; in Northern Ireland with the adoption of the Northern Ireland Act (1998); in Wales with the adoption of the Government of Wales Act 1998. Additional documents, such as the Sewel Convention and Memorandum of Understanding address inter-governmental relations under devolution. Before devolution, England, Scotland and Wales were run by a central government located in London. A devolved parliament and government had been set up for Northern Ireland by the Government of Ireland Act 1920, and suspended in 1972.

Devolution was then suspended in Northern Ireland in October 2002 and restored in May 2007. <https://www.nidirect.gov.uk/articles/overview-government-northern-ireland#toc-1>, accessed 04/03/2022.

³⁸⁰ E.g. in Scotland the Scotland Act 2012 deepening the transfer of financial powers from Westminster and the Scotland Act 2016 devolving further powers to Scotland.

³⁸¹ Designating by metonymy respectively the United Kingdom Parliament and Government.

‘devolved matters’, in a distinction resembling the share of competencies in a federal state. The first are reserved to the UK institutions (Westminster and Whitehall), and cover matters such as, for Scotland, macroeconomic and fiscal issues, foreign policy and international relations, defence and national security, employment or immigration³⁸². All matters that are not reserved are considered as devolved. Environment matters are part of devolved matters for Scotland³⁸³ and Northern Ireland³⁸⁴ and Wales³⁸⁵. As such, the Scottish Parliament is free to adopt its own rules protecting the environment, whereas the Westminster Parliament adopts *statutes* for England.

Several reasons are raised by Bell and McGillivray to explain why there is “not a wide diversity in environmental laws across the different countries”³⁸⁶. First, “in the UK most of the formal sources of environmental law are statutory” and up to now greatly driven by the need to comply with European law or international obligations. While Scotland and Northern Ireland should comply with European law or international obligations in the exercise of devolved competences³⁸⁷, UK authorities detain powers in case of incompatible national laws or failure to transpose European laws in countries³⁸⁸. Second, some aspects of law-making haven’t been devolved such as tax and duties, restraining the possibility to introduce or alter economic instruments.

The central executive administration department in charge of the environment is the Department of the Environment, Food and Rural Affairs (DEFRA), created in 2001. It is the UK Government lead ministry for environment protection³⁸⁹. Although it has been criticized as having poor operational powers and a wide portfolio with activities “often in direct conflict

³⁸² Schedule 5, Scotland Act 1998.

³⁸³ “Scotland Act 1998, ss. 28-30, 38 (as amended). Reserved matters are list in Sch. 5 and include areas that have environmental implications such as energy, transport, and fishing outside national waters”, BELL Stuart, United Kingdom, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p.364.

³⁸⁴ Excepted matters are listed in the schedule 2, and reserved matters in the schedule 3 of the Northern Ireland Act (1998). Transferred matters are defined as “any matter which is not an excepted nor a reserved matter” (section 4, (1)). As such, environment matters are transferred.

³⁸⁵ The transfer of competences to Wales in environmental matters is more limited than to Northern Ireland and Scotland as it “only has the power to make orders within legislation determined at Westminster”, BULMER Simon et BURCH Martin, « British devolution and European policy-making: a step-change towards multi-level governance ? », *Politique europeenne*, 6, 2002, n° 2, p. 114-135, p. 127.

³⁸⁶ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p, p. 107-110.

³⁸⁷ Scotland Act 1998 s. 29

³⁸⁸ e.g. Scotland Act 1998 s. 35

³⁸⁹ Law and Your Environment, <http://www.environmentlaw.org.uk/rte.asp?id=299>, accessed 04/03/2022.

with environmental aims”, “a significant proportion or control of environmental matters falls to the Department”³⁹⁰. Additionally, the Department lays Statutory Instruments required to implement Acts of Parliament, signed by its Secretary of State (*i.e.*, minister).

Besides, regulatory agencies such as the Environment Agency (EA) in England or the Scottish Environment Protection Agency (SEPA) are in charge of enforcement of environmental law and policy³⁹¹.

As raised by Bell, “the structure of the administration of environmental law in the UK is complex”, “responsibilities for environmental matters are spread widely across a diverse range of administrative bodies” and devolution has added a layer of complexity with “parallel layers of administration with increasingly distinctive and sophisticated governance arrangements”³⁹². Back in 2012, the United Kingdom Environmental Law Association “criticized the state of environmental law in the UK as being *overly* complex, incoherent and lacking in integration and transparency”³⁹³. Other authors criticise the large part of discretion left to some actors in the implementation and enforcement of environmental law³⁹⁴.

This complexity isn’t expected to diminish with the UK’s departure from the European Union decided by referendum in 2016 and acted since January 1st, 2021. Since UK’s entry into the European Union in 1973, national environmental law and policy has been greatly influenced by legislation adopted by the European Union³⁹⁵. When leaving the EU, multiple questions arise. Some UK environmental laws are built in a European context, with references to definitions

³⁹⁰ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p., pp. 113-114.

³⁹¹ Scottish Environment Protection Agency, <https://www.sepa.org.uk>, accessed 04/03/2022. For the specific status of SEPA and competence distribution with EA, see for example See *ibid*, p. 123.

³⁹² BELL Stuart, United Kingdom, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p.364.

³⁹³ ELCOATE Vicki, FILGUEIRA Begonia et SCOTFORD Eloise, « The State of UK Environmental Law in 2011-2012 Is there a case for legislative reform? », London, UK Environmental Law Association, King’s College London, Cardiff University, 2012, p. 7.

³⁹⁴ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, *op. cit.*, p.99. “Wide discretions are frequently given in the legislation. This is a particularly clear feature of British environmental law. There are many examples, ranging from the discretion given to the Secretary of State on the form of delegated legislation, through discretion as to whether an area should be designated for special protection, discretion on the setting of standards (*e.g.*, in the permitted level of a pollutant discharged or emitted), to discretion over the enforcement of the law. In all areas of environmental law it is hard to get away from discretionary decision-making.”

³⁹⁵ MACRORY Richard, « Environmental law in the United Kingdom post Brexit », *ERA Forum*, 19, 2019, n° 4, p. 643-657, p. 643 and REID Colin T., « Mapping post-Brexit environmental law », *ERA Forum*, 21, 2021, no 4, p. 655-665, p. 656.

given in directives or regulations³⁹⁶. Others are “inspired by the need to comply with EU obligations but [are] completely self-contained in UK legislation”³⁹⁷. Bell also points out the risk of loss of substantive coherence across countries of the UK, while “membership of the EU has provided the stability for the UK to devolve environmental law-making powers in a way which encourages distinctive national approaches within the UK whilst maintaining a degree of substantive coherence”³⁹⁸.

Through the Government White Paper in 2017 and later the European Union (Withdrawal) Act 2018, the Government policy was to maximize regulatory certainty through a ‘roll-over’ of EU legislation as far as possible after Brexit. The European Union (Withdrawal) Act 2018 introduces the concept of ‘retained EU law’, namely “any EU Regulation or EU decision addressed to the UK which was operative before the date of exit from the EU will continue to form part of domestic law”³⁹⁹. This leaves time to legislators to incorporate environmental provisions to domestic law without reference to EU law. Given the number of required amendments, section 8 of the European Union (Withdrawal) Act 2018 “allows the regulations to amend Acts of Parliament as well as other regulations” contrary to “the legislative practice is that an Act of Parliament can only be amended by another Act of Parliament”⁴⁰⁰.

This arrangement enables to include the study of UK environmental law in this study through two case studies (England and Scotland) in a political context marked by Brexit. Both England and Scotland adopted statutory instruments regulating plastic bags⁴⁰¹.

³⁹⁶ E.g., “the legal definition of “waste” is essentially defined in terms of the EU Waste Directive (Dir. 2008/98) (Waste Management Licensing (Scotland) Regulations 2011, SSI 2011/228, reg.2).”, REID Colin T., « Brexit: challenges for environmental law », *Scots Law Times*, 27, 2016, p. 143-147, p.143.

³⁹⁷ E.g., “the legal definition of “waste” which lies at the centre of the law on that topic is essentially defined in terms of the EU Waste Directive (Dir. 2008/98) (Waste Management Licensing (Scotland) Regulations 2011, SSI 2011/228, reg.2).”, REID Colin T., « Brexit: challenges for environmental law », *Scots Law Times*, 27, 2016, p. 143-147, p.143.

³⁹⁸ BELL Stuart, United Kingdom, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p.372.

³⁹⁹ MACRORY Richard, « Environmental law in the United Kingdom post Brexit », *ERA Forum*, 19, 2019, n° 4, p. 643-657, p. 644.

⁴⁰⁰ A minimum 850 amendments were counted by the Secretary of State for Environment, Food and Rural Affairs in September 2017, Letter from the Secretary of State to Chair, House of Commons Select Committee on Environment, Food and Rural Affairs, cited in MACRORY Richard, « Environmental law in the United Kingdom post Brexit », *op. cit.*, p. 646.

⁴⁰¹ See Part II, Title 1, Chapter 2, b.

Section 2) France and Ireland: a European umbrella

The European Union (EU) is a supranational organization composed of 27 Member States⁴⁰², among which France⁴⁰³ and Ireland⁴⁰⁴. Its construction was impulsed just after the Second World War, around economic motives. As such, the protection of the environment was absent from the beginning of European integration, but is now “recognised as a leading proponent of international action on environment”⁴⁰⁵. EU Member States’ environmental law is now strongly influenced by European environmental law. Additionally, the principle of the primacy of EU law means that where there is a conflict between EU law and a Member State, EU law prevails. Primacy of EU law is not explicitly provided for in EU Treaties. Case law of the European Court of Justice is at the origin of this principle through the *Flaminio Costa v ENEL*⁴⁰⁶.

The power to regulate to protect the environment is a shared competence between Member States and the European Union⁴⁰⁷. The provisions organising the EU’s actions to protect the environment are provided for by the Title XX of the Treaty on the Functioning of the European Union (TFEU)⁴⁰⁸, comprised of the articles 191⁴⁰⁹, 192⁴¹⁰ and 193⁴¹¹.

⁴⁰² As of 15/06/2021.

⁴⁰³ Since January 1st, 1958.

⁴⁰⁴ Since January 1st, 1973.

⁴⁰⁵ https://ec.europa.eu/environment/international_issues/index_en.htm, accessed 02/09/1994.

⁴⁰⁶ *Flaminio Costa v ENEL* (Case 6/64), EU:C:1964:66, [1964] ECR 585, 15 July 1964.

To go further see for example CLERGERIE Jean-Louis, GRUBER Annie et RAMBAUD Patrick, *Droit institutionnel et matériel de l’Union européenne*, 13ème édition., Paris, Dalloz, 2020, pp. 287-289, 1164p.

⁴⁰⁷ The list of shared competencies is provided by Article 4, *Consolidated version of the Treaty on the Functioning of the European Union*, 26 October 2012, Official Journal n°32, pp. 1-390, also known as TFEU. “Environment” is listed in fifth position.

⁴⁰⁸ European Union, *Consolidated version of the Treaty on the Functioning of the European Union*, 26 October 2012, Official Journal n°32, pp. 1-390.

⁴⁰⁹ Article 191 TFEU sets the general strategic approach of the Union in regard to the protection of the environment, such as general objectives and prevailing principles. It also encourages a realistic politic based on “available scientific and technical data” or “the potential benefits and costs of action or lack of action”.

⁴¹⁰ Article 192 TFEU provides for the procedure of adoption of regulations enabling to achieve the objectives set in Article 191. The European Parliament and the Council may adopt texts in accordance with the ordinary legislative procedure organized by the article 294 of the same treaty. These texts can be of several nature, with different implications for Member States, as set by article 288 (*i.e.*, regulations, directives, decisions, recommendations and opinions). Only recommendations and opinions are not binding. Decisions are often addressed to specific regulatees. Regulations and directives are both binding. The first are directly applicable and “binding in its entirety” in all Member States. Directives are “binding, as to the result to be achieved” to the Member States to which it is addressed “but shall leave to the national authorities the choice of form and methods.” As such, the EU has several legislative means to influence or lead environmental policy in Member States.

⁴¹¹ Article 193 TFEU precises that above mentioned protective measures adopted by the EU should not prevent “any Member State from maintaining or introducing more stringent protective measures” as long as they are compatible with the Treaties and notified to the EU Commission.

Under Article 2 §2 of the TFEU, in case of shared competencies, “the Member States shall exercise their competence to the extent that the Union has not exercised its competence. The Member States shall again exercise their competence to the extent that the Union has decided to cease exercising its competence.”.

A distinction must be made between formal compliance with EU law and compliance in practice, requiring enforcement by national regulatory agencies⁴¹². The European Union disposes of specific means to ensure that Member States implement European Law on national territories, and continuously comply with the Treaties. Hence, the European Commission can bring proceedings for failure to fulfil obligations provided for the Treaties and European Union law, under the articles 258, 259 and 260 of the Treaty on the Functioning of the European Union, above mentioned. Nonetheless, the European Union disposes of limited material means to directly implement and enforce European law. It is mainly to the Member States to implement European law⁴¹³.

At the EU level, plastic bags are regulated by the Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015⁴¹⁴. Article 1 § 2⁴¹⁵ details the objectives to achieve, but Member States may introduce economic instruments or bans to achieve these objectives, in regard to national contexts. In addition, the Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment⁴¹⁶ highlights the importance to reduce marine litter (recitals 3 & 4). To achieve that objective, it aims to phase out the single-use plastics, which represent “around 86% of the single-use plastics found, in count, on beaches in the Union”.

⁴¹² BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p., p. 191.

⁴¹³ THIEFFRY Patrick, *Droit de l'environnement de l'Union européenne*, 2ème édition., Bruxelles, Bruylant, 2011, 528p., p. 82.

⁴¹⁴ Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags (Text with EEA relevance) Official Journal L 115, 06/05/2015 p. 11-15.

⁴¹⁵ Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015, above mentioned.

⁴¹⁶ Directive 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (Text with EEA relevance), Official Journal L 155, 12/06/2019 p. 1-19.

a. Ireland competence specifics

Ireland joined the European Union in 1973. Environmental regulation is thus a shared competence with the EU, under the conditions detailed *supra*.

The Irish government “designs and implements policies which deal with a range of environmental issues”⁴¹⁷. The Irish Environmental Protection Agency (EPA) is in charge of enforcement⁴¹⁸. In the field of waste, the Environment Fund⁴¹⁹, orchestrates the funding of a range of waste-related purposes.

b. France competence specifics

France is one of the founding countries of European integration. Environmental regulation is thus a shared competence with the EU, under the conditions detailed *supra*.

The Ministry in charge of the environment acts as an impulsion and coordination agency for environmental policy in the country. The Ministry “prepares and implements the Government’s policy in the fields of sustainable development and the environment” and works closely with other ministries to streamline environmental policy⁴²⁰. A wide range of public agencies are placed under the authority of the Ministry of Environment⁴²¹ with the aim “to adapt instruments for environmental management either to specific areas or specific objectives”⁴²².

Section 3) Cape Verde and Senegal: a national competence

Cape Verde (a) and Senegal (b) compose the last of the three groups as shaped by the three above-mentioned criteria. Both unitary countries, the power to regulate on environmental matters is not dispatched on a geographic basis nationally. In addition, neither Cape Verde, nor Senegal share competences in the field of plastic regulation with a supranational organisation. As such, the power to regulate on this subject is held nationally.

⁴¹⁷ <https://www.gov.ie/en/policy-information/26f183-environmental-policy/>, accessed 02/09/2021

⁴¹⁸ <https://www.epa.ie>

⁴¹⁹ Provided for by the Waste Management (Amendment) Act, 2001. It is controlled and managed by the Minister for Communications, Climate Action and Environment. See <https://www.gov.ie/en/publication/f6b84-environment-fund-accounts/> for accounts of the Environment Fund.

⁴²⁰ Article 1, Décret n°2020-869 du 15 juillet 2020 relatif aux attributions du ministre de la transition écologique, JORF n°0174 du 17 juillet 2020.

⁴²¹ Article 2, Décret n°2020-869, above mentioned.

⁴²² NEYRET Laurent, France, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 171-189. For a list and description of these agencies, see PRIEUR Michel, *Droit de l’environnement*, 8ème édition., Paris, Editions Dalloz, 2019, 1394 p., pp. 393-416.

a. *Cape Verde*

In Cape Verde, the fundamental right to a healthy environment is set at the article 73 of the Cape Verdean Constitution⁴²³.

The *Ministerio da Agricultura e ambiente* (MAA) “formulates and implements policy guidelines”⁴²⁴ on a variety of environmental policy subjects⁴²⁵. It should also “propose, share and disseminate legislative, regulatory and administrative measures related to the respective sectors of its competence and ensure their effective application”.

Cape Verde is also engaged in the fight against plastic pollution and more specifically plastic bags, through Lei no 99/VIII/2015 de 27 de Agosto⁴²⁶.

b. *Senegal*

In Senegal, the fundamental right to a healthy environment is set at the article 8 of the Constitution⁴²⁷.

The Ministry in charge of the environment holds a central role in the impulsion and coordination of environmental policy. The Minister “prepares and implements the policy defined by the President in terms of environmental monitoring, pollution control and protection of nature, fauna and flora”⁴²⁸. It is assisted in this endeavour by state agencies and autonomous structures, each specialized in specific sectors⁴²⁹. Other Ministries occasionally work with the Ministry of the Environment, depending on thematic.

Given the diversity of power to regulate settings in the seven case study countries, the developed methodology must carefully meet the comparative challenge. In this perspective, reliance on the functional method of comparative law seems promising.

⁴²³ Constituição da República de Cabo Verde, Boletim Oficial n°17, I Série, 3 de Maio de 2010.

⁴²⁴ <http://www.maa.gov.cv/index.php/maa/missao-visao-e-estrategias>, consulted on 15/06/2021

⁴²⁵ Sectors of agriculture, forestry, livestock, agribusiness, food security, environment, water and sanitation, <http://www.maa.gov.cv/index.php/maa/missao-visao-e-estrategias>, consulted on 15/06/2021

⁴²⁶ published in the Bulletin Oficial n°51 du 27/08/2015 pp. 1600-1603

⁴²⁷ Loi n°2001-03 du 22 janvier 2001 portant Constitution, Journal Officiel de la République du Sénégal , numéro spécial 5963 du 22 janvier 2001, p. 27.

⁴²⁸ « *Sous l'autorité du Président de la République, le Ministre de l'Environnement et du Développement durable prépare et met en œuvre la politique définie par le Chef de l'Etat en matière de veille environnementale, de lutte contre les pollutions et de protection de la nature, de la faune et de la flore* ». Article 1, Décret n°2020-2214 Relatif aux attributions du Ministre de l'Environnement et du Développement Durable, JORF n°0306 du 19 décembre 2020.

⁴²⁹ BONNIN Marie, LY Ibrahima, QUEFFELEC Betty *et al.* (dir.), *Droit de l'environnement marin et côtier au Sénégal*, Dakar, Sénégal, IRD, PRCM, 2016, 532 p, p. 89.

Chapter 2. A comparative challenge: functionality in the fight against plastic bag pollution

The comparison of the legal approaches developed by 7 countries requires to meet the challenge to find common ground making the countries comparable. Therefore, the comparison of countries with different state organisations, levels of international integration, and across thematics treated along different power to regulate distributions entails to follow an explicit methodology. The functional method, which relies on the identification of a common question the regulation intends to solve as a *tertium comparationis*, offers interesting perspectives (section 1). The comparability of the object of the comparison – plastic bag regulation – must therefore be analysed, revealing comparative opportunities and challenges (section 2).

Section 1) A functional approach in a comparative perspective

Given the aim of this work, which could be summarized as a trial of the measure of the potential contribution of law to the protection of the environment, the interest is rather to analyse the end-of-pipe legal solutions designed by countries to face plastic bag pollution, rather than to focus on ‘who does what’ and to compare institutional settings in different countries.

As such, the functional approach emerged as a key to comparability across diverging political, legal and thematic settings, but requires to be aware of and to monitor a few weak spots (a). The articulation of both aspects sets the methodological bases of this research (b).

a. The functional approach, an established comparative law methodology

According to Jansen, “comparison is the process of constructing relations of similarity and dissimilarity”⁴³⁰. Similarity and dissimilarity are relative. Two elements, A and B, can be similar in regard to a criteria x, but be different in regard to criteria y or element C⁴³¹. Therefore, precision in the definition of the compared elements and the criteria used are directly related to the validity of the analyses. Besides, the identification of differences is as valuable as the identification of commonalities, whereas often discarded⁴³².

⁴³⁰ JANSEN Nils, Comparative law and comparative knowledge, in REIMANN Mathias et REINHARD Zimmermann (dir.), *The Oxford Handbook of Comparative Law*, 1st edition., Oxford, Oxford University Press, 2006, 1430 p., pp. 305-338, p. 336.

⁴³¹ *Ibid.*, pp. 310-312.

⁴³² DE CONINCK Julie, « The Functional Method of Comparative Law: “Quo Vadis”? », *The Rabel Journal of Comparative and International Private Law*, Bd. 74 H. 2, 2010, p. 318-350, p. 330.

The specificity of the functional approach is that it “does not directly address rules and institutions as they appear in different legal systems, but approaches them as a response to certain problems”, through their “social function, *i.e.*, its responsiveness to a (...) problem”⁴³³. The functional method shifts “the research from a study of rules to a study of functions”⁴³⁴.

As presented by Siems, “the core element of functional comparative law [is] that a socio-economic problem should be the starting point of a comparative analysis”⁴³⁵. Rather than starting “with a hypothetical problem in order to examine how this problem would be solved in different legal systems”⁴³⁶, functional comparative research starts with a socio-economic question, and examines the answers of different legal systems.

The functional question here would be “which is the protection potential of countries’ legal answers to the issues of plastic bag pollution”. The support for comparison is then whatever legal texts are in force to address this functional question in the different studied jurisdictions. If the functional question had been broader, investigating *all* answers to plastic pollution (including non-legal answers), then the analysis would have additionally included “extra-legal forms of economic, social and political organization”⁴³⁷.

Michaels adds that in the functionalist approach, function serves as a *tertium comparationis*, a comparator enabling the comparison to occur⁴³⁸. The legal texts regulating plastic pollution can be very different one from the other, they are comparable “because they all perform the function to tackle the same problem”⁴³⁹. Comparability is ensured through this functional equivalence⁴⁴⁰. As a consequence, functionality enables to compare the content of legal texts adopted by

⁴³³ *Ibid.*, p. 323.

⁴³⁴ DARPO Jan et NILSSON Annika, « On the Comparison of Environmental Law Emerging Theories in Environmental Law », *Journal of Court Innovation*, 3, 2010, n° 1, p. 315-336, p. 318.

⁴³⁵ SIEMS Mathias, *Comparative Law*, 2ème., Cambridge, Cambridge University Press, 2018, 506 p., p. 31.

⁴³⁶ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, pp. 115-136, p. 23.

⁴³⁷ BIGNAMI Francesca, « Formal Versus Functional Method in Comparative Constitutional Law », *Osgoode Hall Law Journal*, 53, 2016, n° 2, p. 442-471, p. 445.

⁴³⁸ MICHAELS R., The Functional Method of Comparative Law, in REIMANN Mathias et REINHARD Zimmermann (dir.), *The Oxford Handbook of Comparative Law*, The Oxford Handbook of Comparative Law, 1st edition., Oxford, Oxford University Press, 2006, 1430 p., p. 342.

⁴³⁹ VIÑUALES, Jorge E., Comparative Environmental law: Structuring a Field in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 13.

⁴⁴⁰ DE CONINCK Julie, « The Functional Method of Comparative Law: “Quo Vadis”? », *The Rabel Journal of Comparative and International Private Law*, Bd. 74 H. 2, 2010, p. 318-350, p. 324.

countries belonging to different legal traditions, and both primary and secondary legislation as understood in the United Kingdom⁴⁴¹.

Besides, the focus on the articulation between the problem and the functional response “is said to offer a neutral perspective”⁴⁴². Even though functionality can tend towards neutrality through its problem-oriented approach, neutrality and objectivity of any method must always be questioned, to mitigate the risk to represent biased perspectives as neutral. Additionally, Jansen highlights the difference between subjective and arbitrary. He argues that comparison is not arbitrary, because “it refers to objective facts, and if we share or even recognize the author’s perspective and his epistemological interests, we can perfectly understand his judgement of similarity and dissimilarity”⁴⁴³. Once again, methodological transparency is key to the validity of the results. Functionalism can additionally have an evaluative potential, assessing which, of the different answers to a same problem, are ‘better’ than the others⁴⁴⁴.

It may be for these reasons that functional perspectives have been used in numerical comparative law at different occasions. Siems’ critics of the Djankov *et al.* initiative offer nonetheless a perspective on the risks of the use of this methodology. Siems highlights the lack of available data and the problematic assumption that the same problem exists in the different analysed jurisdictions – which is at the core of the functional approach⁴⁴⁵. On the other hand, he highlights that functional approaches should be attempted in the development of indices to avoid both “home bias” and “hidden benchmarking”. The first refers to a bias one could have in analysing the law of another country, and the second an assessment of how different legal systems are from the researcher’s national system.

⁴⁴¹ Secondary legislation is “is law created by ministers (or other bodies) under powers given to them by an Act of Parliament”. Acts of Parliament are primary legislation. <https://www.parliament.uk/about/how/laws/secondary-legislation/>, accessed 02/03/2022.

⁴⁴² DE CONINCK Julie, « The Functional Method of Comparative Law: “Quo Vadis”? », *op. cit.*, p. 318-350.

⁴⁴³ JANSEN Nils, Comparative law and comparative knowledge, in REIMANN Mathias et REINHARD Zimmermann (dir.), *The Oxford Handbook of Comparative Law*, 1st edition., Oxford, Oxford University Press, 2006, 1430 p., pp. 305-338, p. 313.

⁴⁴⁴ VIÑUALES, Jorge E., Comparative Environmental law: Structuring a Field in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p.13.

⁴⁴⁵ The assumption that different jurisdictions face the same problem is one of the main criticisms addressed to the functional approach. SIEMS Mathias, *Comparative Law*, 2ème., Cambridge, Cambridge University Press, 2018, 506 p., p. 46.

Among other criticisms of functionalism, Siems also raises the fact that “laws may become dysfunctional but remain in force”⁴⁴⁶, requiring to go beyond the existence of law and assessing law in practice. For other authors, “certain legal systems may need to be excluded from a comparative analysis”, such as legal systems at different stages of legal, political and economic development⁴⁴⁷, or such as “Western legal systems with ‘radically different legal cultures’, in particular from the developing world, perhaps with the exception of some technical legal rules”⁴⁴⁸. On the themes of study, Gutteridge argues that “certain areas of law are seen as less suitable for a functional comparative analysis than others because they are heavily influenced by geographical, socio-political, cultural and other peculiarities”⁴⁴⁹. Last, Bell reproaches to functional comparatists to overlook the role of institutions, the “organisational setting, the procedural context and the conceptual structure within which legal problems emerge and the rules are operated”⁴⁵⁰.

All these elements require to describe how the functional approach will be framed and executed in this study.

b. Methodological bases for the recourse to a functional approach

The functional approach offers interesting comparative perspectives, under certain conditions. The use of the functional approach in the context of this research requires to draw attention on potential loopholes, by analysing and answering to the six main critics formulated against this method.

The first criticism formulated above addresses the potential lack of available data to run functional comparative analyses. This work is centred on the analysis of the legal frameworks – set by legislative and executive powers – to regulated plastic bags. As such, it first and foremost requires access to the legal texts adopted nationally by both powers. Remote access to legal texts has long been challenging. The recent development of online and open-access

⁴⁴⁶ SIEMS Mathias, *Comparative Law*, 2ème., Cambridge, Cambridge University Press, 2018, 506 p., p. 47

⁴⁴⁷ *Ibid.*, p. 33, citing CRUZ Peter De, *Comparative Law in a Changing World*, 3rd edition., London, Routledge-Cavendish, 2007, 544 p., p. 226-7 and GUTTERIDGE Harold C., *Comparative Law, An Introduction to the comparative method of legal study and research*, 2nd Edition., Cambridge, United Kingdom, Cambridge University Press, 1949, 214 p., p. 73.

⁴⁴⁸ SIEMS Mathias, *Comparative Law, op. cit.*, p. 33, citing RILES Annelise, “Wigmore’s Treasure Box: Comparative Law in the Era of Information”, *Harvard International Law Journal*, 40, 1999, p. 221-283.

⁴⁴⁹ GUTTERIDGE Harold C., *Comparative Law, An Introduction to the comparative method of legal study and research*, 2nd Edition., Cambridge, United Kingdom, Cambridge University Press, 1949, 214 p., p. 32.

⁴⁵⁰ SIEMS Mathias, *Comparative Law, op. cit.*, p. 41, citing BELL J., “Legal Research and the Distinctiveness of Comparative Law”, in HOECKE Mark Van (dir.), *Methodologies of Legal Research: Which Kind of Method for What Kind of Discipline?*, London, Hart Publishing, 2011, 294 p., p. 170.

environmental law databases (such as Ecolex⁴⁵¹) or of national open-access law databases (such as Légifrance⁴⁵²) enables to overcome this challenge. In countries where national law databases aren't regularly updated, such as Senegal, the update of environmental law databases might also be delayed. In this context, contact with national environmental law professors can facilitate access to the required legal texts.

The second criticism formulated above pertains to the problematic assumption that different countries face the same problems. It closely relates to the criticism stating that certain areas of law are too influenced by local factors. The combined effect of globalization and the cheapness of plastic have shaped consumption habits and plastic's ubiquity globally⁴⁵³. This specific case study therefore offers a comparative ground escaping this criticism. The analysis of other sources of land-based pollution – pesticides and sewage – could nonetheless be more problematic⁴⁵⁴. The application of the developed methodology to these case studies would therefore require a specific investigation of the comparability of the problems faced by different countries. Areas of law which would be too influenced by local factors would have to be excluded from comparative analyses.

Regarding the fact that in force law may be dysfunctional, requiring an additional analysis of implementation and enforcement, this work acknowledges that further research will be needed to investigate these elements, which lie out of the scope of the present study. Likewise, whereas functional approaches could tend to overlook the role of institutions, this aspect will be analysed in a later stage, focused on the investigation of the implementation and enforcement of legal provisions. In addition, the next chapter is dedicated to the functional approach.

Last, a common made criticism to functional approaches to comparative law highlights that legal systems too different from one another should not be compared, unless on very technical subject. Due to its technicality, environmental law is likely to fall under the exception granted to this critic. Viñuales adds that environmental law's technicality is one of the reasons why that it is often absent from comparative law analyses⁴⁵⁵. In addition, the influence of international

⁴⁵¹ ECOLEX, <https://www.ecolex.org>, accessed 03/03/2022.

⁴⁵² LEGIFRANCE, <https://www.legifrance.gouv.fr>, accessed on 21/01/2022.

⁴⁵³ AZOULAY David, VILLA Priscillia, ARELLANO Yvette *et al.*, « Plastic Threatens Human Health at a Global Scale - New Report », Center for International Environmental Law (CIEL), 2019, p. 51.

⁴⁵⁴ See Part III, Title 3.

⁴⁵⁵ VIÑUALES, Jorge E., “Comparative Environmental law: Structuring a Field” in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 4-5.

organisations and agreements in this field tend to a harmonization of environmental law, facilitating comparisons⁴⁵⁶. Besides, this research could open the door to explore whether institutional, legal, political and socio-economic differences influence environmental protection approaches. Last, the technicality of plastic bag regulations facilitates comparison.

The answers to these criticisms highlight the necessity to conduct preliminary studies questioning the commonality of the problem faced by different countries, and the explanatory limits of the developed approach⁴⁵⁷.

As far as comparison between countries is concerned, the comparability of common law and civil law countries is sometimes questioned. The particularities of environmental law nonetheless facilitate comparison. According to Robinson, “Environmental Law tends to contain the same sort of substance and procedure across legal traditions” for four reasons: a common body of knowledge shaping societies’ answers to environment degradation, the diffusion of technological systems causing similar externalities, the commonality of the administrative systems of the modern state” and the development of worldwide environment protection movements requesting “similar political and social responses”.⁴⁵⁸ Comparison is nevertheless interesting, as the responses to these problems “are shaped by their own traditions and cultures”, specificities emerging in the analysis and comparison of different types of answers to the same problems⁴⁵⁹. The range of responses is nonetheless limited⁴⁶⁰, facilitating comparison. It is specifically this diversity among legal responses that this research aims to explore.

On this matter, comparison of civil law and common-law countries such as the UK and Ireland is facilitated as “most of the formal sources of environmental law are statutory (...) [or] consists

⁴⁵⁶ DARPO Jan et NILSSON Annika, « On the Comparison of Environmental Law Emerging Theories in Environmental Law », *Journal of Court Innovation*, 3, 2010, n° 1, p. 315-336, p. 316.

⁴⁵⁷ Darpo and Nillson speak of a “healthy scepticism”; DARPO Jan et NILSSON Annika, « On the Comparison of Environmental Law Emerging Theories in Environmental Law », *Journal of Court Innovation*, 3, 2010, n° 1, p. 315-336, p. 319.

⁴⁵⁸ ROBINSON Nicholas A., « Comparative Environmental Law: Evaluating How Legal Systems Address Sustainable Development », *Environmental Policy and Law*, 27, 1997, n° 4, p. 338-347, p. 341.

⁴⁵⁹ ROBINSON Nicholas A., « Comparative Environmental Law: Evaluating How Legal Systems Address Sustainable Development », *Environmental Policy and Law*, 27, 1997, n° 4, p. 338-347, p. 343.

⁴⁶⁰ VIÑUALES, Jorge E., “Comparative Environmental law: Structuring a Field” in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., p. 25.

of the interpretation of statutory provisions⁴⁶¹, or find its sources in the implementation of EU provisions and international treaties. Viñuales goes further, by arguing that “the emphasis on the common/ civil law divide can disguise the commonalities shared by Western legal systems”⁴⁶², which share many common concepts and ideas. This does not mean that there are no differences, but rather that “it is unhelpful to regard this divide as the main tool to understand [differences]”⁴⁶³, and even less helpful to exclude any comparison.

Nonetheless, the comparison of countries speaking different languages can be an additional challenge. Darpo and Nilsson recommend to “be constantly aware of the possibility of damage done to the meaning and substance of legal terms and systematic functions by translation” and to “realize one's limitations in relation to such difficulties as getting at the real meaning in translating the message contained in a legal text, in describing and analysing the foreign legal system, and in presenting the results”⁴⁶⁴. At such occasions, contacts with national lawyers is required.

As this work is a trial to explore the pros and cons of a developed methodology, this study is limited to seven countries⁴⁶⁵, prementioned. Diversity across legal traditions, geographies, levels of development and language has been researched to investigate potential links between one of these characteristics and convergence in environmental protection approaches. Nevertheless, the diversity of environmental competence distribution required a few compromises on the geographical scope of analyses.

For federal countries⁴⁶⁶, where the power to regulate is in the hands of the States and not the Federal government outside of pre-emption exceptions, two States have been chosen⁴⁶⁷. In Brazil, the two States are Pernambuco and Sao Paulo, and in the United States Florida and Texas. Alike, in the United Kingdom where the competence is devolved, the analyses will be limited to England and Scotland. The regulations adopted by a single State do not presume on

⁴⁶¹ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p., p. 101.

⁴⁶² VIÑUALES, Jorge E., *Comparative Environmental law: Structuring a Field*, *op. cit.*, p. 78.

⁴⁶³ VIÑUALES, Jorge E., *Comparative Environmental law: Structuring a Field*, *op. cit.* p. 82.

⁴⁶⁴ DARPO Jan et NILSSON Annika, « On the Comparison of Environmental Law Emerging Theories in Environmental Law », *Journal of Court Innovation*, 3, 2010, n° 1, p. 315-336, p. 322.

⁴⁶⁵ Brazil, Cape Verde, France, Ireland, Senegal, the United Kingdom, and the United States of America.

⁴⁶⁶ Brazil and the United States of America.

⁴⁶⁷ The analysis of State regulations in federal countries is one of the inputs of this work, which is most often overlooked in plastic bag regulation studies. For example, The UNE report UNE, « Single-use plastics: A Roadmap for Sustainability », Nairobi, United Nations Environment, 2018 only takes into account regulations adopted at the national level, offering a biased vision of the legal frameworks adopted in federal countries.

the regulations adopted by other States in the same country. High discrepancies exist. The selected States should not be considered as flagships representing the approach of the entire country. They have not been selected to be representative of the state of the art of the existent regulations in a country, but rather as examples of what may exist. These States have been chosen for a number of reasons. All these States border the Atlantic Ocean. In the United States, Texas and Florida have been chosen for their agricultural surface, at a time of this project when the regulation of pesticides should have been analysed in addition to the regulation of plastic bags. In the United Kingdom, Scotland is the country where devolution has been the most advanced. It has therefore been chosen, along with England, to offer the wider range of dissimilarity possible. As for Brazil, the States of Sao Paulo and Pernambuco have been chosen in the continuity of past research partnerships with universities in both States.

For the other countries with a unitary political organisation⁴⁶⁸, the legal texts analysed cover the entire territory. On the subjects where international integration has an impact on nationally applicable law, these texts will be included in the analyses.

For all countries, the type of text will be mentioned in the country own terms, in italics for non-English speaking countries: *statute, loi, décret, arrêté, lei, etc.*

In all countries, legal texts adopted at a municipal or local-authority level are excluded of the analysis. This choice governed by time constraints is one of the limitations of this work, especially when the legal text adopted by the city of Sao Paulo, governing near to 24 times the population of Cape Verde, is excluded of the analyses.

This work's aim is to analyse the content of legal texts to qualify and quantify their potential of protection in regard to plastic bag pollution, based on the case study of 7 countries' regulation of plastic bags. To do so, and in the particular context of this research as above mentioned, the functional method appears as a solution to raise the challenge of comparing seven countries with different power to regulate settings, along with different economic, political, socio-economic and legal contexts. The major risks and limits related to the recourse to the functional method, above-mentioned, are mitigated through the adoption of specific methodological bases. Other criticisms, such as the importance to investigate implementation and enforcement of legal texts through the investigation of the role of institutions or of the potential dysfunction of some

⁴⁶⁸ France, Senegal, Cape Verde, Ireland

laws, are not specific to the functional method. Whereas this focus lies out of the scope of the present study, they offer interesting perspectives for further research.

A *sine qua non* condition of the recourse to the functional method is nonetheless the acknowledgement that the different countries face a common problem, intended to be solved. In this respect, it is necessary to guarantee that land-based pollution, and more specifically the issue of plastic bags, offers this required commonality.

Section 2) Plastic bag pollution as a shared problem: comparability opportunities and challenges

The identification of a shared problem is a prerequisite to the launch of a functional comparative approach. As presented by de Coninck, “to focus on the way different legal systems solve the same problem, as a means to warrant comparability, supposes the problem occurs in all systems under comparison”⁴⁶⁹. This hypothesis may require “conducting (or at least relying upon) a prior investigation regarding the actual presence of the problem in the systems under scrutiny”. Therefore, the development of this methodology requires to question the universality of identified problem, through the definition of comparison criteria (a). The defined criteria will be used to define the focus key question of plastic bag pollution (b).

a. Setting comparative criteria: selection of key questions of pollution sources

For the functional method to be used, the legal frameworks analysed must answer to a common problem. The focus on sources of land-based pollution is too large to serve as a basis to the development of the comparative methodology, as it requires the analysis of a wide area of environmental law. This study is a pilot, whose aim is to be constructive rather than exhaustive, privileging the deep analysis of a limited number of issues rather than overflying a large number of themes. From these analyses will emerge questionings that will enable to refine the methods and processes. If the conclusions are compelling, the research will be broadened to other issues affecting ocean health to provide a more comprehensive picture of law’s protection of oceans. This work’s case study is set on the analysis of plastic bag regulations, considered as a key question of the mitigation of plastic pollution. A key question can be defined as a subtopic of the pollution source for which it is possible to analyse and compare applicable regulation. On

⁴⁶⁹ DE CONINCK Julie, « The Functional Method of Comparative Law: “Quo Vadis”? », *The Rabel Journal of Comparative and International Private Law*, Bd. 74 H. 2, 2010, p. 318-350, p. 329.

the subject of plastic pollution, other key questions could be the regulation of other single use objects, such as plastic cutlery or bottles.

The comparability of the items to be compared is “a fundamental question of all legal or non-legal comparative research”⁴⁷⁰. Therefore, these key questions must be relevant in all the case study countries, and enable to assess the protection potential held by environmental law addressing this issue. To facilitate their choice, a list of criteria has been developed.

The overarching ambition of this work is to inform the extent to which adopted legal frameworks would protect the environment, if they were fully implemented, enforced and complied with. Therefore, the first criterion is to choose an issue recognized as harmful to marine ecosystems. In other terms, based on available scientific evidence, the chosen object is recognized as having major impacts on marine ecosystems.

The second criterion relates to the universality of the object, which needs to be relevant in all the countries of the case study – or at least acknowledged as irrelevant and not taken into account. It is unlikely that a legal system would regulate a specific source of pollution on national territory if this source is inexistent nationally. The absence of legal provision on this matter would not mean that the country’s protection of marine environments is incomplete, but rather that the chosen object is irrelevant. The non-legal context is thus to be investigated in the process of choosing objects as much as the legal context.

Precision in the definition of the key question is the third criterion and an additional challenge. Precision is key to maximise the objectivity and legibility of the indicators. For example, in the fight against plastic pollution, single-use plastics are asymmetrically regulated. Whereas in 2020 137 countries had passed or planned to adopt plastic regulations by 2021, only 17 countries - representing 9% of countries with some form of plastic-related legislation - “have policies covering more than half of the waste items found in beach clean-ups”⁴⁷¹. If anti-plastic bags policies have emerged throughout the world these last decades, it may hide high discrepancies on other objects. Therefore, this works explicitly analyses plastic bag related regulations rather than some form of plastic related regulation. Therefore, it must be kept in mind that as precision increases, comparability may decrease. For example, the comparison of

⁴⁷⁰ DE CONINCK Julie, « The Functional Method of Comparative Law: “Quo Vadis”? », *The Rabel Journal of Comparative and International Private Law*, Bd. 74 H. 2, 2010, p. 318-350, p. 323.

⁴⁷¹ WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020, pp. 12-13.

plastic bag policies related to bags of a certain size or thickness would greatly diminish the number of comparable countries.

These criteria enable to test the comparability of the regulation of plastic bags, as a key question of legal approaches to the fight against plastic pollution.

b. *Plastic bags: a comparability test*

Back in 1987, “the Brundtland report emphasized the opportunities “new” materials like high-performance plastic would bring about and did not mention plastics as an environmental problem”⁴⁷². Today, plastic is ubiquitous in consumption patterns all over the world, but can also be found in the most remote places⁴⁷³, just like on the streets due to the breadth of its usages added to poor management. Science attempting to measure the impacts of its presence in the environment is fairly recent but has already started to show that the issue is too big to ignore. Plastic can therefore be recognised as harmful to the ecosystems all over the world.

According to UNEP⁴⁷⁴, polyethylene, the material from which most bags are made, is first synthesized in an industrially practical way in 1933. Kept secret during the World War II, the one-piece polyethylene shopping bag is patented by Celloplast in 1965. It then rapidly replaces cloth and paper in Europe, cheaper and more resistant. Throughout the 1980s, supermarkets across the world progressively switched to plastic bags. The use of plastic bags has become so common and the pollution it generates so visible, that for example commentators on the African continent renamed them ‘African flowers’ or ‘South African national flowers’⁴⁷⁵. Therefore, plastic bags can be considered as universal.

Legislation banning or limiting the use of plastic has sprouted across the globe these last decades, be it on the subject of microbeads, plastic bags, single-use or packaging⁴⁷⁶. The

⁴⁷² KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead: What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, 2018, n° 6, p. 1994, p. 1995. Reference of the Brundtland report: World Commission on Environment and Development. Report of the World Commission on Environment and Development: Our Common Future; Oxford University Press: Oxford, UK, 1987.

⁴⁷³ A plastic bag has been found in the Mariana trench: CHIBA Sanae, SAITO Hideaki, FLETCHER Ruth et al., « Human footprint in the abyss: 30 year records of deep-sea plastic debris », *Marine Policy*, 96, 2018, p. 204-212.

⁴⁷⁴ <https://www.unep.org/news-and-stories/story/birth-ban-history-plastic-shopping-bag>, accessed on 13/09/2021.

⁴⁷⁵ See for example “Nairobi Journal; Flower of Africa: A Curse That's Blowing in the Wind”, New York Times, April 7, 2005, Section A, Page 4, accessed <https://www.nytimes.com/2005/04/07/world/africa/flower-of-africa-a-curse-thats-blowing-in-the-wind.html>, on 13/09/2021.

⁴⁷⁶ See for example UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018.

visibility of pollution due to plastic bags and the scenic nature of its damages⁴⁷⁷ led a number of countries to regulate plastic bags. The body of legal texts provides material for comparative analyses. In many cases, regulations on other objects responsible of plastic pollution (single-use such as cutlery, cotton buds, packaging) emerged in the years following the plastic bag regulation⁴⁷⁸. Such regulations, more recent and less spread across jurisdictions, provide less material for comparative analyses. Thus, the focus on plastic bags offers the required precision. Therefore, the selection of plastic bag regulation as a key question meets the three identified criteria to run a methodology based on a functional comparative method.

Conclusion of Title 2

This title has enabled to set the bases of the development of a tailored methodology.

First, the analysis of the power to regulate settings in environmental matters and more specifically in the plastic bag regulation context has highlighted the diversity of legal settings. For three case-study countries – Brazil, the United Kingdom and the United States of America – the power to regulate plastic bags lies first and foremost in the hands of States or devolved entities. This setting enables multiple approaches to plastic bag regulations inside the borders of a single country. Ideally, the legal frameworks of each state and devolved entity would have been analysed, to offer a fair representation of national approaches to the regulation of plastic bags. Nonetheless, time constraints required to limit the analysed legal frameworks to two subnational entities per federal or affiliated country: namely Texas and Florida for the United States of America, England and Scotland for the United Kingdom, and the states of Sao Paulo and Pernambuco for Brazil. Among the case-studies with a unitary political organisation, France and Ireland are members to the European Union, and share the power to regulate environmental matters with the latter's institutions. On the matter of plastic bags, the adopted directives leave states the choice of the means to reduce the incidence of plastic bags in the environment. Last, Senegal and Cape Verde, both unitary states, have adopted national laws relative to plastic bags.

⁴⁷⁷ Photographs of marine animals entrenched in a plastic bag or dead animals with the stomach full of plastic have massively circulated these last years.

⁴⁷⁸ Such as the Directive EU 2015/720 followed by the Directive (EU) 2019/904; in Senegal the *Loi* n°2015-09 followed by the *Loi* n°2020/04.

The diversity of power to regulate settings reflects the diversity of countries chosen as case-studies. If this diversity can be considered as a challenge in a comparative perspective, it is also an occasion to analyse the diversity of countries' answers to a common source of pollution.

This diversity nonetheless requires to adopt a specific methodological approach to enable the comparison of the case studies' legal frameworks. Given the objective of this work, which is to analyse the potential of protection offered by legal frameworks in themselves, prior to their enforcement, the functional approach offers interesting perspectives. As developed above, the functional approach "does not directly address rules and institutions as they appear in different legal systems, but approaches them as a response to certain problems"⁴⁷⁹. Therefore, it enables to compare legal frameworks adopted in different power to regulate settings, and supported by different types of institutions so long as they address a common problem. Among the main criticisms addressed to functional approaches, is the assumption that different countries face common problems. The specific case-study or plastic bag regulations nonetheless enable to circumvent this criticism. Other criticisms, pertaining to the limits of the functional method to take into account the extent to which legal frameworks are implemented and enforced do not apply to this work, implementation and enforcement lying out of the scope of this study.

The analysis of plastic bag regulations appears as a relevant case study to test a methodology built on these bases. The contours of a methodology and numerical tools enabling to qualitatively and quantitatively analyse the potential of protection offered by legal frameworks still need to be defined.

⁴⁷⁹ DE CONINCK Julie, « The Functional Method of Comparative Law: "Quo Vadis"?, *The Rabel Journal of Comparative and International Private Law*, Bd. 74 H. 2, 2010, p. 318-350, p. 323.

Title 3. Producing a digital tool in service of an analytical and numerical framework

This research pursues a double objective. It aims to explore the added value of the recourse to quantitative tools and indicators to analyse the content of law, specifically in regard to its adequacy to protect the environment. Environmental law is technical and often interlocks several sets of legal texts, rules and of exceptions. Assessing the potential contribution of legal frameworks to the protection of the environment requires the design of an entire methodological framework composed of two complementary pillars, and a relevant toolbox.

The first methodological pillar sets the analytical framework of the analysis, which refers to the “careful or scientific examination of [relevant] facts and information”⁴⁸⁰ contained in legal texts. Therefore, the analytical pillar should lay the conceptual ground for an analysis of the potential contribution of legal frameworks to the protection of the environment. Doing so, it should enable to draw the big picture of the drivers and obstacles to the protection of the environment at the stage of law’s conception (Chapter 1).

The second methodological pillar establishes the building blocks of the digital and numerical frameworks. The first consists in the development of a relational database tailored to the analysis of the content of legal texts, be it qualitatively, quantitatively, or through indicators. The second provides for the development of indicators (Chapter 2).

Put together, these numerical and analytical frameworks will enable both to compare the different strategies set up by a set of countries to tackle a source of pollution, and to assess the potential of protection of these different strategies.

The approach developed in this work is definitely heuristic. Based on a trial-and-error method, its aim is first and foremost to serve as an aid to explore, discover and potentially contribute to solve some of the challenges laid by the current knowledge gap on the potential contribution of law to the protection of the environment. As objectivity arises from precision, the methodology developed here requires the transparent and clear articulation of methods and data, along with the identification and disclosure of the limits and generalisability of conclusions.

⁴⁸⁰ Definition of ‘analytical’ given by <https://dictionary.cambridge.org/fr/dictionnaire/anglais/analytical>, accessed 22/07/2020.

Chapter 1. Designing an analytical framework: comprehensiveness and forcefulness

The design of the analytical framework, or conceptual ground of the method, requires to explore the extent to which the legal texts' general guideline is relevant to protect the environment.

There are two complementary avenues by which legal provisions, as drafted, can spur environment's protection: they must be comprehensive enough and strong enough to protect the environment⁴⁸¹. In other words, legal frameworks must be comprehensive in their grasp of the problem, and forceful in their application.

The words *comprehensiveness* and *forcefulness* are not commonly used to describe law. The word comprehensiveness relates to “the quality of being wide-ranging and large in scope”⁴⁸². Therefore, the study of comprehensiveness aims to characterise the breadth of the material scope of the studied legal provisions in regard to the protection of the environment. A fully comprehensive text deals with the issue at stake – here for example plastic bag pollution – in a holistic manner.

The word forcefulness relates to law's quality of being “strong and assertive; vigorous and powerful”⁴⁸³ in achieving its objective. Therefore, the study of forcefulness aims to characterise the means provided for in the legal texts to enforce the required system change to protect the environment. It is a measure of the potential of force of a legal framework, questioning whether the set of rules are supplied by the necessary tools to be enforced and instil change on the ground. Forcefulness is closely related to enforcement, defined as “the act of compelling compliance with a law”⁴⁸⁴. It is nonetheless distinct from enforcement. Whereas enforcement “necessarily contains an element of constraint, of force”⁴⁸⁵, forcefulness questions the existence and force of enforcement provisions such as controls and sanctions – the rule's operationalisation – but also, the intrinsic force of the chosen policy instrument in curbing actors' behaviour toward the desired outcome – the force of the rule in itself. A forceful text thus provides the necessary tools to enforce the rule on the ground.

⁴⁸¹ DAUVERGNE Peter, « Why is the global governance of plastic failing the oceans? », *Global Environmental Change*, 51, 2018, p. 22-31, p. 23.

⁴⁸² Oxford Dictionary, Lexico, <https://www.lexico.com/definition/comprehensiveness>, accessed on 14/02/2022.

⁴⁸³ Oxford Dictionary, Lexico, <https://www.lexico.com/definition/forcefulness>, accessed on 14/02/2022.

⁴⁸⁴ KRAMER Ludwig, *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p., p. xvi.

⁴⁸⁵ *Ibid.*, p. xvi.

The analysis of comprehensiveness and forcefulness is taking a step to the side from the analysis of the implementation and enforcement of the law or the analysis of law's effect or impact on its object, but could usefully inform both. For example, uncomprehensive law could tend to miss its target or to leave way to so many exemptions that the existence of a rule becomes an exemption in itself. It would then be illusory to consider that a high level of enforcement would effectively protect the environment. Likewise, unforceful law could lack the force to drive change, and impede enforcement. The analysis of comprehensiveness and forcefulness therefore enable to pre-identify the potential obstacles to enforced and effective law, from the start. It would enable to save precious time in the identification of the hinders and drivers of truly protective environmental legal frameworks.

Therefore, the methodology's analytical framework is based on the exploration of two complementary aspects of the regulations: their comprehensiveness (section 1) and their forcefulness (section 2). Both aspects are based on technical components which will be detailed here, with the objective to facilitate the identification of legal indicators used for numeric and comparative analyses in the next section.

Section 1) Comprehensiveness: characterising the material scope of the legal provisions

Comprehensiveness is about striking the right balance between too comprehensive rules and too poorly comprehensive rules. Taking an image, a large fishing net with the smallest meshes is likely to catch every living creature, which could also provoke bycatch (or perverse effects). A very small fishing net with large meshes is unlikely to catch any fish at all. Baldwin refers to this problematic as over or under regulation⁴⁸⁶.

Two elements combined contribute to determine how comprehensive legal provisions are: the range of targeted activities (a) and the scope of the objects of the text (b).

a. The range of targeted activities: a determination of the reach of the legal provisions

The regulation of a product might target a variety of behaviours or activities attached to this product, from its production to its use, passing by its import, export, distribution and commercialisation. The determination of which behaviours are targeted by the regulation is central to the analysis of the regulation. As summarized by Ferraro and Failler, "the process of policy formulation, decision-making, implementation and enforcement directs societal actors'

⁴⁸⁶ See BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p.

behaviour towards the expected change”⁴⁸⁷. In the same idea, Deumier considers law as the science or the art to orientate behaviours, and the rule as a technique to drive human behaviours”⁴⁸⁸.

Therefore, the analysis of the comprehensiveness of the regulation is strictly linked to the analysis of the activities targeted by the regulation. First, it is expected that the larger the range of targeted activities, the most comprehensive the regulation will be. Second, it is assumed that the respective impacts of all these activities may diverge. When tackling a source of pollution, the regulation of its production upstream is likely to be more decisive than the regulation of its commercialisation downstream. This idea is embodied by the principles that preventive action should be taken, and that environmental damage should, as a priority, be rectified at source. It is therefore here considered that a regulation targeting upstream usages (production and import) is more comprehensive than a regulation targeting downstream usages (commercialisation, distribution and use). A regulation targeting all usages is the most comprehensive of all.

Analysing the latter also enables to bring out both the diverging approaches to pollution regulation, and the identification of “who” is held responsible for the pollution.

b. The scope of the object: the cornerstone of the regulation

The object of the text is the cornerstone of the regulation, as it determines *what* is regulated. Its study relates to analyse the precision of the definitions given of the object of the regulation, but also the comprehensiveness of these definitions. A vague or imprecise definition weakens the comprehensiveness of the regulation, by blurring its contours⁴⁸⁹. Alternatively, a regulation with a poorly comprehensive but well-defined object is likely to have a limited protective effect. In addition, some objects might be exempted from the regulation. Overly-comprehensive exceptions would curtail the comprehensiveness of the regulation as a whole. As such, the scope of these exceptions is inversely related to (has a negative effect on) the comprehensiveness of the regulation.

⁴⁸⁷ FERRARO Gianluca et FAILLER Pierre, « Governing plastic pollution in the oceans: Institutional challenges and areas for action », *Environmental Science & Policy*, 112, 2020, p. 453-460, p. 456.

⁴⁸⁸ DEUMIER Pascale, *Introduction générale au droit*, 4th éd., Issy-les-Moulineaux, LGDJ, Lextenso éditions, 2017, 390 p, p. 19.

⁴⁸⁹ It also threatens the enforcement of the regulation. Assessing the enforcement of the regulation is out of the scope of this study. The analysis of the comprehensiveness of the regulation might nonetheless highlight conceptual weak points of the regulation, which should be scrutinized while assessing the enforcement.

In its “Better Regulation Checklist”, IMPEL⁴⁹⁰ puts a special focus on the importance of clear consistent and precise definitions, as related to “the quality of the legislation”⁴⁹¹. The importance of the minimization of exceptions is also highlighted⁴⁹².

Section 2) Forcefulness: analysing the pre-requisites to enforcement

Forcefulness relates to law’s quality of being “strong and assertive; vigorous and powerful”⁴⁹³ in achieving its objective. It is a measure of the potential of force of a rule, questioning whether the set of rules are supplied by the necessary tools to be enforced and instil change. Taking the same image of the fishnet as for comprehensiveness, forcefulness is about guaranteeing that the net’s mesh will not loosen with time, or break under the pressure of the fish. Forcefulness therefore requires an adaptative approach, in reaction to dynamic social strategies to circumvent the rules.

An aspect of the rule’s potential of force is whether it is sustained by a sometimes-necessary legal arsenal. As presented by Bell and McGillivray in the United Kingdom, “legislation often requires implementation by statutory instrument before it comes into force”⁴⁹⁴. More generally speaking, legal provisions frequently require, to be enforceable, the assistance of further legal provisions adopted through other legal texts. It may be, for example, the need to set a minimum price for a good⁴⁹⁵ or technical standards⁴⁹⁶, or even to determine enforcement conditions⁴⁹⁷.

⁴⁹⁰ European Union Network for the Implementation and Enforcement of Environmental Law, <https://www.impel.eu>.

⁴⁹¹ IMPEL-NEPA, « Better Regulation Checklist to assess practicability and enforceability of legislation », Brussels, Belgium, European Union Network for the Implementation and Enforcement of Environmental Law, 2010, p.12, question n°21.

⁴⁹² IMPEL-NEPA, *ibid.*, p.12, question n°23.

⁴⁹³ Oxford Dictionary, Lexico, <https://www.lexico.com/definition/forcefulness>, accessed on 14/02/2022.

⁴⁹⁴ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford; Oxford University Press, 2006, 910 p., pp.97-98.

⁴⁹⁵ Cape Verde, Lei n°99/VIII/2015 de 27 de Agosto, BO n°51 du 27/08/2015 pp. 1600-1603. Art.7.2 « *Sobre cada saco de plástico convencional fornecido nestes estabelecimentos incide uma importância cujo montante máximo será determinado por despacho do membro do Governo responsável pelo Ambiente, sob proposta do Conselho Superior das Câmaras de Comércio, a ser paga pelo consumidor que o tenha requisitado.* »

⁴⁹⁶ Senegal, Loi n° 2015-09 du 04 mai 2015 relative à l’interdiction de la production, de l’importation, de la détention, de la distribution, de l’utilisation de sachets plastiques de faible micronnage et à la gestion rationnelle des déchets plastiques. Art 4 « *Les sachets plastiques d’une épaisseur supérieure ou égale à 30 microns doivent respecter les normes techniques concernant la fabrication, la composition des matériaux, l’étiquetage et l’écotoxicité fixées par un décret pris sur proposition du ministre en charge de l’environnement.* »

⁴⁹⁷ France, Loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte, Publiée au JORF n°189 du 18/08/2015. Art. 75 « (...) « *Un décret en Conseil d’Etat détermine les conditions d’application du présent II. Il fixe notamment la teneur biosourcée minimale des sacs en matières plastiques à usage unique mentionnés au 2° et les conditions dans lesquelles celle-ci est progressivement augmentée. Il fixe également les*

Without these implementing provisions, the rule is amputated in its application and loses potential force. The presence or absence of implementing provisions is not specifically assessed in this scheme. Legal texts are analysed for their content rather than for their status in the hierarchy of norms. If a country's regulation presents an implementation gap⁴⁹⁸, it will be identified during the comprehensiveness and forcefulness analytical processes. Another aspect of the potential of force of a rule is conditioned to the fact that the text is and remains in force. This criterion is analysed previously to the analysis of forcefulness, as it is considered as a pre-requisite to the analysis as a whole⁴⁹⁹.

As above-mentioned, there are two components to the analysis of forcefulness. The first questions the intrinsic force of the chosen policy instrument in curbing actors' behaviour towards the desired outcome. Policy instruments, be they binding or not binding, or based on economic incentives rather than on a command-and-control rationale, exert a varying level of constraint on actors' behaviour (a). The second questions the existence and force of enforcement provisions such as controls and sanctions to enable the rule's operationalisation. As such, it questions the enforceability of the provisions (b).

a. Force of the policy instrument: a matter of constraint

As a reminder, policy instruments are “developed by the government as a way to implement their policies and influence the behaviour of citizens and businesses”⁵⁰⁰; they are “the set of techniques by which behavioural change [is triggered] among a particular target group”⁵⁰¹.

The focus is here set on the regulation toolbox provided by policy instruments⁵⁰². As such, the proposed typology analyses policy instruments under the prism of their binding nature and the

modalités d'information du consommateur sur la composition et l'utilisation des sacs vendus ou mis à sa disposition. »

⁴⁹⁸ On implementation gaps, see ROSE Gregory L., « Gaps in the Implementation of Environmental Law at the National, Regional and Global Level », Kuala Lumpur, Malaysia, UNEP, 2011.

⁴⁹⁹ See Part II, Title 1, Chapter 2. Temporality of the plastic bag regulation adoption.

⁵⁰⁰ BOUWMA I. M., GERRITSEN A. I., KAMPHORST D. A. *et al.*, « Policy instruments and modes of governance in environmental policies of the European Union : past, present and future », Wageningen, Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), 2015, p. 19, citing HOWLETT Michael, « Policy Instruments, Policy Styles, and Policy Implementation », *Policy Studies Journal*, 19, 1991, n° 2, p. 1-21 and BEMELMANS-VIDEC Marie-Louise, RIST Ray C. et VEDUNG Evert (dir.), *Carrots, Sticks & Sermons: Policy Instruments & Their Evaluation*, New York, Routledge, 2017, 280 p.

⁵⁰¹ LEE Rhiannon, DEN UYL Roos et RUNHAAR Hens, « Assessment of policy instruments for pesticide use reduction in Europe; Learning from a systematic literature review », *Crop Protection*, 126, 2019, p. 104929.

⁵⁰² A number of regulatory instruments will not be addressed here, as non-relevant for the scope of this study. These cover market-harnessing controls such as tradable permits or regulation by contract; disclosure regulation regulating the disclosure of information to correct information asymmetries ; nudge strategies involving soft influence on the architecture of decisions; the allocation of rights and liabilities (e.g. to clean water) to encourage

degree of state intervention. The sum of these two criteria leads to analyse the degree of flexibility / the degree of constraint exercised on actors in the performance of their choice. We will see how it relates to the force of the policy instrument.

Policy instruments are commonly divided in four categories, “based on the mechanisms they employ to influence and coordinate collective action”⁵⁰³: command and control, market-based, informational and cooperative⁵⁰⁴. Other distinctions exist, such as between affirmative and prohibitive instruments. The first encourage a positive behaviour or describe what should be done⁵⁰⁵, whereas the second disincentivize negative behaviours⁵⁰⁶. This work does not question the existence of these categories, but rather aims to analyse the diversity of their effects.

The first discriminatory criterion between policy instruments is whether the instrument is binding or non-binding. This criterion is purely binary, either ‘it is’ or ‘is not’. The main characteristic of a binding instrument is that the decision doesn’t require the regulatee’s consent to apply⁵⁰⁷. Bans and taxes are typical binding instruments, as they apply regardless of the consent of the regulatee. On the contrary, subsidies most often require the regulatee’s consent through the justification of a demand. Informational and education-based instruments also require the regulatee’s consent, as the change in behaviour is here only suggested and voluntary. Cooperative instruments, such as voluntary agreements, are also non-binding. Based on cooperation between private actors or between private actors and the state, their aim is to establish voluntary measures⁵⁰⁸.

socially beneficial behaviour; and public compensation or social insurance schemes “linking premiums paid to performance records”.

See for example BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., pp. 114-128.

⁵⁰³ BÖCHER Michael, « A theoretical framework for explaining the choice of instruments in environmental policy », *Forest Policy and Economics*, 16, Elsevier, 2012, n° C, p. 14-22, p. 15.

⁵⁰⁴ See for example BOUWMA I. M., GERRITSEN A. I., KAMPHORST D. A. *et al.*, « Policy instruments and modes of governance in environmental policies of the European Union: past, present and future », Wageningen, Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), 2015; GUNNINGHAM Neil et SINCLAIR Darren, « Policy Instrument Choice and Diffuse Source Pollution », *Journal of Environmental Law*, 17, 2005, n° 1, p. 51-82.

⁵⁰⁵ These instruments are marked by a * on the graph 1.

⁵⁰⁶ RACHEL KARASIK Tibor Vegh, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020, 309p., p. 27.

⁵⁰⁷ PÂQUES Michel, « Instruments souples, instruments non contraignants, instruments de marché : une alternative pertinente ? », *Acteurs et outils du droit de l’environnement*, Ed. JADOT Benoit, Anthemis, 2010, 387 p., p. 22.

⁵⁰⁸ BÖCHER Michael, « A theoretical framework for explaining the choice of instruments in environmental policy », *op. cit.*, p. 14.

Family of instrument	Policy instrument	Example in a plastic-bag regulation perspective
Binding		
Command-and-control	Ban	Prohibit production, sale or use of plastic bags.
	Permit	Condition the production or the import of plastic bags to to obtention of a permit.
	Standard	Condition the production of plastic bags to the respect of defined standards.
Market-based	Taxation	Charge for example the distribution of plastic bags. The revenues of the charge are collected by the state.
	Obligation to charge	Charge for example the distribution of plastic bags. The revenues of the charge are collected by the seller.
	Subsidy	Provide payment for plastic bag use reduction.
Non-binding		
Informational	Awareness-raising campaigns	Organisation of campaigns to raise awareness on the damages of plastic pollution, or on alternatives to plastic bags.
Cooperative	Preferential service	Provide for a preferential service for customers reusing their plastic bags.

Table I.2 Policy instrument examples distinct per type and binding nature.

Source: the author.

Table I.2 offers examples of policy instruments in a plastic bag regulation context, on the basis of their binding nature and of their belonging to different family instruments.

The degree of state intervention varies from one instrument to another. The ban is the instrument that requires the most state intervention, as the state must produce detailed regulation on what actors can or cannot do. On the contrary information sharing requires the least state intervention, as the production of content can be delegated to private actors. The state can nonetheless encourage NGOs or private companies to share information through funding or subsidies, in order to correct information asymmetries and empower citizens to make informed choices⁵⁰⁹. This simplistic dichotomy should be nuanced, as regulatory authorities can also produce very detailed and process-oriented information campaigns requiring a high level of state involvement, and appear like “quasi-regulatory ‘guidelines’”⁵¹⁰.

In regard to market-based instruments such as taxes or subsidies, the degree of state intervention is lower than for the ban as the state only sets economic incentives to which economic actors

⁵⁰⁹ OECD, « Regulatory Policies in OECD Countries: from interventionism to regulatory governance », Paris, France, OECD Publishing, 2002.

⁵¹⁰ *Ibid.*

are free to react flexibly⁵¹¹. Cooperative instruments lie in between market-based and informational instruments, requiring both the actors' and the state's cooperation.

Crossing the binding and the state-intervention criteria leads to analyse the constraint exerted on actors through regulation, or, to the contrary, the flexibility left to actors. As defined by Sinclair, "flexibility refers to the scope firms are given to tailor regulatory responses to their individual circumstances"⁵¹². Flexibility can arise at different stages of the regulatory process. In the context of market-based or cooperative instruments, flexibility may be left to actors to adjust their emission levels, in regard to their own constraints. The process by which pollution is reduced can also be a matter of flexibility. During the policy design stage, definitions may be left intentionally unclear to preserve flexibility in the application of the law⁵¹³.

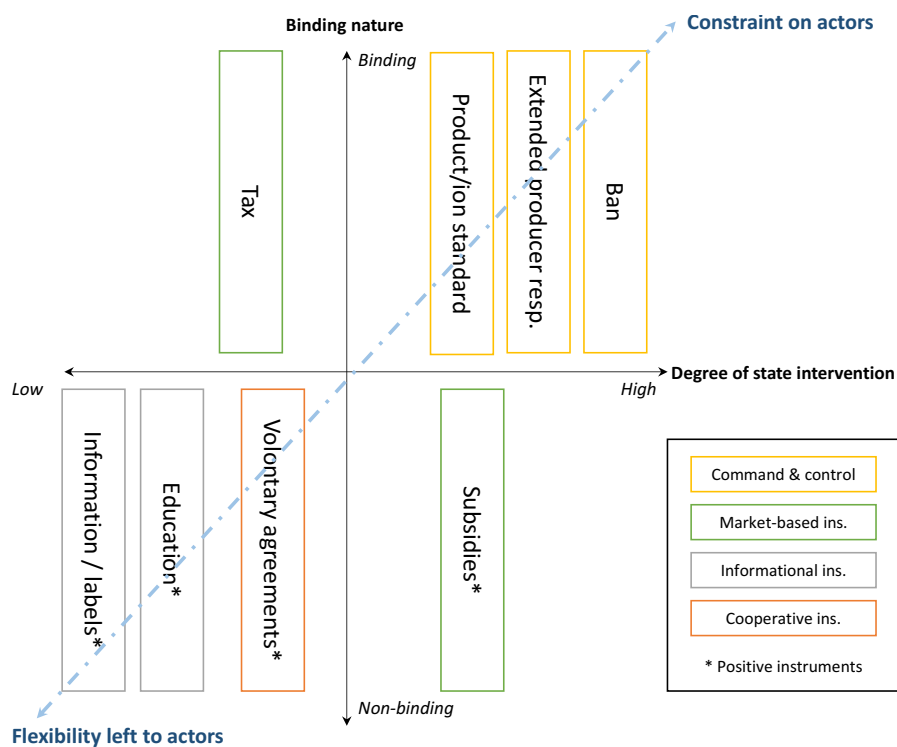


Figure I.5 Typology of regulatory instrument under the prism of their binding nature and the degree of state intervention.

Adapted by the author from Böcher (2012), figure 1⁵¹⁴.

⁵¹¹ BÖCHER Michael, « A theoretical framework for explaining the choice of instruments in environmental policy », *Forest Policy and Economics*, 16, Elsevier, 2012, n° C, p. 14-22, p. 14.

⁵¹² SINCLAIR Darren, « Self-Regulation Versus Command and Control? Beyond False Dichotomies », *Law & Policy*, 19, 1997, n° 4, p. 529-559, p. 539.

⁵¹³ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p., p. 98.

⁵¹⁴ BÖCHER Michael, « A theoretical framework for explaining the choice of instruments in environmental policy », *Forest Policy and Economics*, 16, Elsevier, 2012, n° C, p. 14-22, p. 15.

Figure I.5 represents the balance between the binding nature of instruments, the degree of state intervention, and the degree of flexibility left to or constraint on actors. By their design and by the mechanism through which they influence actors, instruments are more or less flexible. Bans are the least flexible, precisely setting what is and what is not allowed. Market-based instruments such as taxes and subsidies are more flexible, but still shape desired behaviours through economic mechanisms. As such, actors can be economically constrained in their choices. Information and education are mere influence, but the flexibility left to actors is high, as they have a full liberty of choice.

As highlighted by Böcher, the nature of the policy problem may influence the choice of instruments. He argues that in the 1970s, environmental policy was dominated by command-and-control type instruments to provide quick solutions to a specific type of problem structure (such as smog or river contamination). He then argues that the change in problem structures in the 1990s, with the emergence of long-term environmental problems such as climate change, required the emergence of market-based instruments, “more flexible in their influence on the individual behaviours of polluters”⁵¹⁵. Other authors highlight the weight of economic lobbies in shaping climate change negotiations, in favour of more flexibility⁵¹⁶.

Sinclair adds that “flexibility is likely to be counter-productive” in case of “acute environmental dangers (...) where there is an immediate danger to public health or the loss of a species/habitat”⁵¹⁷. It could be argued that the environmental problem structure in the 2020s is different to what was perceived in 1990s. Climate change and the multiple threats to biodiversity and human civilisations is no longer a long-term potentiality, but a short-term reality.

There is an important body of literature discussing and comparing the benefits and drawbacks of both command-and-control and market-based instruments⁵¹⁸. This work doesn't aim to

⁵¹⁵ *Ibid.*, p. 16.

⁵¹⁶ See AYKUT Stefan et DAHAN Amy, *Gouverner le climat ?*, Les Presses de Sciences Po, 2015, 752 p.

⁵¹⁷ SINCLAIR Darren, « Self-Regulation Versus Command and Control? Beyond False Dichotomies », *Law & Policy*, 19, 1997, n° 4, p. 529-559, p. 543.

⁵¹⁸ See for example BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p.;

LANGE Bettina, “Command and Control Standards and Cross-jurisdictional Harmonization” in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p.

SINCLAIR Darren, « Self-Regulation Versus Command and Control? Beyond False Dichotomies », *op.cit.*, p. 529-559.

contribute to this debate, which are mainly centred around challenges related to their enforcement, effectiveness, and efficiency which are all out of the scope of this study. Second, the type of instrument used is just one out of many components of what makes a rule both comprehensive and forceful, thus likely to be protective.

It is therefore considered for the rest of this work that the less an instrument is flexible, the more is it likely to constrain actors into behavioural change, the more it is likely to have a protective effect on the environment. As put by Baldwin et al., “the essence of command-and-control regulation is the exercise of influence by imposing standards backed by criminal sanctions”⁵¹⁹. As such, its strength is to impose or prohibit specific behaviours with immediate effect, in a quite clear manner. Moving away from command-and-control instruments has nonetheless been encouraged by a range of governments and international organisations in favour of more flexible market-based instruments⁵²⁰. The partial irrelevancy of market-based regimes in the protection of the environment is highlighted by several authors in the case of acute dangers, in sectors changing rapidly or when preventive or precautionary measures should be taken. As incentive regimes operate indirectly, a regulatory lag may be observed⁵²¹ and predicting the effect on the ground of the incentive may be challenging⁵²². The flexibility offered by these instruments, including a trial-and-error approach is thus ill-adapted to high risks and urgency. Further, taxes are accused of failing “for their failure to designate certain acts as unacceptable”⁵²³.

In any case, the ‘best’ instrument to address a problem is closely related to a set of characteristics among which the characteristics of the object in itself. In a study on marine plastic pollution, Abbott *et al.* highlight that bans may be more efficient than incentive regimes when “the marginal benefits of the good are small and the marginal social costs associated with

⁵¹⁹ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, *ibid.*, p. 106.

⁵²⁰ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, *ibid.*, citing GREAT BRITAIN BETTER REGULATION TASKFORCE, *Imaginative Thinking for Better Regulation*, Better Regulation Task Force, 2003, 53p.

⁵²¹ SINCLAIR Darren, « Self-Regulation Versus Command and Control? Beyond False Dichotomies », *Law & Policy*, 19, 1997, n° 4, p. 529-559, p.538.

⁵²² BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, *op.cit.*, p. 113.

⁵²³ *Ibid.*

its production/use or improper disposal are high”⁵²⁴, such as in the case of plastic bags, as long as substitutes do not have a higher social cost.

Additionally, several authors promote healing the rift between command and control and market-based instruments. Sinclair highlights the “complementary combinations of components of both types of instruments” to “accommodate a wide variety of environmental circumstances”, arguing “that different options will be appropriate to different environmental problems”⁵²⁵. Bell and McGillivray suggest that “the key to using the ‘tools’ in the environmental lawyer’s ‘tool box’ is to combine different instruments so that the strength of certain types of ‘tool’ complements the weaknesses of others”⁵²⁶, to address particular environmental problems. It requires an extensive understanding of the problem in itself, its mechanisms and to put this information in perspective with the institutional capacity for implementation and enforcement. The combination of instruments will therefore be considered as contributing to enhanced environmental protection.

b. Enforceability of the rule: from control to sanctions

The second aspect of forcefulness is how enforceable the rule is. As defined by IMPEL, “Enforceability refers to the suitability of the legislation in terms of the ability of the competent authorities to use legal tools [...] at their disposal [...] to encourage or, in the event of wilful non-compliance, compel individual addressees to comply with their obligations under the legislation”⁵²⁷. Therefore, enforceability finds its source in the legal provisions provided for in the legal texts⁵²⁸. In short, enforceability paves the way for effective enforcement⁵²⁹. In that sense, enforceability issues emerge at various stages, from the policy design to the monitoring of enforcement.

⁵²⁴ ABBOTT Joshua K. et SUMAILA U. Rashid, « Reducing Marine Plastic Pollution: Policy Insights from Economics », *Review of Environmental Economics and Policy*, 13, Oxford Academic, 2019, no 2, p. 327-336, p. 329.

⁵²⁵ SINCLAIR Darren, « Self-Regulation Versus Command and Control? Beyond False Dichotomies », *Law & Policy*, 19, 1997, n° 4, p. 529-559, p. 532-533.

⁵²⁶ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford, Oxford University Press, 2006, 910 p, p. 267.

⁵²⁷ IMPEL-NEPA, « Better Regulation Checklist to assess practicability and enforceability of legislation », Brussels, Belgium, European Union Network for the Implementation and Enforcement of Environmental Law, 2010, p. 3-4.

⁵²⁸ As defined by IMPEL, enforceability is also conditioned on administrative means, which are out of the scope of this study.

⁵²⁹ MINTZ Joel A., “Assessing National Environmental Enforcement: Some Lessons from the United States’ Experience”, in KRAMER Ludwig (dir), *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p.

According to Bell and McGillivray, there are two different styles of enforcement. The first is a compliance approach “where there is an emphasis on all mechanisms other than prosecution in order to promote compliance”. These mechanisms could be awareness-raising or information measures. The ‘sanctioning’ approach “prefers strict punitive measures, notably prosecutions to deter operators from future non-compliance”⁵³⁰, implying both controls and sanctions. Centred on a prosecutive approach, Deumier considers the existence of sanctions as a criterion of the perfection of a law⁵³¹. The compliance and sanctioning approach may also be combined as two steps of a same process.

In its “Better Regulation Checklist”, IMPEL’s questions relating to the enforceability of the legislation span over the clear identification of authorities in charge of carrying out controls, and the provision for enforcement means be they coercive or non-coercive⁵³². In this framework, the identification of administrations in charge of the controls and the precision with which control processes are provided for are considered as contributing factors to enhanced environmental protection. The contribution of sanctions to enforceability will be appreciated through the force of the constraint their application implies. For example, the force implied by the imposition of a fine depends on the amount of this fine. The threat of a jail sentence is also more forceful than the confiscation of the object of the offence.

IMPEL adds a variety of questions whose answers cannot be found in the legal texts. These aspects, covering regulatees’ perception of risk of detection of a violation, “risk of incurring a sanction if violation is detected”, deterrence effect of sanctions or peer-pressure to comply⁵³³, are out of scope of this study. Similarly, the occurrence of controls or the pronouncement of sanctions relate to the enforcement of the regulation, and are thus left to further research. Last, further institutional aspects of enforcement such as the question: is multiple institutional responsibility an obstacle to or an enabler of enforcement? Are these institutions humanly and technically capable to carry out their enforcement mission? These questions highlight that the

⁵³⁰ BELL Stuart et MCGILLIVRAY Donald, *Environmental law, op.cit.*, p.296.

⁵³¹ DEUMIER Pascale, *Introduction générale au droit*, 4th éd., Issy-les-Moulineaux, LGDJ, Lextenso éditions, 2017, 390 p., p. 34.

⁵³² See questions 37 and 38, IMPEL-NEPA, « Better Regulation Checklist to assess practicability and enforceability of legislation », Brussels, Belgium, European Union Network for the Implementation and Enforcement of Environmental Law, 2010.

⁵³³ See questions 48, 49, 50 and 51 IMPEL-NEPA, *ibid.*

analysis of the enforcement of the legal provisions, on the ground, is a necessary complement to the analysis of enforcement means as provided for in the legal texts.

Based on the analytical framework providing the conceptual ground, a quantitative approach to the analysis of legal frameworks' potential contribution to the protection of the environment requires to develop relevant digital and numerical frameworks.

Chapter 2. Building blocks of the digital and numerical frameworks

The double objective pursued by this research – the investigation of the added value of the recourse to quantitative tools and indicators to analyse the content of law, specifically in regard to its adequacy to protect the environment – requires to design the methodology’s digital and numerical frameworks. This technical toolbox is constituted of two distinct blocks.

The digital framework relates to the computer technology developed as a support to the analysis. Traditional legal research methods are limited by the complexity and technicality of law itself, increasingly so in a comparative perspective. A specifically designed relational database can therefore open new avenues for research and analysis by offering a complementary compartmentalized access to legal texts (section 1).

The numerical framework relates to the application of quantitative methods to the analysis of law, through the definition of variables and indicators (section 2). Hull highlights the importance to integrate quantitative methods from the outset of the design of a project rather than lay “the quantitative design on top of a more traditional, doctrinal work”⁵³⁴. This is precisely the purpose of this section. The definition of these indicators are issued from the exploration of the diversity and complexity of quantitative / legal indicator approaches to law⁵³⁵, and based on the above-mentioned conceptual ground as set by the analytical framework⁵³⁶.

Section 1) Production of a relational database: an enabling framework

The development of a relational database is a key element of the method developed here. Time-consuming at first, this tool is a major asset for efficient and precise multi-criteria analyses in a numerical comparative law perspective. First, precision must be brought as to why and how a relational database can be useful in legal analyses (a). Second, the structure of the database must be spelled out to better understand its functioning (b). Third, this newly developed tool should be articulated with existing legal databases (c).

⁵³⁴ HULL N. E. H., « The Perils of Empirical Legal Research Review Essay », *Law & Society Review*, 23, 1989, n° 5, p. 915-920, p. 918.

⁵³⁵ See Part I, Title 1.

⁵³⁶ See Part I, Title 3, Chapter 1.

a. *Usefulness of a relational database: a tool to tackle complexity*

The complexity of law is nothing new. Back in 1949, Loevinger stemmed that “it is one of the greatest anomalies of modern times that the law, which exists as a public guide to conduct, has become such a recondite mystery that it is incomprehensible to the public and scarcely intelligible to its own votaries”⁵³⁷. He pleads for the development of ‘jurimetrics’, which he defines as “the scientific investigation of legal problems”⁵³⁸. Decades later, Donald highlights the growing gap between the coevolution of the substance of law with society’s changing needs, and the “conceptual tools available within the discipline of law”⁵³⁹. Therefore, the complexity of law calls for the development of new tools, increasingly so in a comparative perspective with the simultaneous analysis of different legal systems and solutions.

Traditionally, law is analysed in a textual and descriptive way, keeping quantitative and statistical techniques at bay. This can be explained on the one hand by the shared aversion of many lawyers to numbers⁵⁴⁰, and on the other hand by the very structure of law, which by its very nature interweaves different elements. Thus, the written representation of legal texts does not allow for a visualisation of the multidimensional links that structure the law. This inadequacy challenges quantitative and empirical research, the enforcement of law, and its communication outside the spheres of law.

Back in 1964, the legal research opportunities offered by computer technologies were stressed by Cades as “almost infinite” but limited by the cost of access to this technology⁵⁴¹. Nowadays, information on a variety of subject can be easily accessed, due to the development and democratisation of IT technologies, and the diffusion of the world wide web. Nonetheless, this unstructured information cannot be assimilated with knowledge. If unstructured information can be related to “facts about a situation, person, event, etc”⁵⁴², knowledge requires the ‘understanding’⁵⁴³ of this information. Data is the missing piece between the two. As a

⁵³⁷ LOEVINGER Lee, « Jurimetrics--The Next Step Forward », *Minnesota Law Review*, 33, 1949 1948, n° 5, p. 455-493, p. 455.

⁵³⁸ *Ibid.*, p. 483.

⁵³⁹ DONALD David C., « Law in Regression - Impacts of Quantitative Research on Law and Regulation », *Columbia Business Law Review*, 2015, 2015, n° 2, p. 520-612, p. 524.

⁵⁴⁰ SILVER Carole et ROCCONI Louis, « Learning from and about the Numbers Journal of Legal Metrics », *Journal of Law*, 5, 2015, n° 1, p. 53-84.

⁵⁴¹ CADES J. Russell, « Jurimetrics and General Semantics Articles and Reports », *M.U.L.L. Modern Uses of Logic in Law*, 5, 1964, n° 1, p. 8-17, p. 15.

⁵⁴² <https://dictionary.cambridge.org/dictionary/english/information> accessed 01/07/2020

⁵⁴³ <https://dictionary.cambridge.org/dictionary/english/knowledge> accessed 01/07/2020

“collection of facts or numbers (...) examined and considered and used to help decision-making”, the role of data is to structure information to enable its comprehension.

Data can be stored and structured in a variety of ways. The solutions vary upon the type and amount of data to be organised. At first, word documents or excel sheets could be enough to store and organise data, but soon shown their limits. Databases are specifically designed to fill this role and defined as “any collection of data or information, that is specially organised for rapid search and retrieval by a computer”⁵⁴⁴. The organisation and structure of the database facilitates “the storage, retrieval, modification and deletion of data”. Relational databases enable to reproduce the relationships between different types of data. The way the data is structured therefore impacts the results of the data search and retrieval.

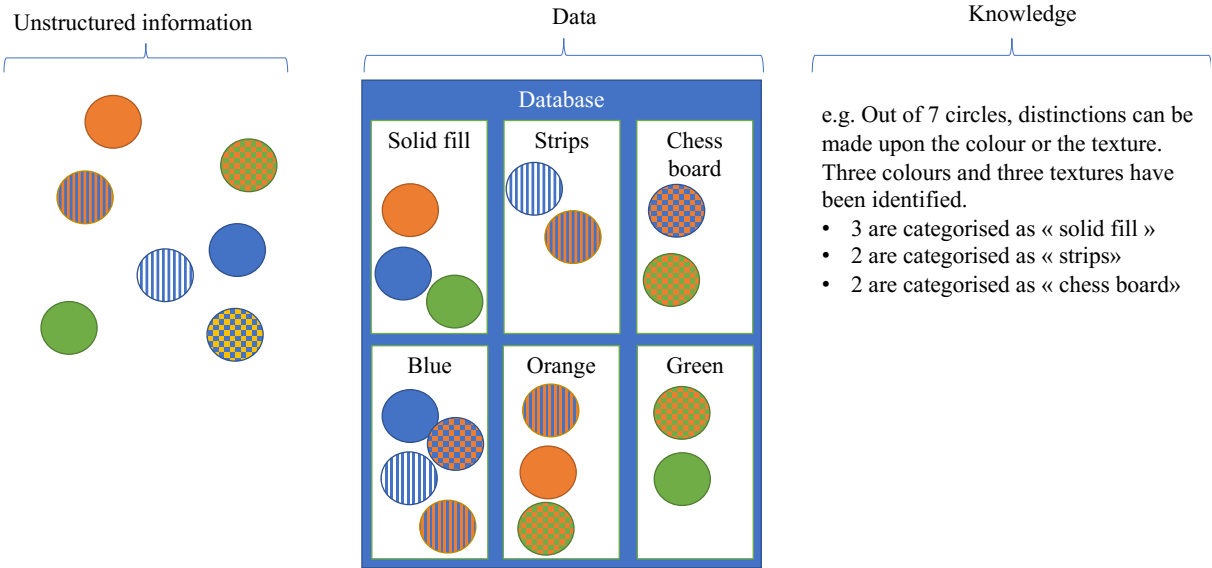


Figure I.6 From unstructured data to knowledge, illustration of the role of databases

Figure I.6 is a simple illustration of the role played by a database to structure data and facilitate the emergence of knowledge. The categorisation operated by the database enables to characterise the circles along two main characteristics (fill and colour), each composed of three criteria. The more complex and diverse the unstructured information is, the more the database will be useful to organise and structure the data at first, and then search the database to extract understanding and knowledge.

Let’s go back to the context of this research project. The objective is here to measure the potential contribution of legal frameworks to the protection of the environment. This project requires a thorough understanding of the legal drivers of the protection of the environment and

⁵⁴⁴ <https://www.britannica.com/technology/database> accessed 01/07/2020

the relationships between these drivers. Drivers can work in synergy when their cumulated effect is stronger than the sum of individual effects, or in dissonance if one of the drivers impedes the actions of the second. To date, there is no known available set of data corresponding to this project's needs. This project thus requires the collection, storage and structure of a variety of data, ranging from the existence of legal texts, to the provision for sanctions or the definition of the object of the rule. As such, the development of a database was a necessary precondition to the pursuit of this project. It greatly facilitates efficient searches and the emphasis of underlying drivers of law's protection of the environment.

The relational database is an analytical tool useful in a diversity of perspectives. First, it acts as a dissection tool, bringing to light the inner structure of law, and the relationships between the different elements composing the law. Unravelling the complexity of the structure facilitates its analysis, by facilitating the diagnosis of weak points – such as the number of exceptions to a single instrument. Second, it acts as a distillation tool; enabling the dissociation of a homogeneous mix to strata of elements. This process facilitates the comparison of elements in their function inside a country or between countries. Third, it acts as a multifunction storage facility. Through its 'find' mode – or its research function – it is possible to combine multiple research criteria for context-responsive research. Multicriteria searches may reveal unexpected trends or results, invisible to the naked eye. Fourth, the compilation of texts through time facilitates the monitoring of the evolution of legal texts through time, and thus the progress or regression of environmental law. Last but not least, the relational database may be a tool empowering the legibility or communication of law outside of the legal sphere. By increasing readability, the aim is also to increase the utility of law⁵⁴⁵, and enhance its protection potential. It is nonetheless important to highlight that the use of a relational database can also be a path disseminated with pitfalls, which will be analysed in the discussion⁵⁴⁶.

b. Steps and choices in the database development process

As a pre-requisite to the design of a relational database, knowledge of the theoretical background underpinning the development of relational databases has been consolidated through interactions with people working in this sector⁵⁴⁷, and training in IT development skills

⁵⁴⁵ SIEMS Mathias, « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540, p. 533.

⁵⁴⁶ See Part III, Title 1, Chapter 1, Section 1, b.

⁵⁴⁷ I would like to thank here Mathias Rouan and Cédric Chauvel for their support.

was pursued⁵⁴⁸. These theoretical and technical database-related skills were then applied to the context of this research. The development of a relational database is not straightforward. It must be tailored to the conceptual framework of the research. As such, it follows three successive steps. First, the ontological representation of environmental law's protection process enables to break down this complex process into parts and relationships between the different parts of the system. Second, the conceptual model requires the transformation of this textual analysis into a graphical representation of the parts and relationships. Last, the physical model is the translation of the conceptual model into an operative system.

The development of a relational database requires breaking down the observed phenomenon into sets (or classes) of similar data described by attributes (or properties) and relationships between different sets. In computer and information sciences, this process is described by the word 'ontology'⁵⁴⁹. Ontologies are the description of the parts composing a system and the relationships between these parts. They compose a "semantic level" in the development process of database, prior to more technical 'conceptual' or 'physical' levels. For example, a basic ontological description of the process by which law protects the ocean from plastic pollution could be the following:

'To fight plastic pollution, a country can adopt one or several legal text banning plastic bags, composed of several articles. The implementation of this ban might require the adoption of other texts. In order for the ban to be enforced, controls must be organised with the possibility to sanction non-compliers. Compliance can be facilitated by the existence of clear rules, with few exceptions. Policy instruments other than the ban can be used, like taxation and permit obtention.'

Sets and relationships emerge from this description, and the reader can start to imagine a list of attributes for each set. For example, attributes for the text set could be the date of adoption and the title of the text. Characteristics of each relationship also emerge. For example, a single country can (non-obligatory constraint) adopt one or several (quantity constraint) texts; on the contrary a legal text is composed (obligatory constraint) of several (quantity constraint) articles.

⁵⁴⁸ The software Filemaker Pro Advance 16 was chosen to develop the database. A specific training on this software, proposed by RCC Consulting, was followed online.

⁵⁴⁹ "In the context of computer and information sciences, an ontology defines a set of representational primitives with which to model a domain of knowledge or discourse. The representational primitives are typically classes (or sets), attributes (or properties), and relationships (or relations among class members)." GRUBER Tom, « Ontology », Liu Ling et Özsü M. Tamer (éd.), Encyclopedia of Database Systems, Springer-Verlag, 2008.

Conceptual modelling is the next step. The aim here is to translate the ontological representation of the analysed phenomenon into a scheme on which to base the development of the future database, representing the different sets identified through the ontology and characterising the relationship between different entities through a verb. Taking the same example as above, the three identified sets are COUNTRY, TEXT and ARTICLE. The verb which could be used to qualify the relationship between COUNTRY and TEXT is “adopts”; whereas between TEXT and ARTICLE the chosen verb could be “is composed of”. The obligatory constraint and quantity constrain are translated into a code. An obligatory constraint is coded as ‘1’, whereas a non-obligatory constraint is coded as ‘0’. Similarly, a quantity constraint limited to 1 is coded by ‘1’, whereas the absence of quantity constraint is coded by ‘N’. Therefore, the relationship between the set COUNTRY and TEXT would be coded as ‘(0, N) as a country can (non-obligatory) adopt one or several texts (no quantity constraint) ; whereas the relationship between the set TEXT and COUNTRY would be coded as (1, 1) as, in a national setting, a text is adopted (obligatory) by a single country (quantity constraint). On this basis, the relationships between different sets are qualified as “one-to-one” as the relationship between TEXT and COUNTRY, as “one-to-several” as between COUNTRY and TEXT, or as “several to several”. The attributes of each entity are identified at this step⁵⁵⁰. For example, the attributes for the TEXT set are its title, its type, the date it has been adopted, whether it is enforced, *etc*⁵⁵¹.

This timely process is key, as a misconceptualised database can lack robustness, searchability or introduce a bias in the analysis of the system. Conceptual modelling is also a useful communication tool among people from different backgrounds in an interdisciplinary approach, as its scheme simplifies the comprehension of a complex phenomenon.

Designing a conceptual model follows a trial-and-error method. The identification of the failures of a diagram leads to reconceptualization, until no more failures can be identified. A failure emerges from the above-mentioned ontological representation: if the development of the database followed this scheme, the database could solely answer requests on the ban of plastic bags, and not on the ban of other objects of law-making. Plastic bags should not appear for themselves, but rather as an attribute of a larger set of data named OBJECT. Another failure

⁵⁵⁰ This step is also called an entity-relationship model. See generally HAINAUT Jean-Luc, *Bases de données - Concepts, utilisation et développement*, 4e édition., Malakoff, Dunod, 2018, 736 p.

⁵⁵¹ See Annex V “Dictionaries of data” to have access to the list of attributes per set.

emerged from a successive version of the conceptual diagram: by linking every set to the TEXT set, the searchability of the database loses robustness. Analyses in law require the citation of the relevant article of the legal text rather than solely the citation of the text. Therefore, in this context, sets must be in direct relationship with the ARTICLE set, itself linked to the TEXT set⁵⁵².

Figure I.7 represents the final version of the conceptual model, which has been used to construct the database. The sets are represented as boxes, the verbs to characterise the relationship between two sets in ellipses and the coded type of relationship are written next to the set from which the relationship departs. On the right hand side, we can find the representation of the relationship between the sets COUNTRY and TEXT. For lisibility purposes, the only attribute here represented for each set is its unique identifier (ID). This means that each occurrence of the TEXT set (for example), will be identified by a unique ID. In other words each text will be associated to a unique ID. It enables to ensure the tracakability of data in the database.

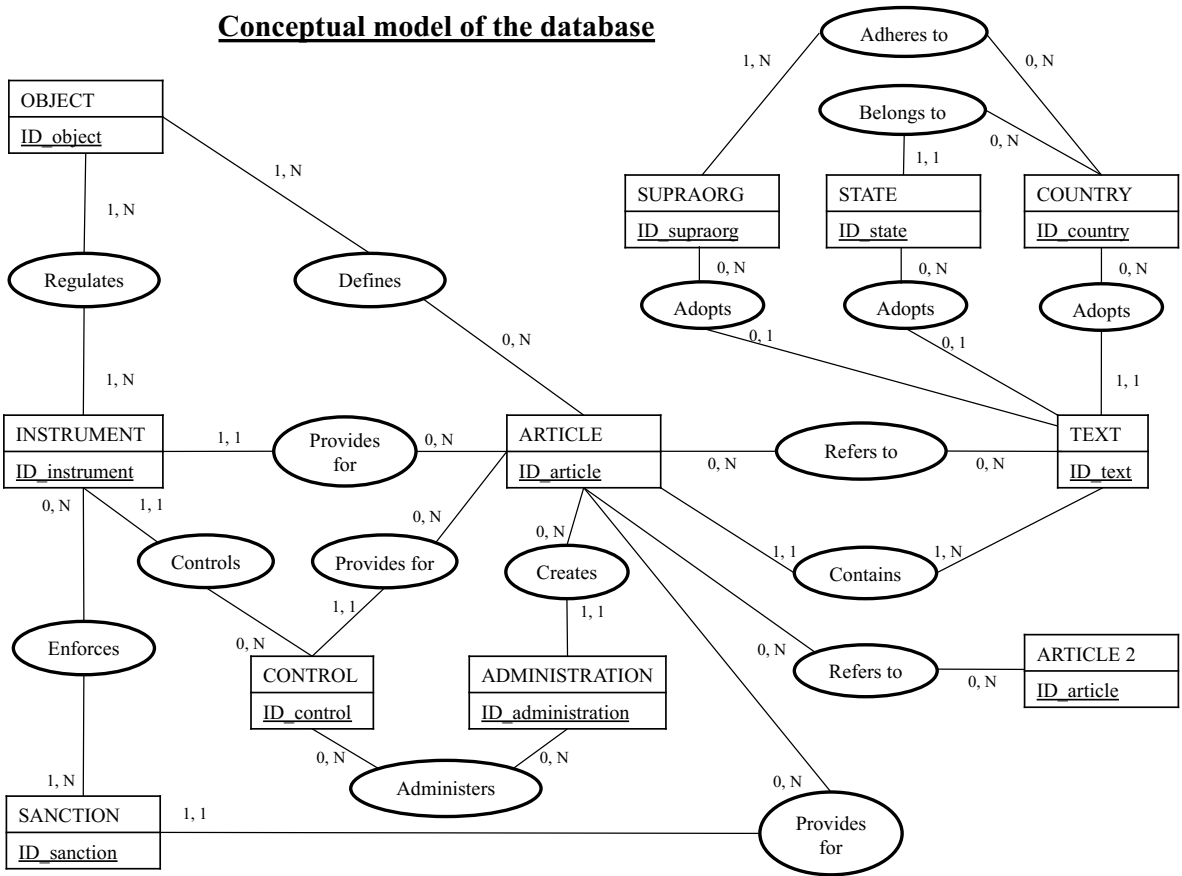


Figure I.7 Simplified version of the conceptual diagram of the relational database

⁵⁵² See Annex VI to have access to the successive conceptual models of the relational database.

Last, the physical model is the translation of the conceptual model into an operative system, understandable by the database software. Entities are translated into tables, which are linked one with another. Several to several relationships require the creation of further tables, such as between TEXT and ARTICLE – completed by the REFERENCE table.

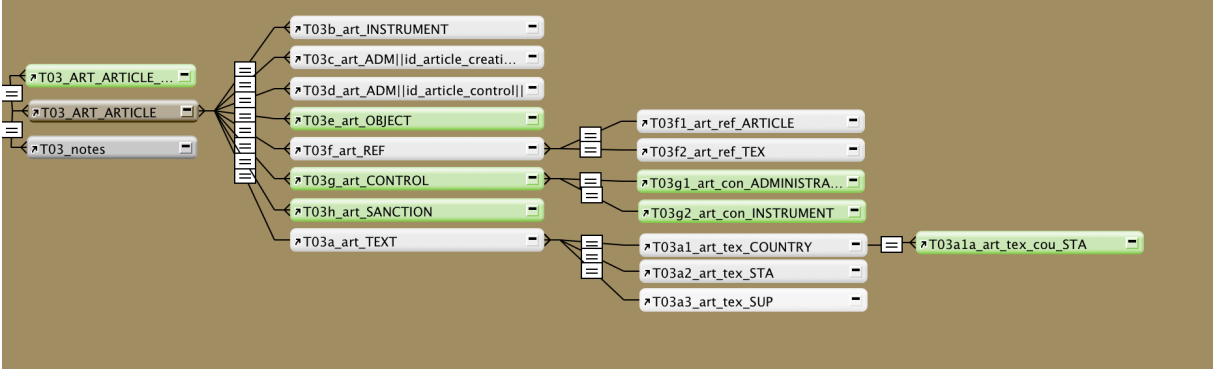


Figure I.8 Anchor-buoy representation of the physical diagram – Article table as anchor

The software Filemaker has been chosen to develop the database, for its accessibility to people novice to coding.

A specificity of the Filemaker software is the anchor-buoy representation of the physical diagram. This methodology is useful to develop complex database systems, as a table (anchor) is linked with other tables (buoys) in an independent manner, thanks to the concept of table occurrences. Looking from an anchor, all the relationships that the database identifies are those created with the buoys (see figure I.8)⁵⁵³.

c. Data collection: an articulation with existing legal databases

The relational database is developed as a tool to explore the law, by reproducing the relationships between its different constituting elements such as objects, instruments, controls, sanctions, administrations, all related to the relevant legal text, article and country.

As such, its raw material is the legal texts adopted by the studied countries. The data required to fill the database is contained in such texts. There are a number of ways by which to collect these texts. Most often, the search is focused on international legal databases such as

⁵⁵³ To know more about the functioning of the database and its conception, see Annexes VII, VIII, and XIX.

ECOLEX⁵⁵⁴, EUR-Lex⁵⁵⁵, or FAO-Lex⁵⁵⁶ or national databases such as Légifrance⁵⁵⁷. Searches in the national press is sometimes useful to identify the adoption of legal texts on a specific matter, before searching it in the pre-mentioned databases⁵⁵⁸. Each country of this case-study provides free online access to voted texts⁵⁵⁹. Only once during this study, a text was unfindable on online databases. A local contact provided access to the researched text as it had just been published in the Senegalese official journal but was not online yet.

The analysis of the texts then enables the manual fill of the database. Any update, provoked by the adoption of further texts, must be done manually. A regulatory watch must thus be constantly maintained.

Regarding access to the data, the database will be made available in open access, in the “data suds” repository⁵⁶⁰ upon the completion of this PhD. The aim is to give access to both the data and the database, to facilitate the emergence of further research, opening up to new fields, methodologies or objectives⁵⁶¹. The database is first and foremost a tool to be used for multiple

⁵⁵⁴ ECOLEX, <https://www.ecolex.org/fr/>, accessed on 21/02/2022.

⁵⁵⁵ EUR-Lex, <https://eur-lex.europa.eu/homepage.html?locale=fr>, accessed on 21/02/2022.

⁵⁵⁶ FAOLEX, <https://www.fao.org/faolex/fr/>, accessed on 21/02/2022.

⁵⁵⁷ French portal, Légifrance, <https://www.legifrance.gouv.fr>, accessed on 21/01/2022.

⁵⁵⁸ When the existence of a text was found on other media than legal databases, the original text, as adopted by the legislative and executive powers of the country, has always been searched for to guarantee the minimum interpretation bias. It is surprising to observe that two published articles on plastic bag legislation rely only on the analysis of secondary data such as peer-reviewed and grey literature, and NGO websites. See SCHNURR Riley E. J., ALBOIU Vanessa, CHAUDHARY Meenakshi *et al.*, « Reducing marine pollution from single-use plastics (SUPs) », *Marine Pollution Bulletin*, 137, 2018 and XANTHOS Dirk et WALKER Tony R., « International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads) », *Marine Pollution Bulletin*, 118, 2017.

⁵⁵⁹ Cape Verde : Imprensa Nacional de Cabo Verde, <https://kiosk.incv.cv>.

Brazil: in Pernambouco, <https://legis.alepe.pe.gov.br>; in Sao Paulo, <https://www.al.sp.gov.br/alesp/pesquisa-legislacao/>.

France : Légifrance, <https://www.legifrance.gouv.fr>

Ireland: Irish Statute Book, <https://www.irishstatutebook.ie>

Senegal: Journal Officiel, <http://www.jo.gouv.sn>, unregularly updated

United Kingdom: Legislation.gov.uk, <https://www.legislation.gov.uk>

United States of America: United States Code, <https://www.govinfo.gov/app/collection/USCODE> ; Florida Statutes and Constitution, <http://www.leg.state.fl.us/statutes/>; Texas Constitution and Statutes, <https://statutes.capitol.texas.gov>.

⁵⁶⁰ See annex XIV, “Data management plan”.

⁵⁶¹ EPSTEIN Lee and MARTIN Andrew D., “Quantitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 909.

purposes. The open access mode also provides access to the database to people outside of the research sphere, who might be interested to access legal data on plastic bag regulation

Section 2) From information to knowledge: trajectories of indicator development

Despite its numerous advantages, the database is a tool to be handled rather than a research robot. Specific methods must be developed to transform the data it contains to information and knowledge. First, the distinction must be made between qualitative and quantitative research methods. These two methods, complementary rather than exclusionary, provide different insights into the dataset (a). This distinction enables to identify variables and indicators, useful to assess the comprehensiveness and forcefulness of legal provisions, but also to explore the complexity of law (b). The aggregation of these indicators into an index of the potential contribution of law to the protection of the environment provides further comparative insights into the flaws and successes of national environmental regulations (c).

a. Leveraging qualitative and quantitative analyses: the need for a mixed method

Qualitative research “attempts to capture and categorize social phenomena and their meanings”⁵⁶², whereas quantitative research “involves measuring the degree to which some feature is present”⁵⁶³. Data collection for qualitative research can be conducted through direct observation, interviews or document analysis. Only the latter will be used as a data-source here. Data collection in quantitative research can be experimental or observational data⁵⁶⁴. This step often requires to move from the abstract real-life object to be measured to the concrete variable which will be measurable, and considered as a measure of the object⁵⁶⁵. The complexity of quantitative research starts here.

⁵⁶² WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 927.

⁵⁶³ KIRK Jerome, MILLER Marc et MILLER Marc L., *Reliability and Validity in Qualitative Research*, Beverly Hills, SAGE Publications, Inc, 1986, 96 p., p. 9.

⁵⁶⁴ EPSTEIN Lee and MARTIN Andrew D., “Quantitative Approaches to Empirical Legal Research”, *op.cit.*, p. 904.

⁵⁶⁵ EPSTEIN Lee and MARTIN Andrew D., “Quantitative Approaches to Empirical Legal Research”, *op.cit.*, p. 907.

Depending on the chosen approach, the analytical spotlight illuminates different aspects of the studied phenomenon ⁵⁶⁶. Qualitative and quantitative research methodologies offer complementary perspectives ⁵⁶⁷. For example, qualitative research can be used when quantification is not possible, or to bring nuance to quantitative results. If qualitative and quantitative research are often opposed, the first tailored for exploratory research⁵⁶⁸ and the second for explanatory research⁵⁶⁹, “both types may be used for descriptive studies”⁵⁷⁰, which is intended here.

In a word, mix methods likely balance each methods’ strengths and weaknesses. This is the reason why Nielsen highlights that the complexity of the empirical study of law most often requires mixed methods, defined as “any research that uses more than one research technique or strategy to study one or several closely related phenomena”⁵⁷¹. The pursuit of such research is not straight forward. The schedule suggested by Nielsen involves the conduct of “exploratory research to develop theory”, the development of “reliable quantitative instruments to measure and count”, and last reliance on a “qualitative or document-analysis phase to better understand the processes that produce the outcomes analysed in the quantitative data”. She highlights that “such research takes years”⁵⁷². Lozowick also emphasizes the importance of qualitative insights to legal quantitative research, as “the exercise of intelligence in the formulation of the problem and in the interpretation of the statistical results is also necessary”. The lawyer’s input is therefore key to the quality of the results, by bringing her “understanding of the legal context of the problem and the nuances of the factual situation”⁵⁷³.

⁵⁶⁶ NIELSEN Laura B., “The Need for Multi-Method Approaches in Empirical Legal Research” in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 952.

⁵⁶⁷ WULF Alexander J., « The Contribution of Empirical Research to Law », *Journal Jurisprudence*, 29, 2016, p. 29-49, p. 42.

⁵⁶⁸ Defined as “research that is designed to examine whether an issue, situation, or problem exists and if so to define it”, WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 928.

⁵⁶⁹ Defined as “research designed to determine why or how an issue, situation, or problem is as it is”, WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, *ibid.*, p. 928.

⁵⁷⁰ Defined as “research designed to describe an issue, situation, problem or set of attitudes”, *ibid.*, p. 928.

⁵⁷¹ NIELSEN Laura B., “The Need for Multi-Method Approaches in Empirical Legal Research”, *op.cit.*, p. 953.

⁵⁷² NIELSEN Laura B., “The Need for Multi-Method Approaches in Empirical Legal Research”, *op.cit.*, p. 970.

⁵⁷³ LOZOWICK Arnold H., STEINER Peter O. et MILLER Roger, « Law and Quantitative Multivariate Analysis: An Encounter », *Michigan Law Review*, 66, 1968 1967, n° 8, p. 1641-1678, p. 1676.

It is part of this research's design to rely on the combination of qualitative and quantitative methods. Qualitative and quantitative analyses of the comprehensiveness and forcefulness of environmental regulations lead to two types of results. The first emphasizes the diversity and complexity of country or state regulations of a same source of pollution, questioning countries' ability to join forces. The second brings to light comprehensiveness and forcefulness flaws and successes. Both contribute to characterise the potential of protection offered by national or state regulations in their fight against a common source of pollution.

b. Defining comprehensiveness and forcefulness variables and indicators

The development of a quantitative approach to the characterisation of the potential contribution of legal frameworks to the protection of the environment requires to design both variables and indicators of comprehensiveness and forcefulness.

It is key to differentiate variables and indicators. A variable is a measure whose value can change over time or across case-study countries. It provides information on the characteristics of a concept. An indicator is a certain type of variable, in the sense that it is measured in relation to an objective. An indicator "reveals relative positions (*e.g.*, of a country) in a given area"⁵⁷⁴. For example, a variable describing the forcefulness of sanctions could be the type of sanctions (qualitative variable) or the number of sanctions (quantitative variable), but an indicator would require to characterize this variable in relation to the objective to maximize enforcement. The qualitative variable of the type of sanction would thus be transformed into a semi-quantitative indicator, providing greater values to more forceful sanctions (*e.g.*, a prison sentence is considered more forceful than the payment of a fine). Another indicator for the forcefulness of sanctions could be the qualitative characterisation of the number and the force of sanctions. Greatest values would then be attached to the qualitative appreciation of a country's provision for numerous and forceful sanctions.

Defining quantitative measures (be they variables or indicators) of multifaceted and complex phenomena - such as the comprehensiveness and forcefulness of environmental law - is the greatest challenge of quantitative social science research⁵⁷⁵. An additional step to the definition

⁵⁷⁴ OECD et JRC EUROPEAN COMMISSION, « Handbook on Constructing Composite Indicators. Methodology and User guide », Paris, France, Organisation for Economic Co-operation and Development, 2008.

⁵⁷⁵ See COLEMAN Ronald J. et VAZ Ana, « Law and Multidimensional Measurement », *Southern Illinois University Law Journal*, 44, 2020 2019, n° 2, p. 253-272, p. 253 and EPSTEIN Lee and MARTIN Andrew D., "Quantitative Approaches to Empirical Legal Research", in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 907.

of indicators is the qualification in regard to the objective of the measure. The process of “translating the relevant properties or attributes of the world (*i.e.*, variables) (...) into a form that the researcher can then analyse systematically” is called coding variables⁵⁷⁶. The coding of variables commonly aims to be as objective as possible but subjective elements are sometimes involved due to the complexity of the explored phenomenon⁵⁷⁷.

Variables (and indicators, understood as a specific type of variable) can be coded in different ways. Binary variables (also called dummy or Boolean) are coded either 0 or 1. 0 signifies the absence, and 1 the presence. Qualitative variables are a textual description of the data. To facilitate their aggregation, they can be rated along a quantitative scale (*e.g.* from 0 to 3) set arbitrarily: these are semi-quantitative variables. Last, quantitative variables are variables corresponding to a number.

Both variables (i) and indicators (ii) of comprehensiveness and forcefulness will be presented here.

i. Comprehensiveness and forcefulness variables

For the purpose of this research, qualitative and quantitative variables of comprehensiveness and forcefulness will be used to quantitatively describe the complexity and diversity of approaches to a single source of pollution, in complement to their qualitative description.

As for the description of the comprehensiveness of law, indicators cover the regulation’s targeted behaviour, the type of objects regulated and exempt from the regulation, and the number of exceptions. As for the description of the forcefulness of law, the indicators are the types of policy instrument, the number of policy instruments, the type of sanctions, the number of sanctions and the existence of controls. Table I.3 summarizes the different variables, their types, and usefulness.

As the complexity and diversity of legal strategies derives from different combinations of variables, analyses will potentially combine variables of comprehensiveness with variables of forcefulness.

⁵⁷⁶ EPSTEIN Lee and MARTIN Andrew D., “Quantitative Approaches to Empirical Legal Research”, *op.cit.*, p. 911.

⁵⁷⁷ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136, p. 124.

Name of variable	Type of variable	Explanatory potential
Comprehensiveness		
Regulation's targeted behaviour	Qualitative	Position of the governing authority on the responsible actors of pollution
Type of object regulated	Qualitative	Position of the governing authority on the types of objects causing pollution
Type of object exempt from regulation	Qualitative	Position of the governing authority on acceptable pollution sources
Number of exceptions	Quantitative	Breadth of planned exceptions to the regulation
Forcefulness		
Type of policy instrument	Qualitative	Position of the governing authority vis-à-vis the protection of the environment: mandatory? market forces? individual choice?
Number of policy instrument	Quantitative	Complexity of the policy setting set up to mitigate the pollution source
Type of sanctions	Qualitative	Position of the governing authority vis-à-vis non compliance
Number of sanctions	Quantitative	Position of the governing authority vis-à-vis non compliance
Provision for controls	Boolean	Position of the governing authority vis-à-vis non compliance

Table I.3 Summary table of variables used to describe the complexity and diversity of approaches to a single source of pollution.

ii. *Comprehensiveness and forcefulness indicators*

If variables enable to describe the complexity and diversity of approaches to a single source of pollution, indicators of comprehensiveness and forcefulness are used to identify conception flaws and successes of the regulation. Doing so, they contribute to assess the potential contribution of legal framework to the protection of the environment.

According to Davis *et al.*, the development of indicators commonly follows a trajectory composed of two successive phases. First, the conceptualisation phase requires the development of a theoretical frame, defining the overarching concept (here legal frameworks' contribution to environment protection) and its organizing concept (here through the definition of the comprehensiveness and forcefulness analytical framework). The definition of the organizing concept entails the identification of specific criteria and measurements⁵⁷⁸. This work enables to identify indicators, translating “broad standards into specific actions”. Then, the production

⁵⁷⁸ See above A, Designing an analytical paradigm: comprehensiveness and forcefulness.

phase starts when the “conceptualization of the indicator [is] married to available or created data”. In data-poor settings, the technical challenges of production can “operate as a constraint on conceptualization”⁵⁷⁹. Last, interpretation of the indicators and their communication or dissemination closes the trajectory.

Attention must be paid to the definition of indicators, as they directly influence the validity of the related analyses. In this perspective, McElfish and Varnell refer to eight essential criteria to choose environmental indicators⁵⁸⁰. The criteria relevant to legal indicators are: to “be measurable”, “rely on sound data obtained through reproducible methods”, “be highly correlated to the trends or conditions it is selected to represent”, and “be obtained at the appropriate geographic and temporal scale”⁵⁸¹. In other words, indicators must “demonstrate conceptual relevance”, “demonstrate feasibility of implementation” and “support interpretation and utility”⁵⁸². According to the definition of legal indicators provided by Davis, they should also “measure the performance of some component of one or more legal systems along a particular dimension”⁵⁸³.

The indicators defined to assess comprehensiveness and forcefulness are similar to the variables identified above, to the exception that they are rated against the objective to maximise comprehensiveness and forcefulness, to maximise legal framework’s potential contribution to the protection of the environment. Semi-quantitative indicators here offer interesting perspectives in answer to the challenge of measuring some aspects of law in a pure quantitative form.

Semi-quantitative indicators are commonly used by methodologies constructing aggregated indices. They offer the possibility to bring qualitative nuance in a quantitative assessment and

⁵⁷⁹ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, pp. 10-13.

⁵⁸⁰ These criteria have been developed by Florida State University for the Environmental Protection Agency in 1995. MCELFISH James M. Jr. et VARNELL Lyle M., « Designing Environmental Indicator Systems for Public Decisions », *Columbia Journal of Environmental Law*, 31, 2006, n° 1, p. 45-86, p. 52.

⁵⁸¹ *Ibid.*, p. 52.

The other criteria are specific to environmental indicators: “address an important environmental issue”, “be relevant to a significant policy goal within that issue”, “provide support for “making policy decisions”.

⁵⁸² *Ibid.*, p. 53, citing JACKSON Laura, KURTZ Janis et FISHER William, « Evaluation Guidelines for Ecological Indicators », Washington DC, Environmental Protection Agency, 2000.

⁵⁸³ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52, p. 39.

facilitate aggregation of qualitative data. For example, the Environmental Democracy Index (EDI) scores practice indicators on a three-point scale⁵⁸⁴. For its Freedom in the World Index, Freedom House uses a scale between 0 and 4 points for each of its indicators⁵⁸⁵. As for the Carbon Capture and Storage Legal and Regulatory Indicator, the scoring is based on a scale from 0 to 3, on the basis of the degree to which the local context satisfies the defined criteria⁵⁸⁶. The 0 to 3 scales used to rate semi-quantitative indicators in this work are inspired from these methods. A score of 0 means that none of the criteria used to characterise comprehensiveness or forcefulness are met, whereas a score of 3 indicates the full completion of comprehensiveness and forcefulness criteria. Scores of 1 and 2 respectively indicate the existence of major or minor limits to the comprehensiveness or forcefulness of the related provisions. For example, to assess the comprehensiveness of the object, the semi-quantitative indicator is calculated as follows: a score of 0 corresponds to an absence of definition of the object, a score of 1 to a definition which would be vague and / or imprecise, a score of 2 to a precise but uncomprehensive definition, and a score of 3 to a definition both clear and uncomprehensive.

Two indicator frameworks have been designed to test the results' robustness across methodological change. Table I.4 presents the indicators and scoring chosen for method 1 and 2. For both methods, all the indicators are semi-quantitative. The interest here will be to test how the results are impacted by this methodological change, and therefore is to explore the results' sensitivity to methodological choices.

The difference between the two method lies in the calculation of the score of three indicators: the targeted activity, the force of the instrument and the provision for sanctions. For these three

⁵⁸⁴ See WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015, p.6-7. “A score of 3 means that the respective provision exemplifies accepted good practice. A score of 2 indicates that a majority—but not all—environmental decision making includes a certain provision, or indicates moderately strong provision. A score of 1 translates to a weaker provision that allows significant discretion to government agencies to fulfil these rights, or that a right only applies to a minority of environmental decision-making processes. A score of 0 indicates that the law is either silent or prohibits some aspect of procedural rights, depending on the indicator.

⁵⁸⁵ “0 represents the smallest degree of freedom and 4 the greatest degree of freedom”, FREEDOM HOUSE, « Freedom in the World 2021 Methodology », Washington DC, Freedom House, 2021, p. 2.

⁵⁸⁶ 0: largely incapable of satisfying the criterion; 1: capable of satisfying the criterion only in some minor respects; 2: Moderately capable of satisfying the criterion, subject to conditions or limitations; 3: Clearly and unequivocally capable of satisfying the criterion. See HAVERCROFT Ian, « CCS Legal and Regulatory Indicator (CCS-LRI) », Melbourne, Australia, Global CCS Institute, 2018, p. 16.

indicators, whereas the second method relies on a 0 to 3 scale just as for the other indicators, the first sums up the different values of the indicator. For example, for the targeted activity indicator, method 1 sums up the following to get the indicator score: 4 points if production is regulated, 3 for import, 2 for export, commercialisation or distribution, and 1 for use. Method 2 relies on a scale from 0 to 3, 0 if there is no distinction as to the type of activity at which the regulation applies; 1 if the regulation only applies at downstream stages (commercialisation and/or use); 2 if the regulation applies at some upstream stages (production, import), 3 the regulation applies at all stages. The same logic is applied for the two other indicators for which the scoring between the two methods diverges (the force of the instrument and the provision for sanctions).

For both methods, a binary variable coding the existence of a currently in force text conditions the pursuit of the assessment. Just like the EDI, all indicators are designed to be actionable, “meaning that users should be able to easily identify what improvements need to be made to increase an indicator’s score”⁵⁸⁷. Some initiatives, such as the Environment Protection Index, standardize their data to enable country comparisons (such as comparing greenhouse gas emissions per unit of gross domestic product)⁵⁸⁸. This step is not required here, due to the type of indicators chosen.

⁵⁸⁷ WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », *op.cit.*, p.4.

⁵⁸⁸ WENDLING Zachary. A., EMERSON John W., DE SHERBININ Alex *et al.*, « Environment Performance Index 2020 », New Haven, CT, Yale Center for Environmental Law and Policy, 2020, p. 137.

Common ground		Method 1		Method 2	
1. Preconditions for the start of the indicator assessment					
Name	Description	Type of data	Scoring	Type of data	Scoring
In force text	Existence of a currently in force text addressing the key issue.	Binary	0: ends assessment 1: assessment continues	Binary	0: ends assessment 1: assessment continues
Type of legal text	Distinctions between <i>lois</i> and <i>décrets</i> , statutes and statutory instruments.		Will not be assessed here		Will not be assessed here
Implementation rate	Rate of legal provisions which have received implementation / legal provisions explicitly calling for implementation.		Will not be assessed here		Will not be assessed here
2A. Assessment of comprehensiveness					
Name	Description	Type of data	Scoring	Type of data	Scoring
Targeted activity	Activity targeted by the regulation. It is considered that the regulation of the following activities has a decreasing impact on environment protection : production > importation > exportation / commercialisation / distribution > use.	Semi-quantitative	Calculation on this basis: 4: production 3: importation 2: exportation / commercialisation / distribution 1: use	Semi-quantitative	Rated on a 4 levels scale 0: there is no distinction as to the life-cycle stage at which the reg. applies; 1: the reg. only applies at downstream stages (commercialisation and/or use); 2: the reg. applies at some upstream stages (production, import); 3: the reg. applies at all stages.
Comprehensiveness of the object	Comprehensiveness of the definition of the regulation's object.	Semi-quantitative	Rated on a 4 levels scale 0: there is no definition of the reg.'s object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.	Semi-quantitative	Rated on a 4 levels scale 0: there is no definition of the reg.'s object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.
Scope of the exception	Number, types and scope of the exceptions.	Semi-quantitative	Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours ; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.	Semi-quantitative	Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours ; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.
2B. Assessment of forcefulness					
Name	Description	Type of data	Scoring	Type of data	Scoring
Force of the instrument	Among binding instrument, command and control instruments leaves less flexibility that market-based instruments to personal choice. The combination of different instruments is considered as a contributing factor to environment protection, so as the provision for several instruments.	Semi-quantitative	Calculation on this basis: 1: cooperative and informational instruments 3: market-based instrument 4: existence of a ban	Semi-quantitative	Rated on a 4 levels scale 0: non-binding (informational or cooperative) instruments only are provided for; 1: market-based instruments are provided for; 2: command-and-control instruments are provided for; 3: several types of instruments are provided for.
Provision for controls	Precision with which controls are provided for.	Semi-quantitative	Rated on a 4 levels scale 0: no control is provided for; 1: controls are provided for, but no administration is explicitly in charge of such controls; 2: controls are provided for, an or several administrations are in charge of the controls. The process is not defined; 3: controls are provided for, the administration is identified, and the process is clearly defined.	Semi-quantitative	Rated on a 4 levels scale 0: No control is provided for; 1: Controls are provided for, but no administration is explicitly in charge of such controls; 2: Controls are provided for, an or several administrations are in charge of the controls. The process is not defined; 3: Controls are provided for, the administration is identified, and the process is clearly defined.
Provision for sanctions	Severity of the sanction.	Semi-quantitative	Calculation on this basis: 0: no sanction is provided for 1: display 2: low fine 3: seizure, confiscation, temporary closure 4: high fine 5: prison	Semi-quantitative	Rated on a 4 levels scale 0: No sanction is provided for; 1: There are a limited number of sanctions which are limited in force; 2: The sanctions provided for have a significant force; 3: There are several types of sanctions, among which some have a significant force.

Table I.4 Summary table of indicators used for method 1 and 2, application to the study of plastic bag regulation

c. *An aggregate indicator of the potential of protection*

The last building block of the numerical framework is the method used to aggregate indicators into a comprehensiveness and forcefulness index, and into an overall index of the potential contribution of legal frameworks to the protection of the environment. As put forward by Worker *et al.* “the use of indices to measure progress and promote change in development and the environment is wide- spread”⁵⁸⁹ due to the facility with which they can be communicated, thus “can help governments and civil society set priorities and take action”.

Aggregation can nonetheless be challenging, when “the components being aggregated [don’t] measure the same concept in the same units”⁵⁹⁰. Risks of decreased reliability can occur when data with correlated biases are aggregated. Another challenge is to decide whether variables are equally important, or whether variables should be weighted according to their relative importance. Additionally, “the same variable may play a completely different functional role in different countries, or different variables may play the same role, with their relative importance varying from one context to another”⁵⁹¹. Therefore, a risk associated with aggregation is increased subjectivity⁵⁹². These aspects will be developed in the part dedicated to the discussion of the results.

For the purpose of this study, a similar aggregation method has been designed for both indicator methods. The score for each indicator is computed into a completion rate. For example, a country scoring 10 on method’s 1 life-cycle stage indicator obtains a completion rate of 100% for this indicator (*i.e.*, the maximum score for this indicator is 10). To aggregate scores of comprehensiveness and forcefulness relevant indicators’ completion rates are arithmetically averaged. To calculate the overall index of the potential contribution of law to the protection of the environment, two methods will be tested: average of all the completion rates of both comprehensiveness and forcefulness indicators; or the selection of the lowest score of comprehensiveness or forcefulness. The choice has been made not to attribute different weights to indicators, in the absence of evidence of differentiated relative importance. These choices

⁵⁸⁹ WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015, p.3.

⁵⁹⁰ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52, p. 44.

⁵⁹¹ SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136, p. 124. Citing AHLERING Beth et DEAKIN Simon, « Labor Regulation, Corporate Governance, and Legal Origin: A Case of Institutional Complementarity? », *Law & Society Review*, 41, 2007, n° 4, p. 865-908, p. 884.

⁵⁹² SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers *op.cit.*, p. 127.

will be discussed in Part III, in the light of their application to the analysis of plastic bag regulations in Part II.

Conclusion of Title 3

The definition of the analytical and numerical frameworks of this methodology set both its conceptual and technical ground.

On the analytical front, the introduction of the concepts of comprehensiveness and forcefulness open new avenues to the analysis of the content of environmental law, by investigating the legal frameworks' scope of application, operability and enforceability in regard to the protection of the environment. Even if the analysis of the enforcement and effectiveness of these texts will be key to assess the extent to which current legal frameworks protect the environment, the analysis of their content enable to identify the main protection hinders and drivers, and therefore potential conception gaps.

Besides, the digital and numerical frameworks provide the technical tools to run a comparative assessment of legal frameworks' potential contribution to the protection of the environment. First, the relational database facilitates the navigation through the meanders of a country's legal frameworks, and between countries by organising the legal data per type (*e.g.*, object, instrument, control, sanction), and by reproducing the relationships between the data of different types. Second, the definition of legal indicators open avenues for the quantification of legal frameworks' potential contribution to the protection of the environment, offering comparative possibilities across time, space and disciplines.

Conclusion of Part I

This part has set the bases for the experimentation of numerical approaches to the analyses of legal frameworks' potential contribution to the protection of the environment, through an exploration of their content.

First, Title 1 has enabled to go through previous experiments of quantitative approaches to law, including through the development of indicators. This inventory of initiatives highlighted the diversity and variety of possible approaches to quantitative approaches to law. Diversity can be found both at the level of the legal constituents on which the measurement focuses, and at the level of the methodologies used. In addition, a wide variety of actors have been involved in law measurement development, in fields ranging from business and finance to governance passing by the environment. This title has also allowed to identify the main critiques formulated against the use of quantitative approaches and the development of indicators to analyse law. Therefore, this literature review has been both a source of inspiration and a guide to set the methodological bases of this work.

Second, Title 2 has addressed a major stake: guaranteeing the comparability of seven countries' legal frameworks attached to regulate a source of pollution in varying legal, political, geographical and socio-economic contexts. Particular attention has been paid to the power to regulate environmental issues, and more specifically plastic bags, in the seven countries. This work has emphasized the diversity of settings across the seven case study countries and the need to adopt a specific methodological approach to guarantee comparability. In this perspective, the functional comparative approach facilitates the comparison of different countries' legal frameworks by focusing on the analysis of the legal answers provided to a common source of pollution.

Third, Title 3 has set up the two pillars of the methodological framework designed and experimented in this work. The first lays down the analytical framework of the analysis, which is the conceptual ground for an analysis of the potential contribution of legal frameworks to the protection of the environment. It introduces the inputs and main components of an analysis of the comprehensiveness and forcefulness of legal frameworks. The second methodological pillar establishes the building blocks of the digital and numerical frameworks: the development of a relational database tailored to the analysis of the content of legal texts, and the characterization of legal indicators.

The methodology, as designed in this first part, must now be tested in the selected geographical and thematic case-studies. In other words, the methodology will be applied to analyse the legal frameworks adopted in Cape Verde, France, Ireland, England, Scotland, Florida, Texas, States of Pernambuco and Sao Paulo, and Senegal to regulate plastic bags, as a source of land-based pollution.

Part II. The method in motion: a contribution to the analysis of plastic bags legal frameworks

The key question of plastic bag regulation has been chosen as a pilot to test the developed methodology. To do so, taking stock of the current knowledge of plastic bag regulations is the first step (Title 1). The application of the method through qualitative and quantitative analyses questions the potential contribution of plastic bag regulations to the protection of the environment in the case-study countries. First, by stressing its disunited character, through the diversity of plastic bag regulations found in a handful of case study countries (Title 2). Second, by highlighting the respective strengths and weaknesses of plastic bag regulations (Title 3). Plastic pollution analysis is the pilot test of this methodology. It enables to identify the strengths, potentialities and limits of the methodology before considering its use in the analysis of other sources of land-based pollution.

Title 1. A freeze-frame: state of the art of plastic bag regulations

Setting the method in motion requires to describe the context in which it unfolds. First, the state of the art of existing environmental law research on plastic bags reveals the lights and shadows cast by current scholarship (Chapter 1). It sets the stage to appreciate the contribution of the method to the progress of legal research. Second, plastic bag regulations have been asymmetrically adopted in the seven case study countries, and more precisely in the ten legal entities analysed⁵⁹³ (Chapter 2). It anchors the legal context related to plastic bag regulation in the studied jurisdictions.

Chapter 1. Lights and shadows cast by plastic bag regulation scholarship

Picturing the contribution of this new methodology to the analysis of plastic bag regulations requires to go through a state of the art of the current research on plastic bag regulations.

In the description of the fundamental debates around environmental law in the United States, Michael Herz identifies four main threads: whether an identified issue requires regulation (*if*);

⁵⁹³ As a reminder: the states of Sao Paulo and Pernambuco for Brazil; Cape Verde; France; Ireland; Senegal; Scotland and England for the United Kingdom; and Florida and Texas for the United States of America.

the institution in charge of the regulation (*who*); the defined objectives (*what*) and the means to achieve these objectives (*how*)⁵⁹⁴. Plastic bag regulation scholarship is mainly centred on the *how* dimension, by describing the diversity of policy instruments used to tackle this source of pollution (section 1). Taking a step back, authors are also attached to determine which of the different methods used (*how*) should be better able to tackle the plastic issue (section 2). From these two approaches one could identify shadows left dimly lit by plastic bag regulation scholarship.

Section 1) A primary analytical focus: a panorama of existing policy instruments

The means to achieve a regulation's objectives (*how*) are mainly analysed, on the plastic bag regulation issue, through the choice and design of policy instruments. A large proportion of plastic related legal academia is focused on describing the diversity of instrumental responses to plastic pollution (a). Others combine an analysis of the instruments used, and the countries' characteristics (b).

a. Describing the diversity of instrumental responses to plastic pollution

A common approach to the analysis of plastic mitigation policy is to review the diversity of policy instruments designed by governments across the world.

The United Nations Environment issued, in 2018, a comprehensive report focused on plastic bags and microbeads regulations globally⁵⁹⁵. Beyond a classical regulatory *vs.* market-based dichotomy, this report provides analyses pertaining to another aspect of the *how* of plastic regulation: the definition of the object of the regulation, *i.e.*, *how* plastic bags are defined, along which criteria. The criteria identified by UNE cover thickness requirements and / or material composition / type requirements. The main input of this report is to provide, for the 127 jurisdictions covered by the study, summary tables regrouped by continent based on the existence of bans, market-based instruments, thickness requirements and material composition or type of requirements for plastic bags.

Two years later, Karasik *et al.* offer an analysis of regulations applied to plastic pollution at large. Plastic bags are one of the plastic pollution sources analysed. They classify the “specific

⁵⁹⁴ HERZ Michael, « Les grands débats autour du droit de l'environnement aux Etats-Unis », *Pouvoirs*, 2008, n° 127, p. 87-107, p. 89.

⁵⁹⁵ UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018.

instruments that governments are using in policies at different levels (...) based on a typology of instruments developed under three broad categories: regulatory, economic, and information instruments”⁵⁹⁶. They find that regulatory instruments (command-and-control type) are by far the most frequently used at different stages in the plastic life cycle, 3.5 times more than economic instruments⁵⁹⁷. One of their inputs is to break down the instrument typology into subcategories such as for the regulatory dimension: prohibitive (ban; irresponsible handling of plastic), affirmative (plan and commitment; responsible handling of plastic; encourage innovation; post-leakage capture). Nonetheless, this study *de facto* excludes policies unavailable in English, restricting its scope.

These reports with a global analytical scale have been preceded by articles focusing on a more limited number of case-studies. Xanthos and Walker provide examples of plastic bags and microbeads policies and instruments at national, subnational and city levels in 2017⁵⁹⁸. The input of this article is to go down to the municipal level, which none of the above propose. Rather than comprehensiveness, this article provides for examples of how intricate plastic regulation can be, and proof of potential biases of country-level analyses. Shnurr *et al.* provide an update of data provided by Xanthos and Walker. They also enlarge the descriptions to other single use plastics, and to non-legislative bottom-up initiatives⁵⁹⁹.

Another set of articles focus on specific regions or provide comparative perspectives.

Kasidoni *et al.*⁶⁰⁰. illustrate the diversity of Member State implementation of Directive 94/62/EC⁶⁰¹ regarding the use of plastic bags in the Europe Union. The input of this article is

⁵⁹⁶ See KARASIK Rachel, VEGH Tibor, DIANA Zoie *et al.*, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020. Authors argue that the inventory is “comprehensive for policies at the international level (containing 67 of 69 known policies, either found or referenced in the literature reviewed, or 97 percent), indicative for policies at the national level (147 of the range of 309 or 377 policies found or referenced in the literature reviewed, or 39 to 47 percent), and provides only examples at the subnational level (77 of 362 known policies, or 21 percent)”, p. 28.

⁵⁹⁷ *Ibid.*, p. 62 “most frequently banning plastic at the point of sale, or 80 percent of the bans, followed by production and import stages at roughly 69 and 64 percent respectively, the use stage at 44 percent, and almost all of the remainder targeted broadly at all stages of the life cycle).

⁵⁹⁸ XANTHOS Dirk et WALKER Tony R., « International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review », *Marine Pollution Bulletin*, 118, 2017, n° 1, p. 17-26.

⁵⁹⁹ SCHNURR Riley E. J., ALBOIU Vanessa, CHAUDHARY Meenakshi *et al.*, « Reducing marine pollution from single-use plastics (SUPs): A review », *Marine Pollution Bulletin*, 137, 2018, p. 157-171.

⁶⁰⁰ KASIDONI Maria, MOUSTAKAS Konstantinos et MALAMIS Dimitris, « The existing situation and challenges regarding the use of plastic carrier bags in Europe », *Waste Management & Research*, 33, 2015, n° 5, p. 419-428.

⁶⁰¹ European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, Official Journal L 365 , 31/12/1994 P. 0010 – 0023, amended by Directive (EU) 2015/720 of the European

to descriptively discriminate the existence of economic or regulatory measures based on the level of littering rate in each country, highlighting the need to tailor initiatives to local contexts. Adam et al. provide a rare focus on West African plastic policies, highlighting the frequent use of regulatory instruments rather than market-based instruments⁶⁰². Going beyond the description of the instruments, the authors extend the analysis of the *how* to the definition of the objects, to the type and severity of sanctions, or to the lag between announcement and implementation. While the authors describe enforcement of these legal texts as low, scientific evidence of these claims are lacking.

b. Combining instrument-use and national characteristics: a comparative perspective

An analytical step forward is made by research combining instrument-use and national country-characteristics in a comparative perspective.

The prementioned UNE report provides an insight on differentiated instrumental approaches to plastic bag regulation on a continental basis. In proportion, African, Asian and Oceanian countries rely more on bans than economic instruments, to the contrary of Europe where economic instruments in proportion more are largely used⁶⁰³.

The findings of the prementioned Karasik *et al.* report is complementary: low income and lower-middle-income countries would lead the way in anti-plastic norm adoption, regardless of the instruments involved. They find that in their sample, the proportion of low income and lower-middle-income countries which have adopted anti-plastic bag regulations is higher than the proportion of higher income countries⁶⁰⁴.

Going further and mixing the last two approaches, Knoblauch *et al.* find that “out of the 51 countries and states that have to date adopted plastic bag bans, 36 (70.6%) are located in the Global South.” The asymmetry also concerns market-based instruments, as “only 11 [countries which have adopted a tax] (or 28.2%) out of 39 are located in the Global South”⁶⁰⁵. While the

Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags (Text with EEA relevance), *OJL 115*, 6.5.2015, p. 11–15.

⁶⁰² ADAM Issahaku, WALKER Tony R., BEZERRA Joana Carlos *et al.*, « Policies to reduce single-use plastic marine pollution in West Africa », *Marine Policy*, 116, 2020, p. 103928, p. 4.

⁶⁰³ UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018, figure 3.4.

⁶⁰⁴ KARASIK Rachel, VEGH Tibor, DIANA Zoie *et al.*, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020, 309p., p. 9.

⁶⁰⁵ KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead: What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, 2018, n° 6, p. 1994, p. 1997.

authors infer that “developing countries adopted more stringent legislation than countries in the Global North”, it might be a hasty conclusion. The aim of this PhD is precisely to show that the potential of protection borne by a legal text is multidimensional. For example, the scope of the regulation’s object and the characteristics of the exceptions to the regulations may impact the stringency of the regulation. Therefore, the potential of protection may go beyond solely the instrument choice.

Clapp and Swanston provide, in an early article in plastic bag regulation scholarship, an interesting time perspective feeding a complementary *when* prospect. In their analysis, the Global south were also the first to adopt anti-plastic bag norms, whereas norm adoption usually follows a North-South pattern. They nonetheless highlight that the context of anti-plastic norm adoption is unusual. In absence of an internationally adopted binding convention which would have guided national legal answers. Anti-plastic bag regulations have been adopted as “an ad hoc series of bottom-up events occurring simultaneously at different jurisdictional levels around the world”⁶⁰⁶. Therefore, the second unusual aspect of anti-plastic norm emergence identified by the authors is simultaneity. The most interesting input of their article is the analysis of why anti-plastic bag norms emerged in the global South⁶⁰⁷ first. The authors put forward locally specific reasons, such as poor municipal waste collection and treatment, the low recycling value of plastic bags, and a clear cause and effect chain between availability of plastic bags and pollution⁶⁰⁸.

Despite the recognized profusion of anti-plastic norm adoption in the global South, it is striking to observe that African legal texts are often omitted in global analyses. Simply considering African countries bordering the Atlantic Ocean⁶⁰⁹, the Xanthos and Walker precited article omits the anti-plastic norms of twelve countries⁶¹⁰. This omission leads the authors to deduce

⁶⁰⁶ CLAPP Jennifer et SWANSTON Linda, « Doing away with plastic shopping bags », *Environmental Politics*, 18, 2009, p. 315-332, p.316.

⁶⁰⁷ Specifically, in Bangladesh, India and South Africa, in 2001.

⁶⁰⁸ *Ibid.*, p.319.

⁶⁰⁹ This example has been chosen as the author has worked specifically on anti-plastic regulation in countries bordering the Atlantic Ocean. See BILLANT Odeline et BONNIN Marie, « Vers l’interdiction des sacs plastique en Afrique atlantique : une analyse numérique en droit de l’environnement », *Mondes en développement*, n° 193, De Boeck Supérieur, 2021, n° 1, p. 7-25.

⁶¹⁰ See XANTHOS Dirk et WALKER Tony R., « International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review », *Marine Pollution Bulletin*, 118, 2017, n° 1, p. 17-26. These countries and year of adoption are: Cameroon (2012), Cape Verde (2015), Congo (2011), Benin (2017), Ivory Coast (2014), Gabon (2010), Democratic Republic of Congo (2012), Sao Tomé (2003), Togo (2011), Gambia (2015), Mozambique (2016), Senegal (2016).

that anti-plastic interventions in Africa are “emerging”, whereas regulations in Europe are “widespread”⁶¹¹. Schnurr *et al.* provide an update of regulations analysed in the Xanthos and Walker article. Doing so, considering only African countries bordering the Atlantic coast, six countries are omitted⁶¹².

These omissions could be due to non-voluntary reasons, such as difficulty to access to legal data in African countries, or difficulty, for English-speakers, to access texts in countries where the national language is either French or Portuguese. In any case, one should be aware of such potential biases when relying on global reviews of anti-plastic norm emergence. Increasingly, research is focused on the analysis of plastic bag regulation in African countries, highlighting the contribution of these countries to the global effort⁶¹³.

Section 2) A secondary analytical focus: How well does it work? assessing drivers and barriers of policy effectiveness

Meanwhile, the assessment of policy effectiveness from an instrument perspective has progressively emerged (a). Rising from the analysis of the legal means provided by the regulation to achieve its objectives (*how*), its aim is to loop back to policy recommendations in order to better inform future decision making. The same objective can be achieved in a mirroring perspective by analysing the barriers of policy effectiveness (b).

a. Assessing policy effectiveness from an instrument perspective

Policy effectiveness can be assessed (or discussed) at different scales. Some authors discuss the results of a particular policy on specific objectives in a limited territory, such as a country or an island.

In a territorial scope limited to Madeira Island (Portugal), Luís and Spínola assessed the influence of a voluntary fee in the consumption of plastic bags in supermarkets. They find a

⁶¹¹ See XANTHOS Dirk et WALKER Tony R., « International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review », *op. cit.*, figure 1.

⁶¹² See SCHNURR Riley E. J., ALBOIU Vanessa, CHAUDHARY Meenakshi *et al.*, « Reducing marine pollution from single-use plastics (SUPs): A review », *Marine Pollution Bulletin*, 137, 2018, p. 157-171, table 1. These countries and year of adoption are: Benin (2017), Ivory Coast (2014), Gabon (2010), Democratic Republic of Congo (2012), Sao Tomé (2003), and Togo (2011).

⁶¹³ See for example BEZERRA Joana Carlos, WALKER Tony R., CLAYTON Andrea *et al.*, « Single-use plastic bag policies in the Southern African development community », *Environmental Challenges*, 3, Elsevier, 2021, p. 100029 ; BILLANT Odeline et BONNIN Marie, « Vers l’interdiction des sacs plastique en Afrique atlantique : une analyse numérique en droit de l’environnement », *Mondes en développement*, n° 193, De Boeck Supérieur, 2021, n° 1, p. 7-25; ADAM Issahaku, WALKER Tony R., BEZERRA Joana Carlos *et al.*, « Policies to reduce single-use plastic marine pollution in West Africa », *Marine Policy*, 116, 2020, p. 103928, p. 4.

significant decrease of bag consumption and increase of bag reutilisation in supermarkets charging a 2 cents fee on plastic bags⁶¹⁴. Enlarging the study to Portugal, Martinho *et al.* find a “74% reduction of plastic bag consumption with a simultaneously 61% increase of reusable plastic bags after the tax was implemented”, with no influence of the distance to the coast on consumer behaviour nor the perception of the tax⁶¹⁵. They nonetheless highlight the importance of providing alternatives to consumers. In the same idea, Convery *et al.* provide an analysis of the Irish plastic bags levy implemented in March 2002, and an explication of the rationale behind the choice of the amount of the tax. Rather than a Pigouvian tax based on marginal external costs of plastic pollution, the amount was chosen to trigger consumers’ behaviour change through the identification of consumers’ maximum willingness to pay⁶¹⁶. They highlight that the success of this levy in reducing plastic bag consumption is due to the amount of the tax, which was approximately six times higher than the maximum willingness to pay, and the efforts made in assuring both acceptance of the tax and support from both the minister and treasury⁶¹⁷. These analyses have no comparative ambition. They simply aim, in a limited time-frame and geographical scope, to analyse the effects of a determined policy, and potentially to share what has worked and what hasn’t. Other initiatives’ ambition is to analyse what is the best instrumental approach to mitigate plastic pollution, potentially depending on local contexts. This is the aim of the last chapter of the Karasik *et al.* report. The authors provide a literature review of “which instruments were most effective in different contexts”⁶¹⁸. They highlight that “the choice of a regulatory ban or economic instrument to address plastic bags does not appear to be determinant, as both have shown significant and consistent reductions in plastic bag consumption in the scientific literature”⁶¹⁹. Rather, reduction rates would be influenced by the amount of the fee, the provision of alternatives and public awareness and acceptance of policy. In that sense, “coupling regulatory and economic instruments with information instruments”

⁶¹⁴ LUÍS Idalina Perestrelo et SPÍNOLA Hélder, « The influence of a voluntary fee in the consumption of plastic bags on supermarkets from Madeira Island (Portugal) », *Journal of Environmental Planning and Management*, 53, 2010, n° 7, p. 883-889, pp. 886-887.

⁶¹⁵ MARTINHO Graça, BALAIA Natacha et PIRES Ana, « The Portuguese plastic carrier bag tax: The effects on consumers’ behaviour », *Waste Management*, 61, 2017, p. 3-12.

⁶¹⁶ CONVERY Frank, MCDONNELL Simon et FERREIRA Susana, « The most popular tax in Europe? Lessons from the Irish plastic bags levy », *Environmental and Resource Economics*, 38, 2007, n° 1, p. 1-11, p. 3.

⁶¹⁷ *Ibid.*, pp. 10-11.

⁶¹⁸ KARASIK Rachel, VEGH Tibor, DIANA Zoie *et al.*, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020, 309p., p. 7.

⁶¹⁹ *Ibid.*, p. 11.

can have a positive effect. The results of the literature review conducted by Schnurr *et al.* are very close⁶²⁰. They add that the combination of legislative and non-legislative interventions complements and influences each other “when working in tandem”⁶²¹.

Context also matters in the research conducted by Alpizar *et al.* identifying suitable policy instruments based on the source of plastic pollution the policy-makers intend to mitigate. To do so, they identify stages at which plastic enters the ocean from production to disposal, including littering and catastrophes⁶²². The identification of a problem leads them to identify tools (or instruments) in four categories: price-based, rights-based, regulation and behavioural instruments. They highlight that waste has “three critical complications” from a policy design perspective, that should be corrected by instruments: the missing-market problem through the allocation of property rights for waste, a moral-hazard problem through which putting too much pressure on certain actors could lead to illegal dumping, and that plastic pollution is a problem of the commons where individual actions are insignificant but ends to be summed up with all actions⁶²³.

A last, more direct approach is to evaluate the impacts of a plastic carrier bag policy on plastic bag consumption, including trash bags, and not solely on the plastic carrier bags targeted by the regulation. This approach highlights the potential leakage or pervert effects of regulation. Taylor for example quantifies leakage effects of California’s plastic carrier bag ban. She highlights that “a 40-million-pound reduction of plastic per year from the elimination of plastic carryout bags is offset by an additional 12 million pounds of plastic from increased purchases of trash bags”⁶²⁴. Additionally, these bags are often made of heavier plastic than conventional plastic carrier bags, which used to be reused as trash bags.

The analysis of the potential barriers to plastic bag regulation pursues the same objectives as the analysis of instrument effectiveness, in a mirroring perspective.

⁶²⁰ See for example SCHNURR Riley E. J., ALBOIU Vanessa, CHAUDHARY Meenakshi *et al.*, « Reducing marine pollution from single-use plastics (SUPs): A review », *Marine Pollution Bulletin*, 137, 2018, p. 157-171, p. 163.

⁶²¹ *Ibid.*, p. 167. See also ALPIZAR F., CARLSSON F., LANZA G. *et al.*, « A framework for selecting and designing policies to reduce marine plastic pollution in developing countries », *Environmental Science & Policy*, 109, 2020, p. 25-35, p.27.

⁶²² See figure 1, *ibid.*

⁶²³ *Ibid.*

⁶²⁴ TAYLOR Rebecca L. C., « Bag leakage: The effect of disposable carryout bag regulations on unregulated bags », *Journal of Environmental Economics and Management*, 93, 2019, p. 254-271, p. 255.

b. *Identifying potential barriers to plastic bag regulation*

The analysis of the potential barriers to plastic bag regulation complementarily aims to identify how the effectiveness of regulations could be impeded by internal or external factors.

Vimal *et al.* provide an interesting insight into this research theme. They identify “22 potential barriers that restricts the successful elimination of single use plastics⁶²⁵” based on a literature review and their own research. These barriers are divided into five groups, namely policy making related barriers, government initiatives related barriers, financial related barriers, technology and infrastructure related barriers, and producer / retailer / customer / consumer related barriers. The policy making related barriers identifies many aspects related to the design of regulations which are poorly addressed by anti-plastic norm scholarship, such as the lack of sanctions, the imposition of a ban without identifying alternatives and education / awareness instruments. The last two barriers (suitable alternatives and awareness-raising) are very present in the other groups of identified barriers. Based on interviews, they statistically assess the level of importance and cause/effect of all the barriers. The lack of sanctions, of suitable alternatives and of awareness measures are identified as important causal barriers⁶²⁶. Although these barriers are identified in developing economy context, these results could usefully inform regulation in developed economies.

Another aspect of existing obstacles to plastic regulation is developed by Loges and Jakobi in a recent article. Analysing the underlying dynamics of norm adoption, they discuss the existence and importance of actors and values behind their emergence. Doing so, they put forward the complexity of the conceptual and political framework in which plastic regulations are designed. For example, they illustrate the diversity of values justifying *if* a regulation should be adopted. These values range from plastic as “a highly problematic material in general, no matter which form, product, or specific polymer”, to the consideration as problematic of specific products, passing by a focus set on the impacts of plastic in the environment⁶²⁷. Additionally, they observe that “different types of actors can be entrepreneurs or antipreneurs,

⁶²⁵ VIMAL K. E. K., MATHIYAZHAGAN K., AGARWAL Vernika *et al.*, « Analysis of barriers that impede the elimination of single-use plastic in developing economy context », *Journal of Cleaner Production*, 272, 2020, p. 122629, p. 122633.

⁶²⁶ *Ibid.*, p. 122641.

⁶²⁷ LOGES Bastian et JAKOBI Anja P., « Not more than the sum of its parts: de-centered norm dynamics and the governance of plastics », *Environmental Politics*, 29, Routledge, 2020, n° 6, p. 1004-1023, p. 1011.

and significant overlap exists”, blurring “the lines laid out in the existing literature on plastic bags and microbeads”⁶²⁸.

In addition to the state of the art of the current knowledge on plastic bag regulations, a preliminary step to the application of the methodology is to identify the legal frameworks adopted in case-study entities, to regulate plastic bags.

⁶²⁸ LOGES Bastian et JAKOBI Anja P., « Not more than the sum of its parts: de-centered norm dynamics and the governance of plastics », *Environmental Politics*, 29, Routledge, 2020, n° 6, p. 1004-1023, p.1016.

Chapter 2. Temporality of plastic bag regulation adoption

Out of the seven case study countries, all have engaged into the regulation of plastic bags at the source. This statement hides discrepancies in the rhythm and ‘maturity’ of legal texts adopted. Setting this context is a necessary step before diving into their analysis.

Plastic bags, have long been massively distributed in selling outlets and became an icon of plastic pollution. Despite being used and discarded throughout the world, awareness of the potential damages to health and the environment of this new source of pollution was raised and transformed into regulations following different rhythms.

Out of our selection of countries and States, all entities have been engaged towards the regulation of plastic bags in the last twenty years. This observation hides variations on two levels: the year the first regulations were adopted (section 1) and the stability of the approaches through time (section 2).

Section 1) An asymmetric rhythmic in plastic bag regulation adoption

The seven case study countries have adopted plastic bag regulations following different rhythms. Ireland is the first entity of this case-study (and one of the first in the world) to regulate plastic bags, in 2001 (a). More than a decade later, the rhythm of plastic bag regulation adoption hastened. Scotland, France, Senegal, and England adopted such regulations in 2014-2015 (b). Lagging behind, Texas and Florida have initiated a regulation process, still postponed (c).

a. Ireland, an early-bird since 2001

In 1997, Charles Moore, an oceanographer and boat captain, discovers the Great Pacific Garbage Patch⁶²⁹. It is the first known observation of plastic debris imprisoned in an ocean gyre. In total, five plastic gyres, corresponding to the five ocean gyres, have been mapped. This discovery intervenes about four decades the deposit of the Celloplast patent on the “t-shirt”

⁶²⁹ MOORE Charles et PHILLIPS Cassandra, *Plastic Ocean: How a Sea Captain’s Chance Discovery Launched a Determined Quest to Save the Oceans*, New York City, Avery, 2011, 358 p.

plastic bag⁶³⁰, and about two decades after the wide diffusion of plastic bags in supermarkets across the world⁶³¹.

Four years later Moore's discovery, Ireland is this first country of this study and one of the first in the world to regulate plastic bags, in 2001⁶³². Bangladesh is often referred to as the first country in the world to *ban* plastic bags, in 2002⁶³³. Ireland's approach is remarkable for at least two reasons. First, as one of the first countries to regulate plastic bags, the initiative finds its source in national awareness raising rather than international peer pressure. Second, the tax on plastic bags appeared to be particularly popular among the population, as analysed by Convery *et al.* five years after its implementation⁶³⁴. The authors point out that the ring fence of the revenues of the tax in an Environment Fund, the involvement of the main stakeholders and informational campaigns were key in ensuring the acceptability of this tax⁶³⁵.

b. 2014-2015, the mass start

More than ten years after Ireland started taxing plastic bags, the years 2014-2015 witness an acceleration of the adoption of plastic bags regulations in the countries of our study. The figure II.1 represents, for each studied entity, the cumulative number of plastic bag regulations adopted from 2001 to 2022⁶³⁶ and the year of adoption of two international texts encouraging the adoption of plastic bag regulations. The surge of plastic bag regulations in 2014-2015 is clearly visible. The number of adopted texts has near to doubled between 2016 and 2022.

⁶³⁰ United States Patent Office, patent n° 3 180 557, Bag with handle of weldable plastic material, deposited by Sten Gustaf Thulin, Norrköping, Sweden, assignor to Aktiebolaget Celloplast, Norrköping, Sweden. Filed July 10, 1962, Ser. No. 208 879. Patented Apr. 27, 1965. Accessed <https://patents.google.com/patent/US3180557A/en>, on 18/10/2021.

⁶³¹ Plastic bags began to be consistently offered to shoppers in the United States in the 1970s, in the 1980s in Europe and in the 1990s in the rest of the world. CLAPP Jennifer et SWANSTON Linda, « Doing away with plastic shopping bags », *Environmental Politics*, 18, 2009, p. 315-332, p.317.

⁶³² Ireland Statutory Instrument n°36 of 2001, Waste Management (amendment) Act, 17th of July 2001 and Ireland Statutory Instrument No. 605/2001 — Waste Management (Environmental Levy) (Plastic Bag) Regulations, 2001, Given under the Official Seal of the Minister for the Environment and Local Government this 19th day of December 2001.

⁶³³ See for example DA COSTA João Pinto, MOUNEYRAC Catherine, COSTA Mónica *et al.*, « The Role of Legislation, Regulatory Initiatives and Guidelines on the Control of Plastic Pollution », *Frontiers in Environmental Science*, 8, 2020, article 104, p.7; CLAPP Jennifer et SWANSTON Linda, « Doing away with plastic shopping bags », *Environmental Politics*, 18, 2009, p. 315-332, p.325; KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead—What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, Multidisciplinary Digital Publishing Institute, 2018, n° 6, 1994, 24 p., p.8.

⁶³⁴ CONVERY Frank, MCDONNELL Simon et FERREIRA Susana, « The most popular tax in Europe? Lessons from the Irish plastic bags levy », *Environmental and Resource Economics*, 38, 2007, n° 1, p. 1-11, p. 2.

⁶³⁵ *Ibid.*, p. 10.

⁶³⁶ This graph does not represent the total number of in force regulations, as an adopted regulation can repeal another regulation.

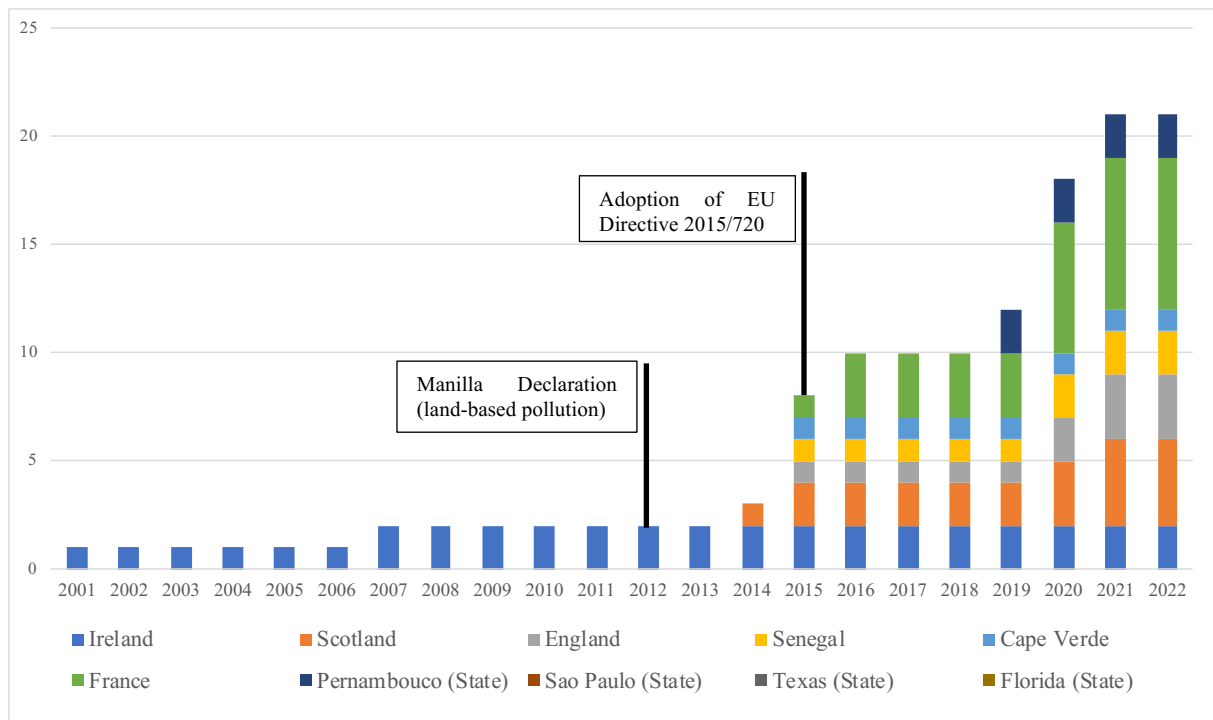


Figure II.1: Cumulative number of plastic bag regulations adopted per entity (2001-2022)⁶³⁷

Interestingly, this regulatory boom is visible on a larger sample of countries. At the global scale, this boom is also present on a figure representing the “estimated number of new regulations on single-use plastics entering into force at the national level worldwide”⁶³⁸. Discriminating data on a Global South-Global North basis, Knoblauch *et al.* show a lag of ten years between a regulatory boom in the Global South and in the Global North. In the Global South the adoption curve becomes steeper around 2005, whereas in the Global North the same phenomenon occurs around 2015⁶³⁹. This observation of an earlier regulatory boom in countries of the South is consistent with the findings of a study focused on African countries bordering the Atlantic Ocean, where the steepening of the adoption curve occurred around 2011⁶⁴⁰. Although scholarship on the diffusion of anti-plastic bag norms provides interesting insights into how and

⁶³⁷ The cumulative number of plastic bag regulations must be distinguished from the number of in force regulations. For example, in Pernambuco, the second regulation adopted in 2019 repeals the first.

⁶³⁸ UNE, « Single-use plastics: A Roadmap for Sustainability », Nairobi, United Nations Environment, 2018, 104p., figure 3.3 p. 25.

⁶³⁹ KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead—What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, Multidisciplinary Digital Publishing Institute, 2018, n° 6, 1994, 24 p., p.8.

⁶⁴⁰ BILLANT Odeline et BONNIN Marie, « Vers l’interdiction des sacs plastique en Afrique atlantique : une analyse numérique en droit de l’environnement », *Mondes en développement*, n° 193, De Boeck Supérieur, 2021, n° 1, p. 7-25, graphique 1, p. 9.

why norms emerge and diffuse across the globe⁶⁴¹, the *when* component is still poorly explored. One of the explanations of the Global South's advance in anti-plastic norm adoption proposed by Knoblauch *et al.*, is that "plastic bag litter is much more visible and harmful due to limited waste collection and recycling rates"⁶⁴². In 2012, the Manila Declaration encourages the adoption of regulations fighting marine litter⁶⁴³.

Regarding the countries studied here, Scotland adopts the Single Use Carrier Bags Charge in 2014.⁶⁴⁴ In 2015, England adopts the Single Use Carrier Bags Charges Order⁶⁴⁵ following a similar approach. In 2015 Senegal⁶⁴⁶, France⁶⁴⁷ and Cape Verde⁶⁴⁸ adopts *loi* and *lei* banning plastic bags. The EU member countries of this study – Ireland, France and the United Kingdom in 2015 – might have been influenced by the adoption, in 2015, of the Directive 2015/720⁶⁴⁹, detailing objectives to achieve in lightweight plastic bag consumption reduction by 2019 and 2025. This directive leaves the Member States free to implement "marketing restriction" (*e.g.*, bans) or economic instruments to achieve these objectives.

The two studied states of Brazil and the United States of America are the four entities left behind the pack of the mass start.

In Brazil, the two studied States are Pernambuco and Sao Paulo. To date, no regulation has been adopted, at the state level, by the State of Sao Paulo⁶⁵⁰. The city of Sao Paulo – with a population

⁶⁴¹ See for example the literature review proposed by SHIPTON Leah et DAUVERGNE Peter, « Health concerns of plastics: energizing the global diffusion of anti-plastic norms », *Journal of Environmental Planning and Management*, September 2021, p. 1-21.

⁶⁴² KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead—What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, Multidisciplinary Digital Publishing Institute, 2018, n° 6, 1994, 24 p., p.15.

⁶⁴³ Recital 5, Manila Declaration on Furthering the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, signed on 26 January 2012 by the representatives of 65 governments and the European Union.

⁶⁴⁴ Statutory Instrument No. 161 of 2014, The Single Use Carrier Bags Charge (Scotland) Regulations, 3rd June 2014.

⁶⁴⁵ Statutory Instrument No. 776 of 2015, The Single Use Carrier Bags Charges (England) Order 2015, 19th of March 2015.

⁶⁴⁶ Loi n° 2015-09 du 04 mai 2015 relative à l'interdiction de la production, de l'importation, de la détention, de la distribution, de l'utilisation de sachets plastiques de faible micronnage et à la gestion rationnelle des déchets plastiques, JO n°6859 du samedi 04 juillet 2015.

⁶⁴⁷ Loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte, JORF n°189 du 18/08/2015.

⁶⁴⁸ Cape Verde, *Lei* n°99/VIII/2015 de 27 de Agosto, BO n°51 du 27/08/2015 pp. 1600-1603.

⁶⁴⁹ Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags (Text with EEA relevance) Official Journal L 115, 06/05/2015 p. 11-15.

⁶⁵⁰

greater than Senegal - has nonetheless adopted a law and a decree regulating plastic bags respectively in 2011 (*Lei* No 15.374 de 18 de Maio de 2011) and a decree (*Decreto* nº 55.827 de 6 de Janeiro de 2015). The municipal level of regulation is excluded from this study, for time reasons. Thus, these regulations do not appear in this study. In the Brazilian State of Pernambuco, article 160 of the *lei* nº16559 of 2019⁶⁵¹ introduced the obligation for supermarkets to propose a preferential checkout service for customers bringing reusable plastic bags. Less than a year after, article 2 of the *lei* nº16758 of 2019⁶⁵² revoked that article without providing explanations. The city of Recife has also adopted a regulation in 2008⁶⁵³, and another in 2011⁶⁵⁴. The municipal level of regulation is excluded from this study, for time reasons. Thus, these regulations do not appear in this study.

c. Non-achieved regulations, a Texas and Florida specificity

In the United States of America (USA), two States are concerned by this study: Texas and Florida. Plastic bag bills have been initiated in 2011⁶⁵⁵ for Texas and 2019⁶⁵⁶ for Florida, but none of these regulations were adopted, nor rejected. The procedure is currently postponed, unclear as to whether or when it will be continued.

Therefore, Texas and Florida are the two entities of this study which have initiated but not achieved the publication of a legal text restraining the availability of plastic bags⁶⁵⁷ - neither adopted nor rejected, the texts are rather postponed. The texts drafted in Florida and Texas were

⁶⁵¹ Above mentioned.

⁶⁵² Lei Nº 16758 de 18/12/2019, Altera a Lei no 16.559, de 15 de janeiro de 2019, que institui o Código Estadual de Defesa do Consumidor de Pernambuco, de autoria do Deputado Rodrigo Novaes, a fim de aperfeiçoar dispositivos desta Lei, publicado no DOE - PE em 19 dez 2019.

⁶⁵³ Lei no 17.475/2008 Dispõe sobre as sacolas e sacos plásticos utilizados pelos estabelecimentos comerciais e órgãos municipais no âmbito do município do Recife.

⁶⁵⁴ Lei no 17.733/2011. Obriga os hipermercados, supermercados, mercados e estabelecimentos congêneres a disponibilizar caixa preferencial aos consumidores que utilizarem sacolas retornáveis.

⁶⁵⁵ A bill to be entitled an Act relating to the imposition of a fee for certain plastic bags provided to customers by retailers to fund a grant program to support local recycling efforts. H.B. No.1877.

⁶⁵⁶ A bill to be entitled an Act relating to the prohibition of plastic carryout bags and straws; creating s. 509.235, F.S.; defining terms; prohibiting a store or food service business from providing to a customer a carryout bag made of plastic film; prohibiting a food service business from selling or providing to a customer a single-use plastic straw; providing an exception; providing penalties; providing an effective date.

⁶⁵⁷ Reminder: only two States in the USA are analysed here, Texas and Florida. California has the reputation to be a leading State on environmental matters. It became the first USA State “to enact legislation imposing a statewide ban on single-use plastic bags at large retail stores” in 2014. Since, seven other States have banned single-use plastic bags: Connecticut, Delaware, Hawaii, Maine, New York, Oregon and Vermont. Source: National Conference of State Legislatures <https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx>.

abandoned during the legislative process. It is unclear as to whether or when the procedure will be continued.

In Texas, the Bill 1877 filed on the 28th of February 2011⁶⁵⁸ was never discussed in House Committee. Even though this bill considered the taxation of plastic bags rather than their ban, the underlying motive was to support recycling efforts and the protection of the environment. This bill was drafted three years before California enacted a state-wide ban of plastic bags in retail stores. Even though this bill has been abandoned early in the process, it shows that plastic bags pollution was already a concern in Texas in 2011, relatively early compared to other entities of the Global North. Reasons of the abandon of this text have not been found.

In Florida, the bill SB40 has been filed by the State Senate on the 2nd of August 2019⁶⁵⁹. During the same month, it was referred to Commerce and Tourism and to Community Affairs. The Bill was “indefinitely postponed and withdrawn from consideration” on the 14th of March 2020, dead “in Commerce and Tourism Senate Committee”. The reasons of the abandon of this text have not been found.

Interestingly, both States in parallel pre-empted local authorities or municipalities to adopt any text regulating the availability of plastic bags locally. While at the State level the effort to regulate plastic bags isn't successfully completed, local authorities are stymied in their own initiatives. Different legal processes have been set up to do so.

First, both states drafted or adopted a bill directly pre-empting local plastic bag regulation.

In Florida, the Energy, Climate Change and Economic Security Act of 2008 creating Florida statute section 403 7033, requires the Department of Environment Protection to issue a report analysing “the need for new or different regulation of auxiliary containers, wrappings, or disposable plastic bags used by consumers to carry products from retail establishments”, by February 1st, 2010. This report should inform the necessity of “both state-wide and local regulations of these materials”. This report is requested by the Florida Legislature, concerned

⁶⁵⁸ Texas House Bill 1877, A bill to be entitled an Act relating to the imposition of a fee for certain plastic bags provided to customers by retailers to fund a grant program to support local recycling efforts. Bill history accessed <https://capitol.texas.gov/BillLookup/History.aspx?LegSess=82R&Bill=HB1877>, on 19/10/2021.

⁶⁵⁹ Florida Senate Bill 40, A bill to be entitled an Act relating to the prohibition of plastic carryout bags and straws; creating s. 509.235, F.S.; defining terms; prohibiting a store or food service business from providing to a customer a carryout bag made of plastic film; prohibiting a food service business from selling or providing to a customer a single-use plastic straw; providing an exception; providing penalties; providing an effective date. Bill history accessed <https://www.flsenate.gov/Session/Bill/2020/40/?Tab=BillHistory>, on 19/10/2021.

that “prudent regulation of recyclable materials is crucial to the ongoing welfare of Florida's ecology and economy”. The State Legislature will then decide whether to adopt a state-wide regulation of plastic bags and other single use items. Until then, “no local government, local governmental agency, or state government agency may enact any rule, regulation, or ordinance regarding use, disposition, sale, prohibition, restriction, or tax of (...) disposable plastic bags”⁶⁶⁰. The published report highlights the environmental and health risks associated with unmanaged plastic bags, while highlighting the limited impact of local regulations and stressing the need for and benefits of state level regulation⁶⁶¹. To date, the Legislature didn't follow the recommendations of this report. A bill considering the deletion of the “pre-emption of local law relating to the disposable plastic bags” filed on the 23rd of August 2019 was indefinitely postponed and withdrawn from consideration on the 14th of March 2020⁶⁶², for unknown reasons. An updated version of the Department of Environment Protection report, published in December 2021 recommend the adoption of “some form of state-wide action or lifting the stay of local government enactment” to regulate the consumption of single use plastics⁶⁶³.

In Texas, the “Shopping Bag Freedom Act” was filed in March 2013 as House Bill 2416. Section 2 intended to amend the Business and Commerce Code, to protect the right, for a business, to “provide to the customer at the point of sale a bag, package or other container made from any material”⁶⁶⁴. This bill nevertheless never made it to house floor, after its discussion in House committee on Urban Affairs in May 2013.

⁶⁶⁰ 2008 Florida Statutes, Title XXIX Public Health, Chapter 403 Environmental Control, Section 7033 Departmental analysis of particular recyclable materials. Accessed <https://www.flsenate.gov/Laws/Statutes/2008/403.7033>, on 19/10/2021.

⁶⁶¹ FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, « Retail Bags Report », Tallahassee, Florida Department of Environmental Protection, 2010.

⁶⁶² Florida Senate Bill 182, A Bill to be entitled an Act relating to the preemption of recyclable and polystyrene materials; amending s. 403.7033, F.S.; deleting preemptions of local law relating to the regulation of auxiliary containers, wrappings, or disposable plastic bags; amending s. 500.90, F.S.; repealing the preemption of local laws regarding the use or sale of polystyrene products to the Department of Agriculture and Consumer Services; providing an effective date. Bill history accessed <https://www.flsenate.gov/Session/Bill/2020/182/?Tab=BillText>, on 19/10/2020.

⁶⁶³ FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, « Update of the 2010 retail bags report », Tallahassee, Florida Department of Environmental Protection, 2021. p. 9.

⁶⁶⁴ Texas House Bill 2416, a Bill to be entitled an Act relating to the provision of bags to customers of a business at the point of sale. Bill history accessed <https://capitol.texas.gov/BillLookup/BillStages.aspx?LegSess=83R&Bill=HB2416>, on 19/10/2021.

Second, cities in Florida and Texas which have adopted local plastic bag regulations have both been sued in front of State Courts. Twice, the State Courts issued decisions striking down the cities' ordinance⁶⁶⁵.

Florida and Texas are the two case study states for the United States. As neither have adopted state-wide bag regulations, it will not be possible to test the methodology on these states. Out of the fifty states of the United States, nine have adopted state-wide bag laws, twelve states have locally adopted bag laws that aren't pre-empted, one has a state pre-emption on bans only and state pre-emption with no state-wide regulation occurs in seventeen states. This leaves twelve states with neither state-wide bag regulations, nor state pre-emption⁶⁶⁶.

In a nutshell, out of the ten entities studied here, six currently have in force plastic regulations, which have been mostly adopted around 2014-2015: Ireland (2001), Scotland (2014), Cape Verde (2015), England (2015), France (2015) and Senegal (2015) repealed by another text adopted in 2020). One entity, Pernambuco, adopted a regulation in 2019, and repealed it the same year. Three entities have currently no state-wide regulation of plastic bags (Sao Paulo, Texas, Florida). As such, these three states are driven out of the case study. The legal approach developed by the State of Pernambuco to plastic bag regulation will be quickly overviewed rather than deeply analysed, as it the text is no longer in force. The second aspect on which case study countries differ is the stability of their approaches through time.

The relational database's input

The year of adoption and status of each text is directly searchable in the database. This information is therefore easily accessible and exportable.

⁶⁶⁵ See for Texas: Supreme Court of Texas, *City of Laredo, Texas, v. Laredo Merchants Association*, no 16-0748, January 11th, 2018. Accessed <https://www.txcourts.gov/media/1441865/160748.pdf>, on 19/10/2021. See for Florida: Florida Third District Court of Appeal, *Florida Retail Federation, Inc., et al., vs. The City of Coral Gables, Florida*, August 14 2019, accessed https://www.3dca.flcourts.org/pre_opinion_content_download/596159, on 19/10/2021.

⁶⁶⁶ Last updated 13/02/2021. Plastic bag law fact sheets, <https://plasticbaglaws.org>, accessed 19/10/2021.

Section 3) A relative stability of plastic bag regulations over time

Intrinsically, law making seeks to influence human behaviour and the society's organisation. As such, legal rules may be called upon to evolve through time, to better fit shifting social and economic realities or progress in scientific knowledge. The relative stability observed here may be explained by the recent character of the analysed regulations.

Out of the ten studied entities, seven have adopted plastic bag regulations; out of these seven entities, all but one⁶⁶⁷ have, at least slightly, amended their initial plastic bag regulation to modify certain aspects. The magnitude and focus of these changes nonetheless greatly differ from an entity to another.

Four entities went through slight modifications of their plastic bag regulation since the adoption of their first legal text (Ireland, Scotland, France and England), although the reasons differ.

Ireland is the first country to make adjustments to its plastic bag policy, in 2007, through the adoption of the Statutory Instrument n°167 of 2007⁶⁶⁸. Article 4 raises the amount of the tax provided for in Statutory Instrument n°36 of 2001 from 15 pence to 22 pence. The underlying reasons of this amount change are not explicated in the document. England also raised the minimum amount for the obligation to charge from 5 pence to 10 pence in 2021⁶⁶⁹. This plastic bag obligation to charge was intended to cease to have effect on the 5th of October 2022⁶⁷⁰. Article 3 of the England Statutory Instrument n°598 provides for an extension of the regulation beyond this date⁶⁷¹.

Adjustments can also be made to complement the initial text by, for example, precisising enforcement means or modifying the material scope of the regulation. These are the underlying purposes of the adjustments made in 2015 in Scotland and 2020 in France. In Scotland, the

⁶⁶⁷ Cape Verde is the only country of this study with no observed modification of its regulation of plastic bags. Neither the States of Sao Paulo, Texas nor Florida have adopted a text regulating plastic bags.

⁶⁶⁸ Ireland, Statutory Instrument No. 167/2007 — Waste Management (Environmental Levy) (Plastic Bag) (Amendment) (No. 2) Regulations 2007, published in “Iris Oifigiúil” of 27th April, 2007.

⁶⁶⁹ Statutory Instrument no. 598 of 2021, The Single Use Carrier Bags Charges (England) (Amendment) Order 2021, adopted on May 20th 2021.

⁶⁷⁰ Article 1, England Statutory Instrument No. 776 of 2015, above mentioned.

⁶⁷¹ Article 3, England Statutory Instrument No. 598 of 2021, The Single Use Carrier Bags Charges (England) (Amendment) Order 2021, adopted on May 20th, 2021.

Regulation n°159 of 2015⁶⁷² clarifies the enforcement means of Regulation n°161 of 2014⁶⁷³ at regulations 2, 3 and 4. Regulation 5 restricts the material scope of the regulation n°161 of 2014 by providing for exceptions to plastic bags' obligation to charge "where a person's liberty may be restricted"⁶⁷⁴, *i.e.*, in a prison, hospital or secure accommodation "where the bag is necessary for reasons of security, good order, discipline or safety". In France, the *loi* n°2020-105⁶⁷⁵ provides for enforcement means (sanctions) and an enlargement of the material scope. The existing ban on the distribution of lightweight bags is extended to the "import and manufacture for the purpose of making available on the national territory, as well as the transfer to natural and legal persons established on the national territory"⁶⁷⁶. The newly provided for sanctions apply to the distribution, the import, the manufacture or the transfer of these bags.

Last, England and Scotland temporarily restricted the material scope of their plastic bag regulation during the Covid-19 pandemic, to exempt from obligation to charge bags used for grocery deliveries. In England, this temporary exception is provided for by regulation 3 of the Statutory Instrument n°324 of 2020⁶⁷⁷ from March 21st to September 21st, 2020. In Scotland, this temporary exception is provided for by regulation 2 of the Statutory Instrument n°118 of 2020⁶⁷⁸, until October 3rd, 2020. Scotland then extends this exception to May 31st, 2021⁶⁷⁹.

These slight modifications highlight that law is not set in stone, but rather a living material in capacity to adapt to evolving economic, social and political realities either temporarily (such as the Covid exemption in England and Scotland) or in the longer run.

Brazil and Senegal undertook greater modifications, in answer to another aspect of the evolution of environmental law.

⁶⁷² The Single Use Carrier Bags Charge (Fixed Penalty Notices and Amendment) (Scotland) Regulations 2015 no 159 adopted on March 31st, 2015.

⁶⁷³ Above mentioned.

⁶⁷⁴ Explanatory note of Regulation n°159 of 2015.

⁶⁷⁵ *LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire (1)*, *JORF n°0035 du 11 février 2020*.

⁶⁷⁶ Art. 77, *Loi n°2020-105 above mentioned*. « A compter du 1er janvier 2021, sont également interdites l'importation et la fabrication à des fins de mise à disposition sur le territoire national ainsi que la cession auprès de personnes physiques et morales établies sur le territoire national, des sacs en plastique à usage unique mentionnés aux 1° et 2° du présent II. »

⁶⁷⁷ Statutory Instrument No. 324 of 2020, The Single Use Carrier Bags Charges (England) (Amendment) 2020, adopted on March 20th, 2020.

⁶⁷⁸ The Single Use Carrier Bags Charge (Scotland) Amendment Regulations 2020 no. 118, adopted on April 1st, 2020.

⁶⁷⁹ Article 2, The Single Use Carrier Bags Charge (Coronavirus) (Scotland) Amendment Regulations 2021 no. 53, adopted on January 28th, 2021.

In the Brazilian State of Pernambuco, article 160 of the *lei* n°16559 of 2019⁶⁸⁰ introduced the obligation for supermarkets to propose a preferential checkout service for customers bringing reusable plastic bags. Less than a year after, article 2 of the *lei* n°16758 of 2019⁶⁸¹ revoked that article without providing explanations. To date, there are no federated state level legislations concerning plastic bags in the two Brazilian states of this study, Pernambuco and Sao Paulo. Therefore, these two states will not be studied further in this section.

Senegal is the only country of this study which has deeply revamped its approach to tackle plastic bag pollution. In 2015, Senegal banned plastic bags thinner than 30 microns⁶⁸² and established a tax for plastic bags thicker than 30 microns⁶⁸³. In 2020 Senegalese legislators revoked the 2015 *loi*⁶⁸⁴ to adopt a different approach. Plastic bags are no longer defined along thickness criteria, but as to where (checkout or retail outlets) they are available⁶⁸⁵. Additionally, taxation is abandoned, replaced by the ban of some types of plastic bags⁶⁸⁶ and the establishment of standards or permit obtention procedures for others⁶⁸⁷.

The process of law creation, from the regulation's draft to its enforcement, is a lengthy process⁶⁸⁸. It can be years between the first draft of the text and its full enforcement, as texts can prescribe enforcement delays⁶⁸⁹. Hindsight might also be required to examine the effects of a given legislation and imagine alternative solutions to correct lags or perverse effects.

⁶⁸⁰ Above mentioned.

⁶⁸¹ Lei N° 16758 de 18/12/2019, Altera a Lei no 16.559, de 15 de janeiro de 2019, que institui o Código Estadual de Defesa do Consumidor de Pernambuco, de autoria do Deputado Rodrigo Novaes, a fim de aperfeiçoar dispositivos desta Lei, publicado no DOE - PE em 19 dez 2019.

⁶⁸² Article 2, *Loi* n°2015-09, above mentioned.

⁶⁸³ Article 3, *Loi* n°2015-09, above mentioned.

⁶⁸⁴ *Loi n°2020-04 du 08 janvier 2020 relative à la prévention et à la réduction de l'incidence sur l'environnement des produits plastiques, publiée dans le Journal officiel du Sénégal n°7206 du 20/01/2020, art. 40.*

⁶⁸⁵ Article 3 and 5, *Loi* n°2020-04 above mentioned.

⁶⁸⁶ Article 5, *Loi* n°2020-04 above mentioned.

⁶⁸⁷ Article 3 and 5, *Loi* n°2020-04 above mentioned.

⁶⁸⁸ According to Convery *et al.*, "The possibility of an Irish plastic bag levy was discussed initially in 1994, but it was not until 1999 that Mr. Noel Dempsey the then Minister for Environment and Local Government, commissioned a report to explore the different options". The Irish plastic bag levy was adopted in December 2001. CONVERY Frank, MCDONNELL Simon et FERREIRA Susana, « The most popular tax in Europe? Lessons from the Irish plastic bags levy », *Environmental and Resource Economics*, 38, 2007, n° 1, p. 1-11, p. 6.

⁶⁸⁹ As far as plastic bag regulation is concerned, three case-study countries provide for enforcement delays: Cape Verde, France and Ireland. The delays range from three months in Ireland (Ireland Statutory Instrument No. 605 of 2001, above mentioned) to 17 months in Cape Verde (article 3, Cape Verde *lei* n°99/VIII, above mentioned). See Title 3, A., 2), a. Policy instrument choice and design for more on enforcement delays.

In addition, stability, or temporal inertia, is a core attribute of law as “one primary purpose of law is to provide stable rules that do not change over a period of time”⁶⁹⁰.

Most legislations analysed here are relatively recent in this time frame. Ireland’s 2001 statutory instrument is the only one to be more than six years old at the time these lines are written.

The relational database’s input

A built-in feature of the database enables to relate the legal texts or articles through relations such as ‘implements’, ‘amends’, ‘repeals’. This architecture enables to easily identify the relationships between these elements and to follow up on modifications made to an initial approach.

Conclusion of Title 1

The state of the art enables to better picture the current research on plastic bag regulations, and its main caveats. First, none of these initiatives offer a holistic analysis of plastic bag regulations, through an analysis of its components (*i.e.* object, instrument, control, sanction) in interaction with each other. Second, the potential of protection of these legal frameworks is also left aside. The application of the designed methodology to the analysis of plastic bag regulations could address both issues. In addition, an analysis of the legal frameworks’ potential of protection could usefully inform analyses of the effectiveness of these regulations, by pre-identifying weak spots.

In other words, this work’s aim is to contribute to an enlargement of knowledge on the means provided by the regulation (the *how*), to dive deeper into the analysis of plastic bag regulation complexity and potential for protection.. Policy instruments will be analysed, in interaction with other constituents of the *regulation*: *e.g.*, the definitions of the objects of the rule, the existence and type of sanctions or of controls. The overarching aim is twofold: showcase the diversity of approaches to regulate plastic bags through a thorough analysis of legal texts, backed by quantitative analyses, and contribute to the reflexion on how well current law works from a legal perspective, by analysing potential loopholes in the regulation of the six case-studies.

The relatively recent character of plastic bag regulations and their relative stability facilitate the test of the methodology on this key question.

⁶⁹⁰ KHAN Liaquat Ali, « Temporality of Law », *McGeorge Law Review*, 40, 2009, n° 1, p. 55-106, p. 81.

Title 2. A disunited plastic bag regulation: diversity and complexity insights

The shared adoption of legal texts regulating plastic bags in the case study countries hides an important diversity of legal techniques, settings and strategies to do so, even though the regulatory objective seems shared across jurisdictions. This first set of results emphasizes the diversity and complexity of country or state regulations of a same source of pollution, questioning countries' ability to join forces. Whereas the qualitative description of plastic bag regulations in the case studies offer a thorough analysis of the diversity and complexity of plastic bag regulations (Chapter 1), the application of numerical methods to harness complexity casts complementary comparative lights (Chapter 2).

Chapter 1. A textual analysis: diving into the diversity and complexity of plastic bag regulations

The textual analysis of plastic bag regulation provides a qualitative perspective on the rules adopted by the case-study entities. The legal regime shaped by the body of rules by which law addresses the plastic bag issue is composed of three pillars: how will plastic bags be regulated (section 1), which plastic bags and behaviours will be regulated (section 2), and how will the regulation be enforced (section 3). The first two relate to the study of comprehensiveness, and the third to forcefulness. Across pillars and borders, the common point lies in the diversity of legal regimes designed to address a common source of pollution.

Section 1) The type of policy instrument: starting point of divergence

The core of a legal regime is composed of the selected policy instrument and their scope of action. First, the types of instruments chosen provide an insight into plastic bag regulation strategies. Our relatively small sample of countries present a diversity of instruments to regulate plastic bags. Three groups emerge: command-and-control (a), “economic incentive” (b) and “command, educate and incentive” (c).

a. *'Command-and-control': a civil law perspective?*

“Command-and-control” refers to a type of binding instrument leaving a very shallow leeway for actors’ adaptation⁶⁹¹. The flagship instrument of this category is the ban, but the introduction of permits answer to the same logic. In our sample, three countries have based their strategy to fight plastic pollution on the ban of some plastic bags (France, Senegal and Cape Verde) and two on the allocation of permits (Senegal and Cape Verde).

In Senegal, since 2020, plastic bags are banned at supermarket checkouts⁶⁹². Two categories of bags are excluded from this ban: bags found at retail outlets⁶⁹³ and bags made of a material “designed in such a way that it is not easy for the consumer to replace the component or components”⁶⁹⁴.

In France, plastic bags were banned progressively. Since January 1st 2016, the distribution of non-reusable plastic bags at supermarket checkouts is forbidden⁶⁹⁵. Non-reusable plastic bags used to pack fruit and vegetables for instance were still authorised until January 1st 2017, when the distribution of any non-reusable or non-compostable plastic bags became forbidden⁶⁹⁶. Additionally, the production, distribution, commercialisation and utilisation of oxo-fragmentable bags is forbidden since the commencement of the 2015 *loi*⁶⁹⁷.

⁶⁹¹ BÖCHER Michael, « A theoretical framework for explaining the choice of instruments in environmental policy », *Forest Policy and Economics*, 16, Elsevier, 2012, n° C, p. 14-22.

⁶⁹² Checkout bags defined as “a bag supplied to consumers at the point of sale of goods or products and which is intended for the transport of said goods or products”. In the text « *sac fourni aux consommateurs dans les points de vente des marchandises ou des produits et qui sont destinés au transport desdits produits ou desdites marchandises* », article 3, Senegal *loi* n°2020-04, above mentioned.

⁶⁹³ Retail bags defined as “plastic bags intended and used at retails to package foodstuffs in order to protect them, to allow their handling or transport from the producer or seller to the consumer, and to ensure their presentation.”. Translated. In the text: « *sacs plastiques destinés et utilisés dans les points de vente pour emballer des denrées alimentaires afin de les protéger, de permettre leur manutention ou leur acheminement du producteur ou du vendeur au consommateur, et d’assurer leur présentation* ». Article 5, Senegal *loi* n°2020-04, above mentioned.

⁶⁹⁴ Translated. In the text: « *Sont exclus du champ d’application de la présente loi, les produits dont un ou plusieurs composants sont des produits constitués ou fabriqués à partir de matières plastiques à condition que le produit principal soit conçu de manière à ne pas permettre facilement le remplacement du ou des composants par le consommateur.* », Article 2, Senegal *loi* n°2020-04, above mentioned.

⁶⁹⁵ « *sacs de caisse en matières plastiques à usage unique destinés à l’emballage de marchandises au point de vente* », France, article 75 of *loi* n°2015-992 above mentioned.

⁶⁹⁶ « *sacs en matières plastiques à usage unique destinés à l’emballage de marchandises au point de vente autres que les sacs de caisse, sauf pour les sacs compostables en compostage domestique et constitués, pour tout ou partie, de matières biosourcées* », France, article 75 of *loi* n°2015-992 above mentioned.

⁶⁹⁷ France, article 75 of *loi* n°2015-992 above mentioned. See Title 3, A., c. Biodegradable bags: an environmental deadlock? for a discussion of the risks associated with the recourse to these bags.

In Cape Verde the *lei* bans the production and importation of ‘conventional’ plastic bags⁶⁹⁸ since July 1st 2016⁶⁹⁹. The ban of the commercialisation and utilisation of these same bags entered into force six months later, on January 1st 2017.

Permits are other instruments by which countries can directly influence the availability and characteristics of plastic bags nationally, without leaving any leeway to consumers. For example, in Senegal the importation of plastic bags requires the obtention of a permit delivered by the Minister in charge of the Environment⁷⁰⁰. In Cape Verde, the production and importation of plastic bags – be they conventional or biodegradable - also require the obtention of a permit, delivered by the central environmental agency⁷⁰¹.

The sample of countries analysed here is too small to draw conclusions on the types of country preferring bans to other regulation instruments. We can nonetheless observe that all the countries of the sample related to the civil law tradition that have adopted plastic bag regulations opted for this approach. This doesn’t mean that all civil law countries choose to ban rather than tax, neither that all entities that have banned plastic bags belong to the civil law traditions. Many counter examples exist for both affirmations. As such, California bans plastic bags since 2014 and Bangladesh was the first country to ban plastic bags in 2002⁷⁰².

Another characteristic can be observed here. Two thirds of the countries of our sample choosing the ban as a tool to regulate plastic bags are usually classified as developing countries. This result is consistent with the results of a much broader study. Comparing the diffusion of plastic bag policies in the Global North and Global South, Knoblauch et al. observe that “out of the 51 countries and states that have to date adopted plastic bag bans, 36 (70.6%) are located in the Global South. (...) Regarding countries that have adopted a tax on plastic bags only 11 (or 28.2%) out of 39 are located in the Global South”⁷⁰³. Therefore, it appears that in the analysed

⁶⁹⁸ ‘Conventional plastic bags’ are defined as “polyethylene bags (chemically formulated (- CH₂ -CH₂-n high density (HDPE) and low density (LDPE)) which are used for the packaging of products purchased in retail outlets”. Translated: “ *os sacos de polietileno (de fórmula química (- CH₂ -CH₂-n de alta densidade (PEAD) e de baixa densidade (PEBD) que têm a fi nalidade de acondicionamento de produtos adquiridos em estabelecimentos comerciais de venda ao público* », article 3, Cape Verde 2015 *lei* n°99/VIII.

⁶⁹⁹ Article 5, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷⁰⁰ Article 5, Senegal *loi* n°2020-04 , above mentioned.

⁷⁰¹ Article 8, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷⁰² See Title 1 A freeze-frame.

⁷⁰³ KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead—What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, Multidisciplinary Digital Publishing Institute, 2018, n° 6, pp. 1994-2018, p. 1997.

case study, bans of plastic bags are more commonly adopted in the Global South and in civil law countries, to the contrary to economic incentives.

b. 'Economic incentive': a common law perspective?

In three entities, the regulation of plastic bags relies exclusively on economic incentives: Ireland, England and Scotland. The approaches of these three entities are close but nonetheless differentiated.

In Ireland, the imposition of a levy for the commercialisation or distribution of plastic bags commenced on March 4th, 2002. Numerous exceptions to this rule are listed in the article 5 of the 2001 Statutory Act⁷⁰⁴.

Although similar exceptions can be found in the Scottish⁷⁰⁵ and English⁷⁰⁶ regulations, the imposed economic instrument is different. In both entities, suppliers (or sellers) must charge

⁷⁰⁴ For a detailed analysis of exceptions, see 2) c., Driving the exception: the use of plastic bags.

⁷⁰⁵ Types of bags excluded from the obligation to charge in Scotland: “1. A single use carrier bag is used for a purpose described in this paragraph if it is—(a) used solely to contain—(i) unpackaged food or feed for human or animal consumption; (ii) unpackaged loose seeds, bulbs, corms or rhizomes; (iii) unpackaged goods contaminated by soil ;or (iv) an unpackaged axe, knife or blade; (b) used solely to contain— (i) a medicinal product, a listed appliance, or any other appliance sold or supplied in accordance with a prescription; or (ii) pharmacy medicine; (c) used solely to contain packaged uncooked fish or fish products, uncooked meat or meat products or uncooked poultry or poultry products, that has a gusset not more than 125 millimetres wide, and is not more than— (i) 205 millimetres wide; or (ii) 458 millimetres high (including any handle); (d) used solely to contain live aquatic creatures in water; (e) used to contain a purchase made on board a ship, train, aircraft, coach or bus; (f) used to contain a purchase made in an aerodrome security restricted area; (g) a mail order dispatch or courier bag; or (h) a gusseted liner used to line or cover a box”, Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁰⁶ Types of bags excluded from the obligation to charge in England:

“2.—(1) The following are excluded bags—(a) Unwrapped food bag: A bag intended to be used solely to contain wholly or partly unwrapped food for human or animal consumption. (b) Unwrapped loose seeds bag: A bag intended to be used solely to contain wholly or partly unwrapped loose seeds, bulbs, corns, rhizomes, flowers or goods contaminated by soil. (c) Unwrapped blades bag: A bag intended to be used solely to contain wholly or partly unwrapped axes, knives, knife blades or razor blades. (d) Prescription-only medicine bag: A bag intended to be used solely to contain a prescription-only medicine, a pharmacy medicine or a listed appliance sold in accordance with a prescription issued by a doctor, dentist, supplementary prescriber, nurse independent prescriber, independent nurse prescriber, optometrist independent prescriber, pharmacist independent prescriber or EEA health professional. (e) Uncooked meat food bag: A bag intended to be used solely to contain uncooked fish or fish products, meat or meat products or poultry or poultry products. (f) Live aquatic creatures bag: A bag intended to be used solely to contain live aquatic creatures in water. (g) Returnable multiple reuse bag: A bag which is sold for an amount not less than the minimum amount specified in article 3 and which— (i) is intended to be returnable to the seller from whom it was purchased to be replaced free of charge; (ii) is made from material the thickness of which is not less than 50 microns but not greater than 70 microns; and (iii) disregarding the width of any gussets, or the height of any handles extending above the main body of the bag— (aa) has a width and height greater (in each case) than 404 mm; and (bb) has a width or height greater (in either case) than 439 mm. (h) Woven plastic bag: A bag the material of which is made by interlacing long threads passing in one direction with others at a right angle to them. (i) Transit goods bag: A bag which is intended to be used to carry goods in a transit place.” Statute 2, England 2015 Statutory Instrument n°776, above mentioned.

the supply of new plastic bags to customers⁷⁰⁷. The benefits of this charge return to the sellers, to the contrary to Ireland, where the charge is returned to the Revenue Commission. In Ireland, some plastic bags are exempt from the levy but are subject to an obligation to charge⁷⁰⁸.

The amount paid is variable from a country to another. In Ireland, the amount of the levy was initially set at 15 cents in 2001⁷⁰⁹, then increased to 22 cents in 2007 in answer to the observation of a rise in the consumption of plastic bags⁷¹⁰. The obligation to charge for reusable bags is set at a minimum of 70 cents⁷¹¹. In Scotland, the minimum amount of the charge for a new single use plastic bag is set at 5 pence⁷¹², just like in England⁷¹³ until 2021, when it was raised to 10 pence⁷¹⁴. Sellers may charge a greater amount. Apart from the amount of the charge which is different in Ireland on the one hand and England and Scotland on the other, the main difference here is that the revenues are collected by a governmental body in Ireland, whereas in England and Scotland profits are kept by the sellers⁷¹⁵.

Therefore, the case studies which are also Member States of the European Union – *i.e.*, France, Ireland and the United Kingdom prior to Brexit – have adopted differentiated approaches to the regulation of plastic bags through the design of dissimilar policy instruments. This flexibility is enabled by the Directive 2015/720 which leaves the Member States free to implement “marketing restriction” (*e.g.*, bans) or economic instruments to achieve the objectives it defines⁷¹⁶.

Strikingly here, only common law countries have chosen economic incentives as a flagship instrument of their strategy to regulate plastic bags. This result should be tempered by the fact that both Cape Verde and Senegal, at some point, relied on economic incentives. In Senegal, plastic bags thicker than 30 microns used to be charged in the first law regulating plastic bags⁷¹⁷.

⁷⁰⁷ See for Scotland the Regulation 6, Scotland 2014 Statutory Instrument n°161, above mentioned; see for England article 3, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁰⁸ Article 5, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁰⁹ Article 3, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷¹⁰ Article 4, Statutory Instrument. No. 167/2007 — Waste Management (Environmental Levy) (Plastic Bag) (Amendment) (No. 2) Regulations 2007, published in “*Iris Oifigiúil*” of 27th April, 2007.

⁷¹¹ Article 5, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷¹² Regulation 6, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷¹³ Article 3, England 2015 Statutory Instrument n°776, above mentioned.

⁷¹⁴ Article 5, England 2021 Statutory Instrument n°596, above mentioned.

⁷¹⁵ In England, sellers are encouraged to donate the collection funds to charities, although it is not an obligation.

⁷¹⁶ Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags, above mentioned, article 1 (2).

⁷¹⁷ Article 3, Senegal *loi* n°2015-09, above mentioned.

Facing enforcement issues, this instrument has been abandoned in 2020. In Cape Verde, the obligation to charge has been used as a transition-instrument towards the ban of plastic bags⁷¹⁸. The regulation strategy implemented by Cape Verde to curb plastic bag pollution is specific enough to deserve a separate analysis.

c. *'Command, educate and incentive': a Cape Verdean melody*

The originality of the Cape Verdean approach lies in the combination of three types of instruments: command-type, education-based and economic incentives. These three types of instruments are used for different purposes, in a symbiotic perspective.

First, economic and command and control instruments are articulated in a timely manner. As of July 1st, 2016⁷¹⁹, the production and importation of “conventional” plastic bags is banned. These “conventional” plastic bags can nevertheless be commercialised and used for 6 more months, until January 1st, 2017⁷²⁰. In the meantime, the bags cannot be distributed free of charge, and the maximum amount is fixed by the Ministry in charge of the Environment⁷²¹. The underlying idea is to make people understand that using plastic bags has a cost that was previously invisible, and to progressively incentive reuse or alternatives to plastic. In addition, meanwhile, the Ministry in charge of the Environment conditions the production and import of plastic bags upon the obtention of a permit, allowing to impose specific characteristics for conventional and biodegradable bags⁷²².

The Cape Verdean *lei* also relies on softer policy instruments such as education, awareness raising, and funding.

Environmental associations are encouraged to “develop active consumer awareness campaigns on the importance of reducing consumption of conventional plastic bags, including through the reuse and use of recycled bags and/or bags with lower impacts on the environment”⁷²³. For this purpose, legislators offer governmental funding to associations, through the Environment

⁷¹⁸ In Cape Verde, obligation to charge is used as a transitory measure to accompany consumers towards the total ban of conventional plastic bags. From the commencement of the 2015 *lei* in July 2015 to the ban of the utilisation of ‘conventional’ plastic bags in July 2017, these bags are charged. Article 7, Cape Verde 2015 *lei* n°99/VIII. The underlying idea is to make people understand that using plastic bags has a cost that was previously invisible.

⁷¹⁹ Article 5, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷²⁰ Article 6, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷²¹ Article 7, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷²² Article 9 and 11, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷²³ Translated. In the text « *As associações ambientais devem desenvolver campanhas activas de sensibilização dos consumidores sobre a importância de redução dos consumos de sacos de plástico convencionais, nomeadamente através da reutilização e utilização de sacos reciclados e/ou com menores impactos para o ambiente.* », article 18 Cape Verde 2015 *lei* n°99/VIII, above mentioned.

Fund⁷²⁴. Additionally, the government must carry out awareness-raising campaigns⁷²⁵. Last but not least, “economic agents with headquarters or a permanent establishment in the national territory, who carry out both wholesale and retail trade, whether formal or informal, or engage in industrial activity” in relation with plastic bags must promote “environmental awareness among employees and consumers to promote responsibility for environmental protection”⁷²⁶. The scope of application of these instruments extends over geographical and material perspectives.

Section 2) From targeted activities to the definition of plastic: a burgeoning material scope of application

Across the case study countries and as far as plastic bag regulation is concerned, the geographical scope is of little interest. No analysed entity discriminates plastic bag regulation within its territory. To the contrary, the analysis of the material scope of application is of major interest. It spans over three strands, each contributing to the scope modulation: the types of activities to which the regulation applies (a), the type of plastic bags to which the regulation applies (b), and the type of plastic bags to which it doesn't (c).

a. Defining the activities targeted by the regulation

From the production to the use of plastic bags, a diversity of activities – and therefore of actors – can be targeted by the regulation such as production, import, export, distribution or commercialisation and use. All, to the exception of export, directly influence the availability of plastic bags inside given borders. These activities can be seen as different stages or levels allowing plastic bags' availability.

In Ireland, England and Scotland, regulation applies only at the distribution / commercialisation level through economic incentives⁷²⁷.

⁷²⁴ Article 18 Cape Verde 2015 *lei* n°99/VIII, above mentioned. This Environment Fund is partly financed by the proceeds of the fines in case of non-respect of the *lei*, which “are fully allocated to the financing of awareness raising and other activities for environmental protection among consumers”, (article 15 Cape Verde 2015 *lei* n°99/VIII, above mentioned). The Central Environment Service must also, “at least once a year on all islands, (...) carry out an awareness campaign to reduce the consumption of plastic bags” (article 9 Cape Verde 2015 *lei* n°99/VIII, above mentioned).

⁷²⁵ “Campaigns to disseminate and raise awareness about the rational use of degradable and or non-biodegradable material (...) [and] inform and empower citizens about possible alternatives that might replace non-degradable and/or biodegradable plastic packaging” article 14 Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷²⁶ Articles 4 and 13, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷²⁷ See A. 1) b. on economic incentive instruments in these three entities.

In Cape Verde, France and Senegal, the command-and-control instruments, such as the ban and the permit obtention, apply at different stages. As far as the permit is concerned, it applies to import in Senegal⁷²⁸, or to production and import in Cape Verde⁷²⁹.

The ban of some plastic bags can apply at production, importation, distribution, commercialisation⁷³⁰ and use stages, such as in Cape Verde⁷³¹. In France, the material scope of application of the ban was progressively extended, through the modulation of regulated stages. From the ban of distribution and commercialisation of some types of plastic bags⁷³² commenced in January 1st, 2016 and 2017, the ban was extended to production and importation for these same bags from January 1st, 2021⁷³³. More precisely, only the production “for the purpose of making available on the national territory, as well as the transfer to natural and legal persons established on the national territory”⁷³⁴ is concerned by this production ban, meaning that such plastic bags can be produced and exported, as long as they do not transit through a national reseller. In the context of the ban of commercialisation and distribution, it is coherent to ban production and import too – there is no need to produce or import bags if they cannot be distributed or commercialised. The ban of export nonetheless prevents those bags – undesirable enough to be banned nationally – to be commercialised and used abroad. These provisions enable to conciliate the protection of the environment nationally and the continuation of a polluting business abroad, putting in question the application of the internationally recognized principle prescribing the prevention of transfrontier pollution. The French ban of oxo-fragmentable bags does not fall into this caveat, by addressing the production, commercialisation, distribution and use of bags whatever their targeted market⁷³⁵. This observation leaves open the question as to why did the legislators ban production for export and use of oxo-fragmentable bags, and not of other non-reusable bags.

⁷²⁸ Article 5, Senegal *loi* n°2020-04, above mentioned.

⁷²⁹ Article 8, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷³⁰ The difference between distribution and commercialisation lies in whether the customer pays for the bag or not. Distribution is free while commercialisation is paid for.

⁷³¹ Article 6, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷³² Non reusable plastic bags found at supermarket checkouts or used for retail. See article 75 of *loi* n°2015-992 above mentioned.

⁷³³ France, article 75 of *loi* n°2015-992 above mentioned and France, article 77 of *loi* n°2020-105 above mentioned.

⁷³⁴ Translated. « fabrication à des fins de mise à disposition sur le territoire national ainsi que la cession auprès de personnes physiques et morales établies sur le territoire national », article 77 of *loi* n°2020-105 above mentioned.

⁷³⁵ France, article 77 of *loi* n°2020-105 above mentioned.

Senegal is the only country which do not explicit the stage at which the ban applies⁷³⁶.

The analysis of the regulated activities reveals different strategies as to who must bear the responsibility not to trigger the resort to plastic bags, which might, in term, generate pollution. In Ireland, Scotland and England, consumers are free to decide whether or not they desire to use – and pay for – a plastic bag.. This resounds with the Texan bill known as the “Plastic Freedom Act” defending the “right of businesses to provide a bag to customers” and preventing any local government to impose bag restrictions locally⁷³⁷. This bill defended both the freedom of consumers and sellers to resort to plastic bags. To the contrary, in France and Cape Verde, the burden of compliance is shared along the chain, from production / import to commercialization or use, offering a holistic approach. In Senegal, the burden of compliance only rests on sellers, although the instrument is a ban rather than economic incentives.

The type of plastic bags to which the regulation applies is another key element of the material scope of application.

b. Outlining the object: meanders in the definition of regulated plastic bags

The precise definition of regulated plastic bags is the linchpin of plastic bag regulations. Although there are few differences between the use and characteristics of plastic bags around the world, it is striking to observe the variety of adopted definitions in our study countries. There are three ways by which countries characterise the scope of their regulation through the definition of the object: the definition of the material composing the plastic bags (i), the other physical characteristics of these bags (ii) and the future use of the bags (iii).

i. Grasping plastic as a substance

The definition of the plastic material from which the bags are composed is central to any plastic bag regulation, forming the foundations of the regulation. However, these definitions vary from country to country, convoluting comparative analysis.

Cape Verde is the most precise country in defining what plastic is, in its definition of a plastic bag. “Conventional plastic bags” are defined as “polyethylene bags (chemically formulated (-

⁷³⁶ Article 5, Senegal *loi* n°2020-04, above mentioned.

⁷³⁷ This bill hasn’t been adopted. See on plastic bag regulation in Texas Title 1, B., 1), c. The lonesome cowboy: non-achieved regulation, a Texas and Florida specificity. Texas House Bill 2416, a Bill to be entitled an Act relating to the provision of bags to customers of a business at the point of sale, above mentioned.

CH₂-CH₂-n high density (HDPE) and low density (LDPE))”⁷³⁸, covering most plastic bags commonly used⁷³⁹.

The Senegalese definition is slightly less precise. Plastic is considered as “a material consisting of a polymer to which additives or other substances may have been added and which can function as a main structural element of final products, with the exception of natural polymers which have not been chemically modified”⁷⁴⁰.

The French definition of ‘plastic’ refers to the definition of ‘polymer’ given in the European Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006⁷⁴¹ at the Article 3, point 5⁷⁴², to which also corresponds the definition given by the Directive (EU) 2015/720 of plastic⁷⁴³. The Irish and Scottish definitions of plastic as a material are the vaguest, respectively defining plastic bags as “a bag (a) made wholly or in part of plastic”⁷⁴⁴ and “a carrier bag made wholly or mainly from plastic”⁷⁴⁵.

The development of new plastic or non-plastic material from which carrier bags are made somehow complexifies the definition process of regulated bags. Simultaneously to the regulation of plastic bags – and therefore to the definition of plastic – legislators of several

⁷³⁸ Article 3, Cape Verde 2015 *lei* n°99/VIII, above mentioned. Translated. In the text: « b) “*Sacos de plástico convencionais*”, os sacos de polietileno (de fórmula química (- CH₂-CH₂-n de alta densidade (PEAD) e de baixa densidade (PEBD) ».

⁷³⁹ To the exception of Linear Low-Density Polyethylene (LLDPE), more resistant than HDPE and LDPE.

⁷⁴⁰ Article 3, Senegal, Loi n°2020-04 du 08 janvier 2020 relative à la prévention et à la réduction de l'incidence sur l'environnement des produits plastiques, JO n°7206 du 20/01/2020. Translated. In the text: « *matériau constitué d'un polymère auquel peuvent avoir été ajoutés des additifs ou d'autres substances et qui peut fonctionner comme un élément structurel principal de produits finaux, à l'exception des polymères naturels qui n'ont pas été chimiquement modifiés* ».

⁷⁴¹ Published in the Official Journal of the European Union L396 on December 30th, 2006.

⁷⁴² Article 1, France, Décret n° 2016-379 du 30 mars 2016 relatif aux modalités de mise en œuvre de la limitation des sacs en matières plastiques à usage unique, JORF n°0076 du 31 mars 2016.

⁷⁴³ “‘plastic’ means a material consisting of a polymer as defined in point (5) of Article 3 of Regulation (EC) No 1907/2006 of the European Parliament and of the Council (3), to which additives or other substances may have been added, and which can function as a main structural component of final products, with the exception of natural polymers that have not been chemically modified’, article 3, Directive (EU) 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags (Text with EEA relevance), Official Journal L 115, 06/05/2015 p. 11-15.

The European Commission provides interpretation guidelines: see EUROPEAN COMMISSION, « Commission guidelines on single-use plastic products in accordance with Directive (EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment », Brussels, Belgium, European Commission, 2021.

⁷⁴⁴ Article 9, Ireland Statutory Instrument n°36 of 2001, Waste Management (amendment) Act, 17th of July 2001.

⁷⁴⁵ Regulation 3, Statutory Instrument No. 161 of 2014, The Single Use Carrier Bags Charge (Scotland) Regulations, 3rd June 2014.

countries regulated other types of material considered as “inoffensive to the environment”⁷⁴⁶ or on the contrary equally harmful. For example, in France oxo fragmentable bags⁷⁴⁷ are considered harmful to the environment⁷⁴⁸ contrary to non-reusable compostable bags⁷⁴⁹. It highlights the importance to explore how the bag will degrade, what will remain and in how much time. In the case of oxo fragmentable bags, the bag degrades in microplastics that will remain in the environment, justifying their ban in regard to the fight against plastic pollution. The shortcut taken by the Cape Verdean law which considers biodegradable bags as harmless can be dangerous if the characteristics and production of these bags are not controlled⁷⁵⁰, such as the conditions to be met for the bags to biodegrade, and the time required for degradation. The precision of the definition has a direct impact on the comprehensiveness of the regulation. An unprecise definition of plastic risks to open avenues to circumvent the regulation. Similarly, an overly-precise definition can *de facto*, exclude many objects from the regulation. To be protective, the regulation must therefore provide for a definition precise enough, but encompass all the objects which require to be regulated.

Some case studies rely on additional criteria to set the principle, *i.e.*, to define the plastic bags concerned by their regulations.

ii. Characterising the bag as an object

Beyond being made of plastic, regulated plastic bags can be characterized through their physical attributes such as thickness, reusability and size. These characteristics contribute to the definition of the material scope of the regulation.

The distinct regulation of plastic bags according to their size is justified by the Directive 2015/720. Recital 4 exposes the rationale for the regulation of plastic bags with a wall thickness

⁷⁴⁶ Article 2 Cape Verde 2015 *lei* n°99/VIII, above mentioned, consider biodegradable bags as “inoffensive for the environment”. Translated. In the text “*os sacos degradáveis e biodegradáveis cuja inocuidade para o ambiente*”.

⁷⁴⁷ Defined as « matières plastiques renfermant des additifs qui, sous l'effet de l'oxydation, conduisent à la fragmentation de la matière plastique en micro-fragments ou à une décomposition chimique », article 2, Décret n° 2020-1828 du 31 décembre 2020 relatif à l'interdiction de certains produits en plastique à usage unique, [JORF n°0001 du 1 janvier 2021](#).

⁷⁴⁸ Article 75 of France 2015 *loi* n°992, above mentioned, « *Un plastique oxo-fragmentable est dégradable mais non assimilable par les micro-organismes et non compostable conformément aux normes en vigueur applicables pour la valorisation organique des plastiques.* ». In English “An oxo-fragmentable plastic is degradable but not assimilable by micro-organisms and not compostable in accordance with the standards in force applicable for the organic recovery of plastics.”

⁷⁴⁹ Article 75 of France 2015 *loi* n°992, above mentioned.

⁷⁵⁰ To go further on single use plastic or plastic bag substitutes, see for example Pew Charitable Trusts and Systemiq, « Breaking the Plastic Wave: a Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution », 2020, p. 55 and following.

inferior to 50 microns, as these represent the majority of plastic bags used while being less often reused than thicker bags, and representing low recycling rates (recital 5). As these bags rapidly become waste, they are more prone to littering than thicker bags. Recital 13 nonetheless exposes the reason why plastic bags with a wall thickness below 15 microns could be exempt from regulation. Being used for primary packaging of loose food, they would guarantee better hygiene and contribute to prevent food waste. On this basis, article 1 of the Directive provides that “Member States shall take measures to achieve a sustained reduction in the consumption of lightweight plastic carrier bags on their territory”.

In the case studies, the English definition of “lightweight plastic material” lies in the coalescence between the definition of plastic as a material⁷⁵¹ and a thickness criterion, inferior to 70 microns in this case⁷⁵². If four entities of this study share this approach, we can find three different thresholds under which the plastic is considered as too thin, and is therefore regulated. In France, the threshold of minimum thickness for reusability is set at 50 microns⁷⁵³. In Scotland, lightweight plastic bags are charged up to a maximum thickness of 49 microns⁷⁵⁴. In its 2015 law, Senegal had set the minimum thickness for reusability at 30 microns⁷⁵⁵. According to a United Nations Environment report, in 2018 thirty-eight countries implemented thickness thresholds for plastic bags, ranging from 15 microns in Uzbekistan to 250 microns in Saudi Arabia⁷⁵⁶.

Besides, in Ireland the material scope of the obligation to charge is based on the criteria of the reusability of bags⁷⁵⁷, without specifying under which conditions a bag is reusable.

Size is another characteristic-based element contributing to set the material scope of application, in Scotland. The obligation to charge applies for plastic bags no more than 404 millimetres wide; [or] no more than 404 millimetres high; or no more than 439 millimetres wide

⁷⁵¹ “Synthetic or semi-synthetic material made from polyamide, polyethylene, polylactic acid, polyvinyl chloride or other polymer, or any combination of polymers”.

⁷⁵² Article 2, Statutory Instrument No. 776 of 2015, The Single Use Carrier Bags Charges (England) Order 2015, 19th of March 2015. 70 microns = 0,07 millimetres.

⁷⁵³ Article 1, Décret n° 2016-379 du 30 mars 2016 relatif aux modalités de mise en œuvre de la limitation des sacs en matières plastiques à usage unique, JORF n°0076 du 31 mars 2016.

⁷⁵⁴ Regulation n°3, 2014 Scotland Statutory Instrument n°161, above mentioned.

⁷⁵⁵ Article 2, Senegal 2015 *loi* n°09, above mentioned. This law has been revoked since, Senegalese legislators arguing that this rule was inapplicable in practice, as Senegalese controllers were not equipped of micrometres (Instrument used to measure microns) as explained in the Preamble to the *Loi* n°2020-04 above mentioned.

⁷⁵⁶ UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018.

⁷⁵⁷ Article 5, Ireland Statutory Instrument No. 605/2001, above mentioned.

and 439 millimetres high” as long as the bags do not correspond to the definition of a “small plastic bag”⁷⁵⁸.

If the regulation applies on criteria based primarily on either the characteristics of the material or the object, exceptions to the regulations are based on the use made of the plastic bag.

c. Driving the exception to the scope: the use of plastic bags

Plastic bags may be used either in specific places either to transport specific goods. In many countries of this study, the one and the other are avenues used to design exceptions to the regulation of plastic bags.

In England, Scotland⁷⁵⁹ and Ireland⁷⁶⁰, bags “used to contain a purchase made on board a ship, train, aircraft, coach or bus”⁷⁶¹ are exceptions to the taxation or the obligation to charge. In England, bags “intended to be used to carry alcohol or tobacco purchased in an area designated by the Secretary of State as a security restricted area (...) and which is sealed after the item is placed in it” have been added to the list of exceptions to the obligation to charge in 2021⁷⁶². Plastic bags used in prisons and hospitals are also exempt from the obligation to charge in Scotland⁷⁶³. As such, plastic bags in these locations can be accessed freely.

Besides, one could ask what is the commonality between a blade, a live aquatic creature, seeds, raw meat or fish, ice and medicine. The answer lies in the analysis of plastic bag regulation in Ireland, Cape Verde, Scotland and England. In these four entities, the bags intended to transport one of these goods benefit from exceptions to the ban, taxation or obligation to charge.

⁷⁵⁸ “Small plastic bag” means a plastic bag that does not have a gusset or a handle and is not more than 125 millimetres wide and 125 millimetres high”. Regulation n°4, 2014 Scotland Statutory Instrument n°161, above mentioned.

⁷⁵⁹ Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁶⁰ The Irish definition is slightly more complex but the underlying idea is the same “d) plastic bags used to contain goods or products sold: (i) on board a ship or aircraft used for carrying passengers for reward, or (ii) in an area of a port or airport to which intending passengers are denied access unless in possession of a valid ticket or boarding card, for the purposes of carrying the goods on board the ship or aircraft referred to in subparagraph (i)”. Article 5, Ireland 2001 Statutory Instrument n°605.

⁷⁶¹ Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁶² Article 9, England 2021 Statutory Instrument n°598, above mentioned.

⁷⁶³ Article 5, The Single Use Carrier Bags Charge (Fixed Penalty Notices and Amendment) (Scotland) Regulations 2015 no 159, 31st of March 2015.

Exceptions for the transport of fresh fish, poultry and meat are the most common, which can be found in Cape Verde⁷⁶⁴, Ireland⁷⁶⁵, Scotland⁷⁶⁶ and England⁷⁶⁷. In Scotland, these bags must be of a certain size⁷⁶⁸. Ice is a Cape Verde specificity⁷⁶⁹, while blades (unpacked axe, knife or blade) bags and the transport of live aquatic creatures and medicine in plastic bags seem only to be a concern in the United Kingdom⁷⁷⁰. The transport of bulk and unpacked goods or products can also benefit from an uncharged plastic bag in Ireland⁷⁷¹, Scotland⁷⁷² and England⁷⁷³.

In some cases, additional physical characteristics of the bag or material are used to delimitate these exceptions to the regulation of plastic bags are provided for.

For example, in Ireland the size of some bags made to transport fresh food must be “not greater (...) than 225mm in width (exclusive of any gussets), by 345mm in depth (inclusive of any gussets), by 450mm in length, (inclusive of any handles)”⁷⁷⁴. In Scotland⁷⁷⁵ and in England, size is used to define multiple reuse bags, exempted of the obligation to charge, as follows “iii) disregarding the width of any gussets, or the height of any handles extending above the main body of the bag—(aa) has a width and height greater (in each case) than 404 mm; and (bb) has a width or height greater (in either case) than 439 mm”⁷⁷⁶.

As for the material, in Cape Verde and France, biodegradable⁷⁷⁷ and compostable⁷⁷⁸ bags are respectively exceptions to the ban. In Cape Verde, biodegradable bags are referred to as

⁷⁶⁴ Article 2, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷⁶⁵ Article 5, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁶⁶ Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁶⁷ Statute 2, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁶⁸ “a gusset not more than 125 millimetres wide, and is not more than— (i) 205 millimetres wide; or (ii) 458 millimetres high (including any handle)”, Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁶⁹ Article 2, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷⁷⁰ England see Statute 2, England 2015 Statutory Instrument n°776; Scotland see Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁷¹ Article 5, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁷² Statute 1, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁷³ Statute 2, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁷⁴ Article 5, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁷⁵ Regulation 3, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁷⁶ Statute 2, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁷⁷ Article 6 and 7, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷⁷⁸ Article 75 of France 2015 *loi* n°992, above mentioned.

“inoffensive for the environment”⁷⁷⁹, and defined as “plastic bags which are not produced from hydrocarbons of fossil origin and whose material may be subject to composting processes”⁷⁸⁰. In France, the bags must, in addition to being compostable, be to the maximum 15 microns thick⁷⁸¹.

Last, temporary exemptions to the obligation to charge for bags used to deliver online grocery purchases have been decided in England⁷⁸² and Scotland⁷⁸³.

As simple as the plastic bag object is, complexity arises in the analysis of what is regulated and how, highlighting the challenges of a comparative analysis. Interestingly, a commonality emerges from this definition hubbub: in all the countries of this case study and across policy instruments, exceptions to the plastic bag regulation are provided for. These exceptions seem dominated, in number, by criteria based on the future use of plastic bags. Quantitative analysis should corroborate or refute this hypothesis.

Besides, the provision for enforcement means is a key element of plastic bag legal frameworks.

Section 3) Grounds for enforcement: enforceability of provisions

Enforceability lies in between the definition of the regulatory objectives, imbedded in the design of policy instruments and their scope of application, and the on-the-ground enforcement of these provisions⁷⁸⁴. It covers the potential for enforcement provided by the legal text through specific provisions such as controls and sanctions, which can have differing characteristics.

According to Baldwin *et al.*, enforcement occurs through five stages: the detection of the non-compliant behaviour; the response to non-compliant behaviour through provided policies, rules

⁷⁷⁹ Translated. In the text “*os sacos degradáveis e biodegradáveis cuja inocuidade para o ambiente*” Article 2, Cape Verde 2015 *lei* n°99/VIII, above mentioned. See Title 3, 1), c. Biodegradable bags: an environmental deadlock? for a discussion on the biodegradability of biodegradable plastic bags.

⁷⁸⁰ Translated. In the text “*Sacos de plástico degradáveis ou biodegradáveis*”, *os sacos de plástico que não sejam produzidos a partir de hidrocarbonetos de origem fóssil e cujo material possa ser sujeito a processos de compostagem*”, article 3, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁷⁸¹ Décret n° 2021-763 du 14 juin 2021 définissant la catégorie des sacs en plastique très légers, above mentioned, article 1.

⁷⁸² Article 3, Statutory Instrument No. 324 of 2020, The Single Use Carrier Bags Charges (England) (Amendment) 2020, adopted on March 20th, 2020. “Online grocery delivery bags are excluded bags from 21st March to 21st September 2020 only”.

⁷⁸³ Article 2, The Single Use Carrier Bags Charge (Scotland) Amendment Regulations 2020 no. 118, made on 01/04/2020, in force until the 3 October 2020. Article 2 of The Single Use Carrier Bags Charge (Coronavirus) (Scotland) Amendment Regulations 2021, made on 18/01/2021, extends this delay to the 31st of May 2021.

⁷⁸⁴ As a reminder, the enforcement of plastic bags regulation lies out of the scope of this study.

and tools; the enforcement through the application of the latter; the assessment of the success or failure of the enforcement activities, and the modification, when relevant of the provided tools and strategies⁷⁸⁵. Three of these five stages can be addressed in regulatory or legislative texts and can be analysed here: the detection, response and the modification. The others are out of the scope of this study. The first two, detection (a) and response (b), can be thought of during the design process of the rule. The last requires the amendment of the initial regulation to provide new tools for both detection and response (c). We will see that the case study countries provide for enforcement means at different stages, enabling to analyse the enforceability of the plastic bag regulations.

a. *Detecting non-compliance: provisions for controls*

Detecting non-compliance with the regulation requires to provide for controls. The procedure for these controls may be more or less precisely provided for in the regulation.

Interestingly, precision seems directly correlated with the type of policy instrument used to regulate plastic bags. Ireland, Scotland and England, which rely on economic incentives, extensively describe the control procedure in the regulation. To the contrary, France, Senegal and Cape Verde, relying mainly on bans, barely address the subject.

In Scotland, suppliers must keep records of the number of regulated plastic bags supplied, the amount charged to the customer for these bags, and the net proceeds raised by the charge⁷⁸⁶. These records must be kept for three years “beginning on 31st May following the end of the reporting year to which the record relates”⁷⁸⁷. These records must be made accessible to enforcement authorities “within 28 days of the request being made”⁷⁸⁸. Administrators are given a set of powers of enforcement, such as the power to “enter a seller’s premises at any reasonable time” or “make test purchases of a seller’s good” so long as “it reasonably believes that a breach has occurred”⁷⁸⁹, including the power to recover the costs of enforcement from non-compliers⁷⁹⁰.

⁷⁸⁵ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., p. 227.

⁷⁸⁶ Regulations 9 and 10, Scotland 2014 Statutory Instrument n°161, above mentioned. The net proceeds, as defined by regulation 9, are the result of the subtraction between the cost charged by the supplier for plastic bags, minus the amount of any VAT included in the charge, and costs “reasonably incurred by a supplier to enable the supplier to comply with these Regulations; and to communicate information about the charge to persons paying the charge”.

⁷⁸⁷ Regulations 10 paragraph 3, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁸⁸ Regulations 11, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁸⁹ Article 7, paragraphs 1 and 2, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁹⁰ Article 12, England 2015 Statutory Instrument n°776, above mentioned.

In addition to the elements contained in the Scottish reports, in England sellers must include the number of bags supplied by the seller and the “uses to which the net proceeds of the charge have been put”. In addition, sellers must supply a copy of the record to the Secretary of State each year, and on demand⁷⁹¹. These records are published on a website by the Secretary of State⁷⁹². The powers of enforcement detained by the Scottish enforcement authority are alike those detained in England, to the exception of the power to recover the costs of enforcement⁷⁹³. In Ireland sellers must also keep records of the number of regulated plastic bags in stock, acquired, and supplied, for each accounting period, and for a period of 6 years⁷⁹⁴. The amount of the levy collected must be returned to the Revenue Commission⁷⁹⁵, which is also in charge of the controls⁷⁹⁶.

The definition of the seller or supplier to which the obligation to keep a record applies is nonetheless different in England and in Scotland. In England, this obligation applied to sellers employing “250 or more employees on the first day of a reporting year”⁷⁹⁷ until May 2021, from which all sellers are concerned⁷⁹⁸. In Scotland, it applies to suppliers employing 10 or more full time members of staff⁷⁹⁹. This distinction reflects different stances as to the charge of proof of compliance in relation to the size of the enterprise.

In France, Cape Verde and Senegal, control modalities are less detailed, and exercised through an indirect media. Rather than detailing the control procedure such as in England, Scotland and Ireland, they assign the responsibility to implement and enforce the regulation to specific institutions such as the ministry in charge of the environment in Cape Verde, Senegal and France, to the police authorities in Cape Verde and Senegal, to “other public entities with powers of implementation provided by the law” in Cape Verde, and to ministries in charge of

⁷⁹¹ Statute 3 paragraphs 1 and 2, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁹² Statute 4 paragraph 2, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁹³ Regulations 13, Scotland 2014 Statutory Instrument n°161, above mentioned.

⁷⁹⁴ Article 11, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁹⁵ Article 10, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁹⁶ Article 9, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁷⁹⁷ Statute 1 paragraph 1, England 2015 Statutory Instrument n°776, above mentioned.

⁷⁹⁸ Articles 4, 8 and 11, England Statutory Instrument n°598 of 2021, The Single Use Carrier Bags Charges (England) (Amendment) Order 2021, made 20th May 2021 and coming into force 21st May 2021.

⁷⁹⁹ Regulations 8 paragraph 2, Scotland 2014 Statutory Instrument n°161, above mentioned.

health, industry, trade and the economy in Senegal⁸⁰⁰. The Cape Verdean Government shall also submit a report to the Parliament assessing the application of, and compliance with the regulation a year after the bans comes into force⁸⁰¹. In France, the Government shall also submit a report on the economic and environmental impact of the implementation of the plastic bag regulation six months after its publication. The report relative to the *loi* 2015-992 highlights the lack of sanctions provided for in case of non-compliance with the plastic bag regulation⁸⁰².

In England, reports on enforcement action should be published every three years, and must cover subjects such as “the cases in which a civil sanction has been imposed”⁸⁰³.

b. Responding to non-compliance: provisions for sanctions

Detection of non-compliance usually leads to a response, which can take different forms depending on both the type of policy instrument and the compliance-seeking strategy. Sanctions are here defined as “a penalty for violation of the law's provisions”⁸⁰⁴.

An analysis of the sanctions provided for in our case-study countries reveals their diversity, but also the predominance of fines.

The imposition of a fine is the most common sanction for plastic bag regulation infringement. Senegal, Cape Verde, France, Ireland, Scotland and England have recourse to this type of sanction.

In Cape Verde, France, and Senegal, legal and natural persons will unlikely pay the same amount.

In Cape Verde, the fine for non-compliance with the production ban is comprised between fifty thousand escudos and four hundred thousand escudos for natural persons, and between two hundred and fifty thousand escudos and eight hundred thousand escudos for legal persons⁸⁰⁵.

⁸⁰⁰ See Article 15 and 16, Cape Verde 2015 *lei* n°99/VIII, above mentioned; see Article 3, France, *Décret* n° 2016-379 du 30 mars 2016 above mentioned and see Article 25 Senegal *Loi* n°2020-04 above mentioned.

⁸⁰¹ Article 19, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁸⁰² CHANTEGUET Jean-Paul, BATTISTEL Marie-Noël et BUIS Sabine, « Rapport d’information déposé en application de l’article 145 du Règlement par la Mission d’information commune sur l’application de la loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte », Assemblée Nationale, 2016, p. 159. Sanctions are provided in August 2016 by the article 124 of the *Loi* n°2016-1087 du 8 août 2016 pour la reconquête de la biodiversité, de la nature et des paysages, publiée au .

⁸⁰³ Statute 4 paragraphs 1 and 2, England 2015 Statutory Instrument n°776, above mentioned.

⁸⁰⁴ Legal Dictionary, <https://legal-dictionary.thefreedictionary.com/Sanction>, accessed 04/01/2022.

⁸⁰⁵ Article 15, Cape Verde 2015 *lei* n°99/VIII, above mentioned. In January 2022, 1 euro ≈ 200 escudos. For natural persons, the fines is comprised between 250 € and 2000 € and between 1250 € and 4000 for legal persons.

In both cases, the amount should double in case of subsequent offence. False declarations on the biodegradability of plastic bags are punishable of a fine from one hundred thousand escudos to five hundred thousand escudos⁸⁰⁶.

In France, non-compliance with the ban on production, commercialisation and importation of single-use plastic bags is sanctioned by a fine up to 1500€ for natural persons and 7500€ for legal persons from August 10th 2016 to February 12th, 2020⁸⁰⁷. This fine is then doubled, to reach 3000€ for natural persons and 15000€ for legal persons⁸⁰⁸. In addition, a criminal fine is provided by article 6 of the *décret* 2010-1724⁸⁰⁹ for producers, importers or distributors to violate the bans on single-use and oxo-fragmentable bags. This *contravention de Vème classe* can reach 1500€, and under certain conditions 3000€ in case of recidivism⁸¹⁰.

In Senegal, natural persons selling or using banned bags risk a fine from 50 000 to 100 000 CFA francs⁸¹¹, and from five to ten million CFA francs for the manufacture or import of bags⁸¹². For legal persons the maximum amount is the latter multiplied by five⁸¹³. The Senegalese *loi* additionally explicitly provides for the recourse to a financial transaction⁸¹⁴. This procedure enables the Minister in charge of the environment to directly settle the amount of the fine, based on the proof of non-compliance. This amount must be coherent with the minimum and maximum amounts provided for in the regulation. The settlement of the financial transaction terminates any further pursuit⁸¹⁵.

In England, Scotland, and Ireland, no distinction is made upon the type of person. In Scotland, the regulation provides for a fixed penalty of £200 and of £100 for the discounted amount, if

⁸⁰⁶ Article 15, Cape Verde 2015 *lei* n°99/VIII, above mentioned. Between 500 € and 2500 € as of January 2022.

⁸⁰⁷ Article 124 of the *loi* n°2016-1087, above mentioned. The article L541-10-11 of the *Code de l'Environnement*, which created by the article 124 just mentioned and which provides for these sanctions is then displaced to the article L-541-9-5, and is no longer applicable to the ban on plastic bags.

⁸⁰⁸ Article 77 of *loi* n°2020-105 above mentioned.

⁸⁰⁹ Décret n° 2020-1724 du 28 décembre 2020 relatif à l'interdiction d'élimination des invendus non alimentaires et à diverses dispositions de lutte contre le gaspillage, [JORF n°0315 du 30 décembre 2020](#).

⁸¹⁰ See article 131-13 of the French *Code Pénal*.

⁸¹¹ Article 27 Senegal *Loi* n°2020-04 above mentioned. In January 2022, 1 euro ≈ 656 CFA francs. For natural persons, the fine is comprised between 76 € and 152 €.

⁸¹² Article 27 Senegal *Loi* n°2020-04 above mentioned. As of January 2022, the fine is comprised between 7622€ and 15244 euros.

⁸¹³ Article 39 Senegal *Loi* n°2020-04 above mentioned.

⁸¹⁴ Article 24, Senegal *Loi* n°2020-04 above mentioned.

⁸¹⁵ See BONNIN Marie, LY Ibrahima, QUEFFELEC Betty *et al.* (dir.), *Droit de l'environnement marin et côtier au Sénégal*, Dakar, Sénégal, IRD, PRCM, 2016, 532 p., pp. 441-446.

payed early⁸¹⁶. In England, the system of monetary penalties is more complex and detailed, with fixed and variable monetary penalties. As for the fixed penalty, the amount for the failure to comply with the requirement to charge is set at 200£, whereas the amount for the failure to keep records or to supply records is set at 100£⁸¹⁷. The maximum amount of the variable penalty is set at 5000£ for all prementioned breaches, and at 20 000£ for “false or misleading information to, or otherwise obstructs or fails to assist, an administrator”⁸¹⁸. For both type of penalty, early payment leads to a discount of 50% and the amount is increased by 50% for late payment. In addition, the penalty can, under certain conditions, be replaced by a “non-monetary discretionary requirement”, which is “a requirement to take such steps as an administrator may specify, within such period as the administrator may specify, to secure that the breach does not continue or recur”⁸¹⁹. In other words, the administrator is free to apply tailored sanctions in replacement of the fines as long as the conditions detailed in schedule 6 as respected⁸²⁰. In Ireland, a person guilty of an offence is liable “to a fine not exceeding £1500”. The continuation of the offence is liable “to a fine not exceeding £200” on every day on which the contravention continues⁸²¹.

Confiscation and seizure represent two other types of sanctions provided for in Senegal⁸²². Banned products can be either seized or confiscated, whereas the means of production of banned bags can be confiscated. The other difference lies in the fact that confiscation only applies to legal persons, in the Senegalese *loi*.

The permanent closure or closure for maximum period of 5 years of establishments which have pursued incriminated acts responds to the same logic, and is also provided for in the Senegalese *loi*⁸²³.

⁸¹⁶ Regulation 4, Scotland 2015 Statutory Instrument n°159, above mentioned.

⁸¹⁷ Schedule 5, England 2015 Statutory Instrument n°776, above mentioned.

⁸¹⁸ Schedule 6, England 2015 Statutory Instrument n°776, above mentioned.

⁸¹⁹ Schedule 6 paragraph 12, Climate Change Act 2008.

⁸²⁰ Schedule 6, England 2015 Statutory Instrument n°776, above mentioned.

⁸²¹ Section 10, Ireland Waste Management Act 1996, number 10 of 1996, enacted on 20 May 1996.

⁸²² Articles 23 and 39, Senegal *Loi* n°2020-04 above mentioned. The terms used in the text are *saisie* and *confiscation*.

⁸²³ Article 39, Senegal *Loi* n°2020-04 above mentioned.

The display of the sanction is a softer sanction, intending to publicly communicate the fact that a sanction has been pronounced against a business. In England, the publicity notice must detail the type of sanction, the grounds on which the sanction has been imposed, the amount of the monetary penalty or the type of discretionary requirement⁸²⁴. Additionally, if the “seller fails to comply with a publicity notice within the time specified under paragraph (3)(b), the administrator may publicise the information; recover the costs of doing so from the seller”. Senegal also provides for this type of sanction of legal persons using the written press “or by any means of communication to the public by electronic means”⁸²⁵.

Besides, Senegal and Ireland are the only studied countries which provide for imprisonment in addition to or in replacement of a fine. In Senegal, the duration of imprisonment can vary from one to three months for the use or sale of banned bags, and from a year to three years for the manufacture or the import of banned bags⁸²⁶. In Ireland, the duration of imprisonment can go up to 12 months⁸²⁷.

There are complementary ways by which it is interesting to analyse the provision of sanctions: through the relationship between the level at which regulation applies and sanctions, through the relationship between different types of instruments and sanctions, or through the analysis of the occurrence of sanction mixes. These complex analyses are facilitated by numerical approaches.

c. Modifying the law: a response to overcome enforcement challenges

The practice of law enforcement can lead to the modification of enforcement means through the adoption of implementing texts or the amendment / repeal of the initial text. Several case study countries adapted the enforceability of their provisions over time.

France made a slight modification in 2020 to its plastic bag regulation in force since 2015, with considerable enforceability consequences. As designed by the *loi* n°2015-992, there was no sanction provided for in case of non-compliance with the plastic bag ban. The *loi* n°2016-1087

⁸²⁴ Article 13, Schedule 6, England 2015 Statutory Instrument n°776, above mentioned.

⁸²⁵ Article 39, Senegal *Loi* n°2020-04 above mentioned. Translated. « *L’affichage de la décision prononcée ou la diffusion de celle-ci, soit par la presse écrite, soit par tout moyen de communication au public par voie électronique* ».

⁸²⁶ Articles 26 and 27, Senegal *Loi* n°2020-04 above mentioned.

⁸²⁷ Section 10, Ireland Waste Management Act 1996, above mentioned.

and 2020-105 addresses this caveat by providing for fines⁸²⁸ in case of non-compliance with the ban on the distribution⁸²⁹, production, commercialisation and importation⁸³⁰ of non-reusable plastic bags.

In response to enforcement challenges, Senegal made a fresh start with the *loi* n°2020-04, repealing the *loi* n°2015-09. The whole approach to plastic bag regulation is re-designed⁸³¹.

The rationale for this modification is exposed in the Preamble of the 2020 *loi*. First, the lawmakers point out the context hasn't changed since the adoption of the 2015 *loi*. Plastic is still ubiquitous in consumption patterns and in the environment, where it has multiple impacts on “fauna and flora, marine environment, quality of life, health, agriculture, fishing and tourism”⁸³². The lawmakers estimate that this absence of change finds its roots directly in the lack of ambition of the 2015 *loi* which defines banned plastic bags along thickness criteria while controllers don't have the technical means to measure the thickness of plastic bags in circulation. Observing that the 2015 *loi* could not provide the expected returns in the fight against plastic pollution due partially to inadequacy and unenforceability, Senegalese lawmakers started again from scratch, with the 2020 *loi*.

As shown by the Senegalese example, the fact that a legal text has been adopted and implemented doesn't necessarily mean that it is enforced and likely to have an effect on the issue it aimed to address. The content of the legal text, the definitions it proposes, the objects designated and the instruments designed to induce behavioural change are determinant factors of the fate and effect of the texts. This example highlights that law making can be an iterative process requiring severe adjustments when adopted regulations misses its target.

Contributions and limits of the database

Even though the analyses developed here are textual, the relational database is a precious analytical tool. Rather than a game-changer, the use of the relational database is here a time-saver. The 'find function' facilitates the extraction of data offering food for thought, and the relational architecture displays the interlinkages between different elements of the

⁸²⁸ See precedent section on sanctions. Articles 124 of the *loi* n°2016-1087 and 77 of the *loi* n°2020-105, above mentioned.

⁸²⁹ Article 75, *loi* n°2015-992 above mentioned.

⁸³⁰ Article 77, *loi* n°2020-105 above mentioned.

⁸³¹ See Title 1, B. 2) a.

⁸³² Translated from « *la faune et la flore, le milieu marin, le cadre de vie, la santé, l'agriculture, la pêche et le tourisme* », Preamble of the *loi* n°2020-04 above mentioned.

database.

Chapter 2. A numerical analysis: harnessing the complexity of plastic bag regulations

The recourse to quantitative or numerical tools casts a complementary light on the characteristics of plastic bag regulations. The database here offers a flexibility for data exploration and exploitation through the representation of the data under different forms, enabling to map the complexity and diversity of plastic bag regulations (section 1). The database also empowers multi criteria analyses, to explore regulatory interlinkages (section 2).

Section 1) Mapping regulatory strategies: representations of the legal framework's internal structure

The analysis of the case-studies' regulatory strategies goes beyond the analysis of regulatory components such as the definition of the object, the provision for sanctions or the choice and design of a policy instrument. It requires a holistic approach to each case-study's regulation. Mapping regulatory strategies consists in representing the relationships between the three main elements of the regulation: the choice and design of policy instruments, the definitions of the object of the regulation and the provision for sanctions⁸³³. The provision for controls has been voluntarily left out, as it isn't very distinctive across the case-studies. References to specific articles has been left out of the maps for more clarity, but references to the legal texts from which the data is extracted is provided.

Mapping the regulatory strategies emphasizes the internal structure of the legal framework and in particular the relationships between its different components. As such, it can be seen as a graphic representation of the relationships linking data in the database.

For example, figure II.2 illustrates the evolution of the French plastic bag regulation strategy between 2015 and 2020. The map of the regulatory strategy facilitates the comprehension of a complex legal framework. In the 2015 framework, three different bans were provided for. The bans were differentiated one from another by the date of commencement, the level at which they were applied, and the type of objects they were applicable to. The expansion of the material scope of application is easily identifiable in the 2020 framework, through the expansion of the

⁸³³ Policy instruments have been coded as follows: BAN: ban; CHA: obligation to charge; PER: permit; STA: standard; AWA: awareness raising; FUN: funding.

level at which the regulation applies. The objects remain unchanged. As for the sanctions, fines are provided for in case of non-compliance with the bans.

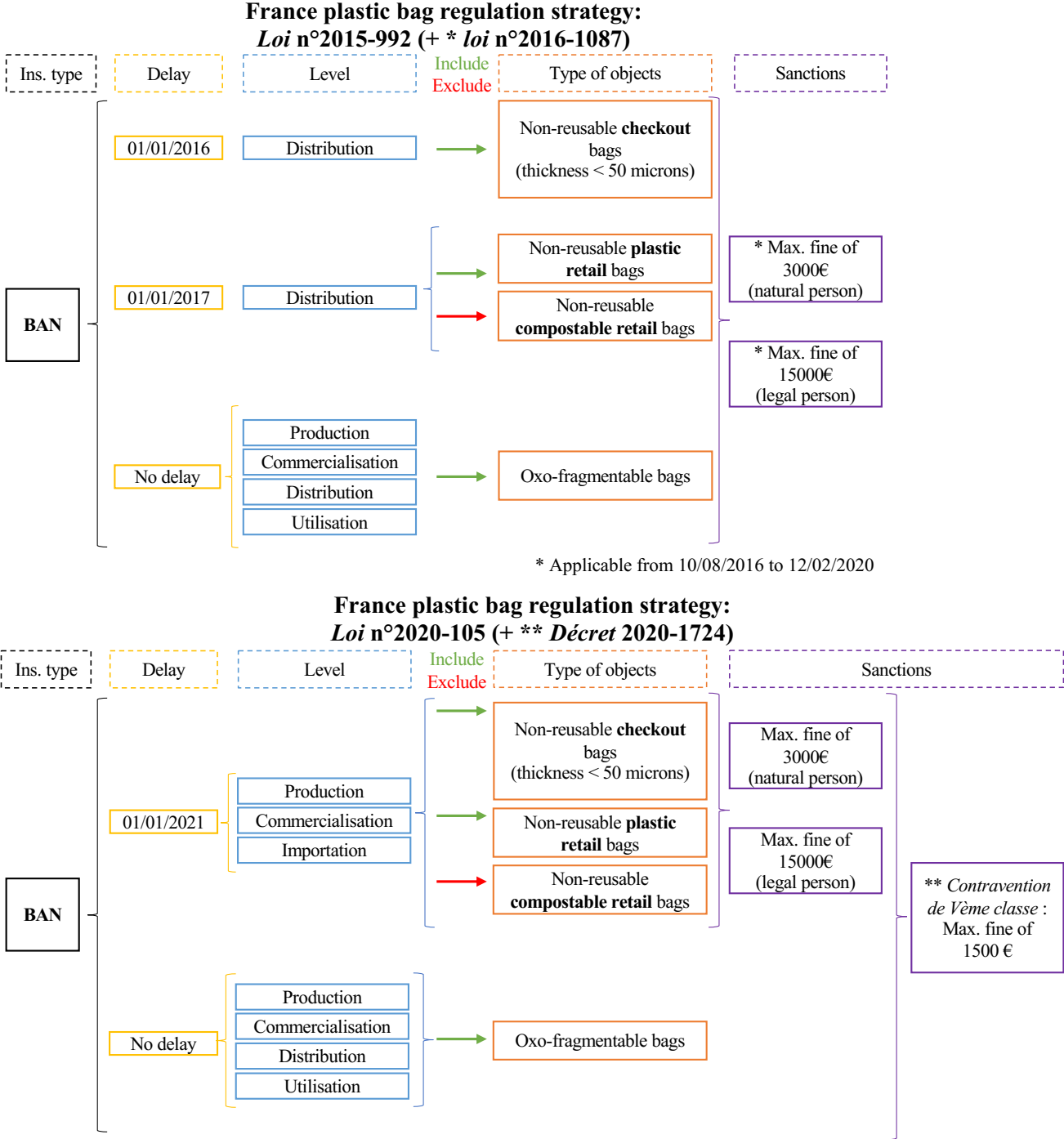


Figure II.2: Evolution of France’s regulation strategy between *Loi n°2015-992*-to *Loi n°2020-105*.

The same work has been conducted for all the case-studies. Figure II.3 maps out the regulation strategy of Senegal.

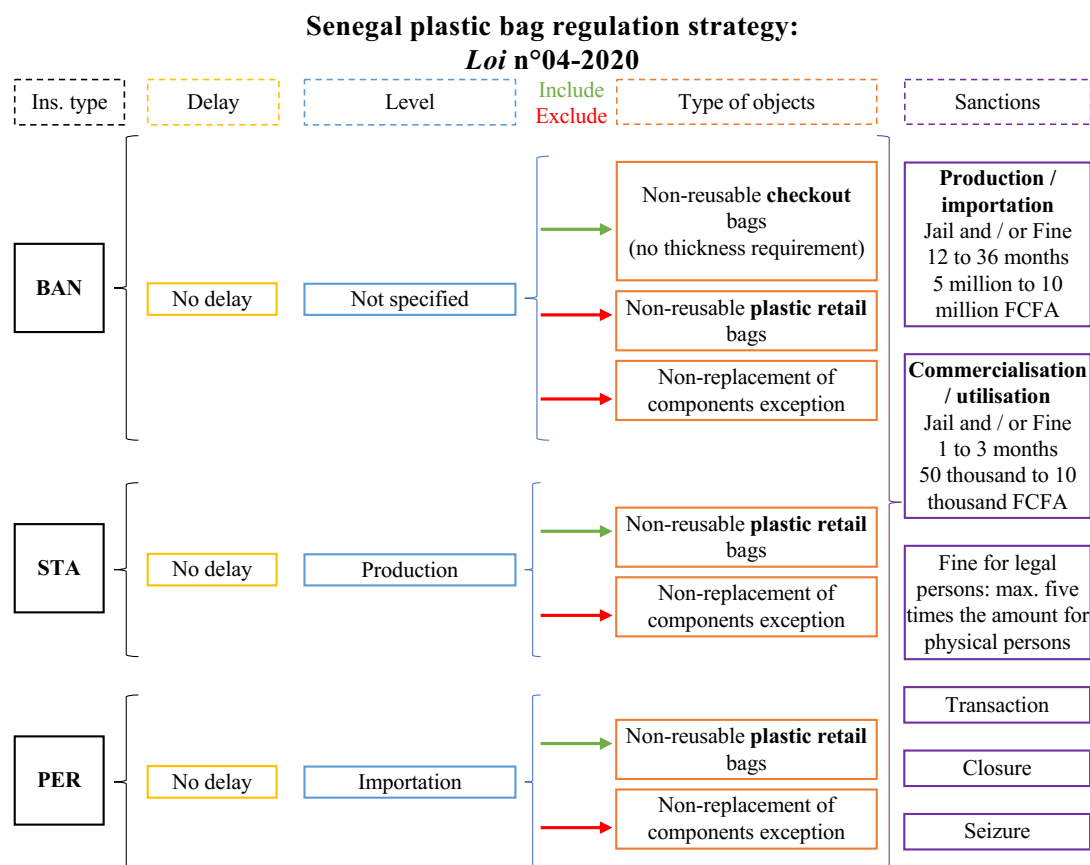


Figure II.3: Senegal plastic bag regulation strategy: *Loi n°04-2020*

BAN: ban; CHA: obligation to charge; PER: permit; STA: standard; AWA: awareness raising; FUN: funding.

The difference with the French regulation strategy is clearly visible. Senegal provides for a single ban, but for a standard and a permit too; additionally, the set of sanctions provided for is much broader. The Senegalese example is interesting as it showcases the potential for interlinkages in regulatory frameworks: non-reusable plastic retail bags, which are exempted from the ban, belong to the material scope of application of the standard. The weaknesses of the Senegalese regulatory framework, due to the lack of precision of the definition of the objects, is nonetheless not visible here, as their identification require a semantic analysis⁸³⁴.

Similarly, the map of the Cape Verdean regulation strategy displays the variety of policy instruments provided for by the regulation, but also the delays with which they are applied (figure II.4). More specifically, it is apparent that the obligation to charge is a transitory measure, ending when the ban on commercialisation and utilisation of conventional plastic bags starts. Just like in Senegal, biodegradable bags and specific uses bags are excluded from the

⁸³⁴ See Title 3, A., 1), a. Plastic bag definitions: blurry and porous contours.

ban and the obligation to charge, but are part of the material scope of application of the permit and the standard.

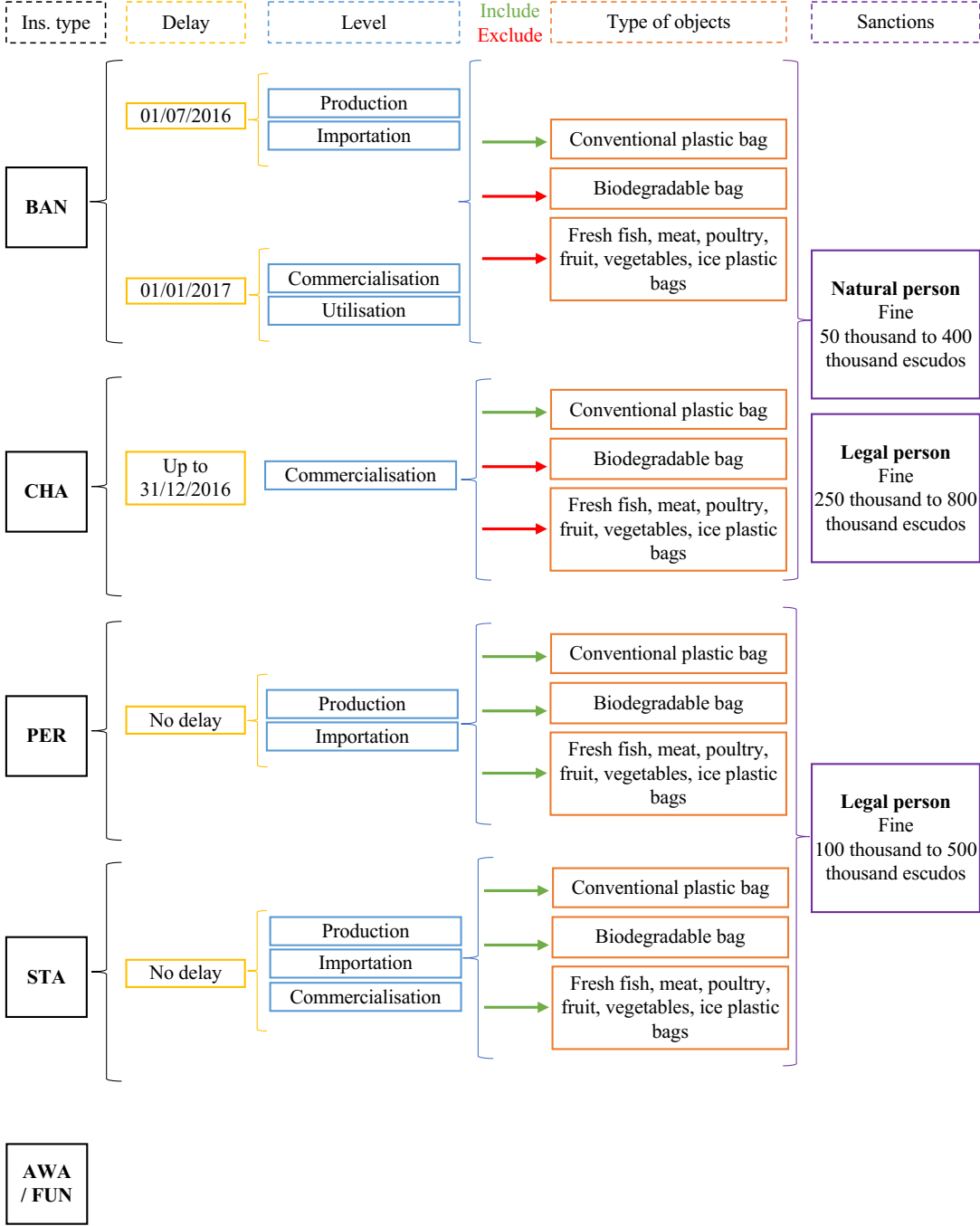


Figure II.4: Cape Verde plastic bag regulation strategy: lei n°04-2020

BAN: ban; CHA: obligation to charge; PER: permit; STA: standard; AWA: awareness raising; FUN: funding.

The plastic bag regulation frameworks of Ireland (figure II.5), England (figure II.6) and Scotland (figure II.7) are somewhat simpler. Ireland is the only one of these three case studies to provide for two complementary instruments such as in Cape Verde and Senegal.

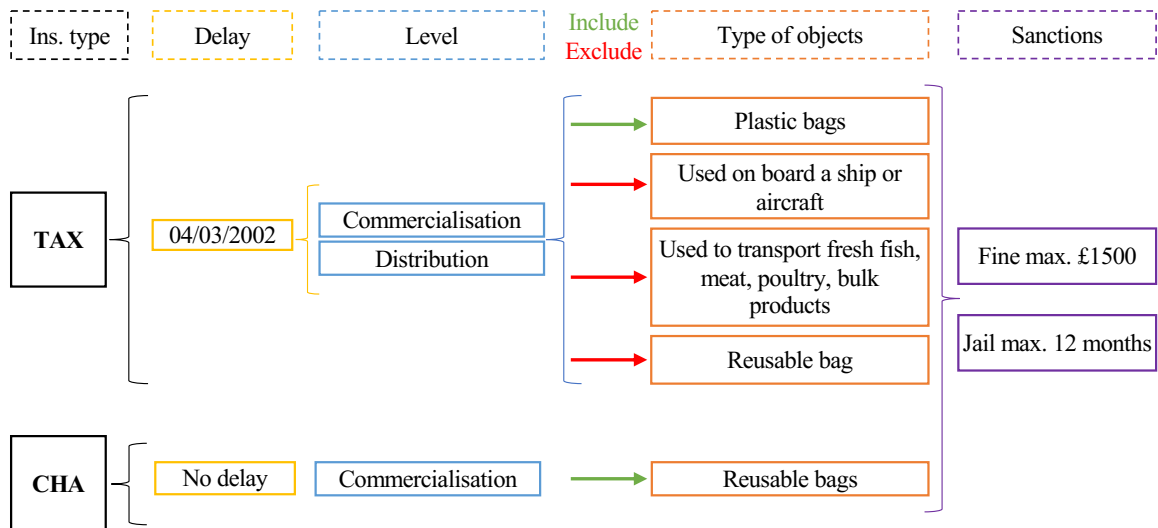


Figure II.5: Ireland regulation strategy: Statutory Instrument n°605 of 2001, Waste Management Act n°10 of 1996
 BAN: ban; CHA: obligation to charge

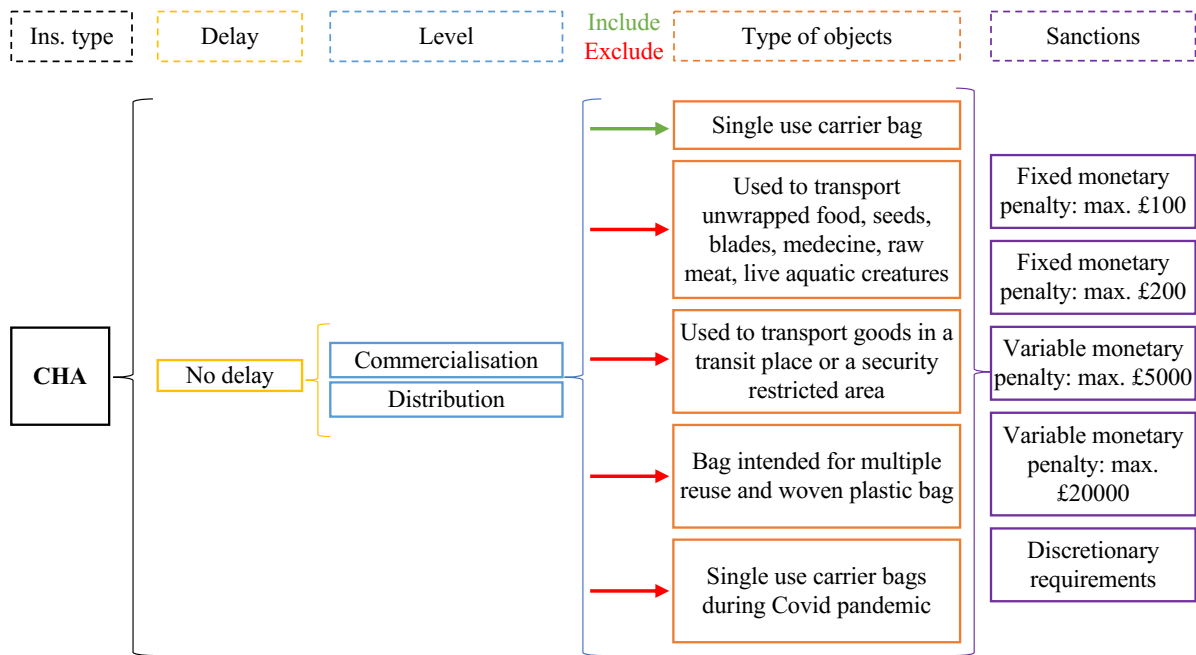


Figure II.6: England regulation strategy: Statutory Instruments n°776 of 2015, n°324 of 2020 and n°598 of 2021
 CHA: obligation to charge

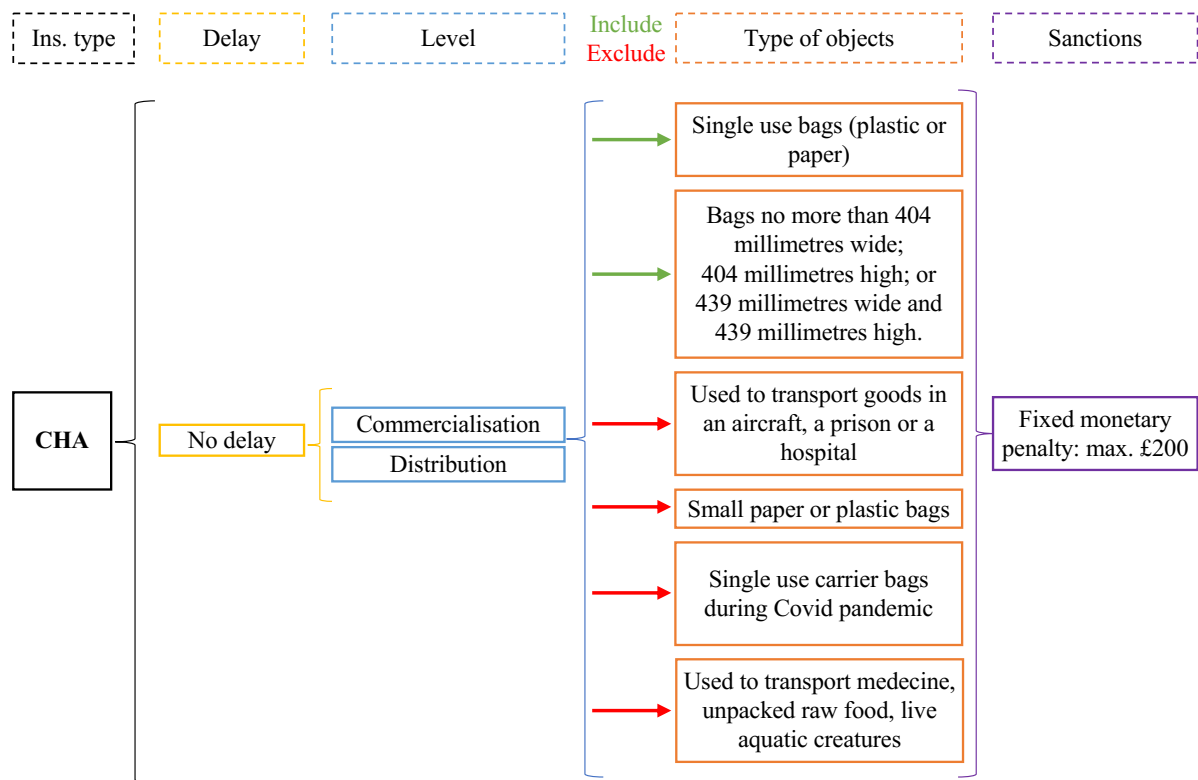


Figure II.7: Scotland regulation strategy: Statutory Instruments n°161 of 2014, n°159 of 2015 and n°118 of 2020
CHA: obligation to charge

The broad set of exceptions to the taxation in Ireland and the obligation to charge in England and Scotland are clearly visible in the respective maps, along with the limited provision for sanctions in Ireland and Scotland.

These graphic representations of the legal frameworks' internal structure interact ambivalently with the analysis of complexity. On the one hand these representations are a simplification of the legal frameworks, shortcutting lengthy definitions or conditions for the imposition of a fine. As such, they can be used to communicate simplified legal information to non-specialists.

On the other hand, these representations highlight that there is no regulation strategy common to two countries among the case-studies. As such, the consecutive display of each case-study's regulatory map emphasizes the complexity of a comparative analysis, but also question the uniformity of the common fight against plastic pollution.

Contributions and limits of the database

The maps of the plastic bags regulatory frameworks are graphic representations of the data and the relationship between the data of the database. As such, the contribution of the database is key. It is nonetheless necessary to extract the data from the database to produce these maps.

Section 2) Multicriteria analyses of legal regimes: exploring regulatory interlinkages

Multicriteria analyses here refer to the analyses of data through the prism of several variables. They enable to explore the distribution of some regulatory characteristics in regard to variables such as the type of policy instrument or the level at which the regulation applies. Two aspects of the regulation are particularly interesting to analyse through multicriteria analysis: the criteria by which objects are defined or excluded from the regulation (a), and the type of sanctions provided for by the legal texts (b). Both aspects highlight the lack of cohesiveness of plastic bag regulations in the case study countries.

a. An object perspective: the use; central to definition of regulated bags

Textual analyses offer an in-depth immersion in the meanders of the definitions of regulated plastic bags⁸³⁵. The purpose of quantitative analyses is to take a step back to analyse the interaction of these interwoven definitions with other regulatory variables such as the instrument choice, or the definition of exceptions to the regulation. The term ‘object’ refers to a unique combination of criteria used to define a bag. Therefore, in this analysis, all objects are bags. For the purpose of the quantitative analysis, a single criterion primarily used to define the bag is selected. By default, all the analysed objects are made of plastic. The ‘plastic material’ criterion can’t be used as a primary criterion when other criteria have been used, as it would be poorly distinctive. Table II.1 provides for a description of the nine criteria used to analyse the objects of plastic bag regulation.

Name of the criteria	Description
Destination what for	Bag defined through its future use, <i>i.e.</i> , the type of good it transports
Destination where	Bag defined through the place where it can be found
Material	Bag defined through material specificities (when not plastic)
Plastic material	Bag solely defined through its plastic composition
Reusability	Bag solely define through its reusability (no technical precision)
Non reusability	Bag solely define through its non-reusability (no technical precision)
Size	Bag defined through size characteristics (height, width, length)
Thickness	Bag defined through the thickness of its material ⁸³⁶
Other	Bag defined through other criteria.

Table II.1 Criteria used to quantitatively analyse objects of plastic bag regulation⁸³⁷

⁸³⁵ See A, 2) b., Establishing the principle: meanders in the definition of regulated plastic bags.

⁸³⁶ It should be noted that non-reusability and thickness criteria are strongly linked, the thickness of the bags being a contributing factor to its reusability.

⁸³⁷ When a bag is defined through several criteria, for example a reusable plastic bag, the primary criteria is considered, here its reusability.

The ‘plastic material’ criterion is used when it is the only criterion used to define a regulated bag. The ‘other’ criterion refers to the exception provided to the Senegalese plastic bag ban for plastic bags “designed in such a way that it is not easy for the consumer to replace the component or components”⁸³⁸. By ‘destination’ is understood here all the plastic bags which are defined by their purpose, their use rather than their characteristics. Two sub-categories stand out: a use defined as ‘where’ the bag can be available and as ‘what goods’ can the bag transport.

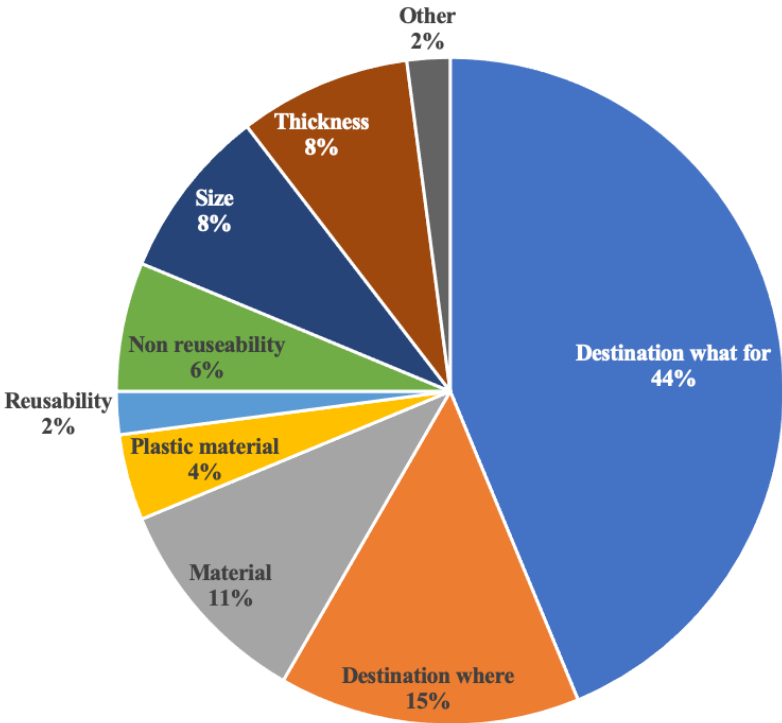


Figure II.8: Criteria primarily used to define carrier bags in case-study countries, in force articles. n=48⁸³⁹

On this basis, figure II.8 represents, for all the adopted and in-force texts adopted by countries of the study, the criteria primarily used to define plastic bags concerned by the regulation⁸⁴⁰. 48 objects are referenced in this figure, as a country’s legal framework commonly regulates different objects. The most eye-catching in this graph is the large part of ‘destination’ criteria representing more than half of the objects. More than half of the objects are defined, in whole

⁸³⁸ Translated. In the text: « Sont exclus du champ d’application de la présente loi, les produits dont un ou plusieurs composants sont des produits constitués ou fabriqués à partir de matières plastiques à condition que le produit principal soit conçu de manière à ne pas permettre facilement le remplacement du ou des composants par le consommateur. », Article 2, Senegal loi n°2020-04, above mentioned.

⁸³⁹ ‘n’ is the number of objects corresponding to the search criteria in case studies: plastic bag type, and in force text. Data compiled by the author.

⁸⁴⁰ This graph covers both ‘included’ and ‘excluded’ objects. Distinction will be made thereafter on the criteria primarily used to define included and excluded bags, relatively to the instruments used (i.e. ban, taxation, obligation to charge).

or in part, by their destination. Out of the plastic bags defined through their destination, two thirds are related to the transport of specific goods. Even though the distinction between these different approaches to the definition of regulated bags had been qualitatively discussed, quantification enables to highlight the predominance of criteria based on the use of the bags rather than on their physical characteristics to define plastic bags.

To go further, objects can be characterised through their type of relationship with the policy instrument (*i.e.*, ban, obligation to charge or taxation). The object can either be included in the instrument (*i.e.*, figure in the instrument's scope of application) or be excluded from the instrument (*i.e.*, figure out of the instrument's scope of application). Additionally, the instruments can either be based upon a command-and-control logic (*i.e.*, a ban) or upon a market-based logic (*i.e.*, an obligation to charge or a taxation). The following graphics (figures 9 to 16) have been designed as a representation of the results of this multicriteria searches⁸⁴¹.

Figure II.9 shows the characteristics of objects that are included in regulations be they banning or taxing plastic bags. Figures II.10 and II.11 offer the same perspective for respectively bans and obligations to charge / taxations. Figure II.12 offer a country-based perspective. These figures highlight the differentiated approaches to the definition of regulated bags.

First, comparing figure II.8 (representing all the objects) with figure II.9 (representing only included objects), we can observe that bags are mainly included in regulative instruments along the destination “where” criterion and criteria related to the physical characteristics of bags (*i.e.*, material, size, thickness, and reusability). The destination “what for” criterion has completely disappeared, whereas it represented 44% of the criteria used to define objects both included and excluded.

⁸⁴¹ The extraction of data from the database was run on March 7th and 8th, 2022. Analyses were then done on Excel. For all the figures of this section, only in force articles at the date of the extraction have been taken into account.

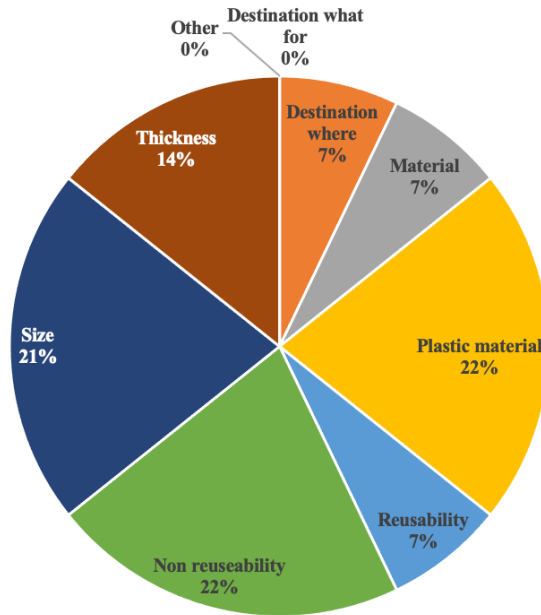


Figure II.9: **Included** carrier bags per type, in force articles. n=14

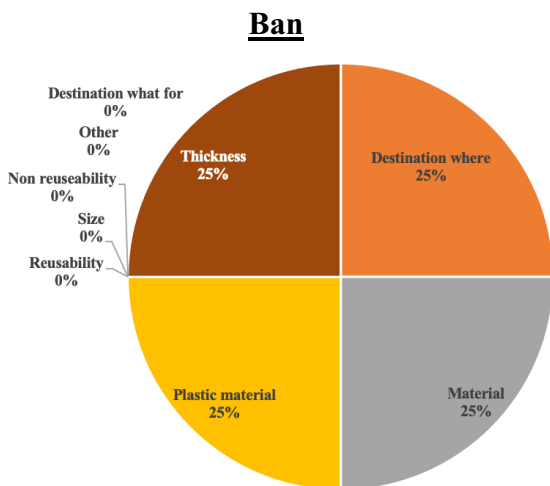


Figure II.10: **Included** carrier bags in ban per type, in force articles. n=4

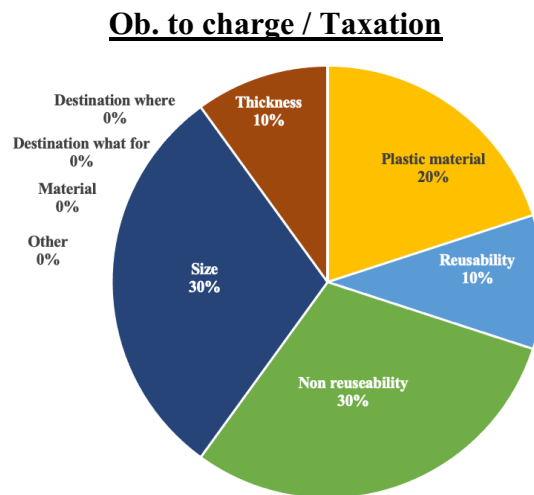


Figure II.11: **Included** carrier bags in ob. to charge / taxation per type, in force articles. n=10

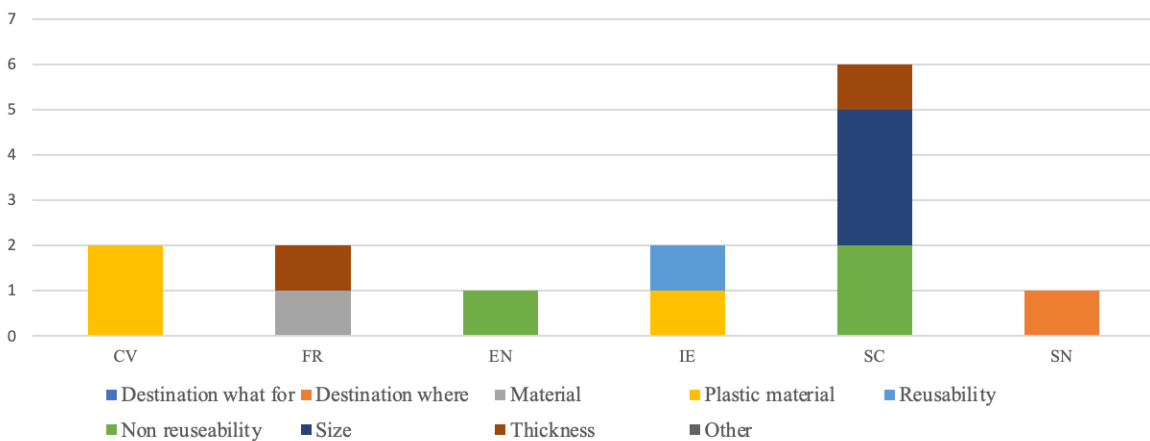


Figure II.12: Criteria used to define plastic bags, per country, in force articles

Comparing graphics II.10 and II.11 offers complementary perspectives on the differentiated strategies between bans and market-based instruments. Three types of criteria are used to include objects in bans: destination “where”, material and thickness, all equivalent in weight. This contrasts with criteria used for market-based instruments, which are solely based on the physical characteristics of bags.

Last, figure II.12 offers a complementary perspective, by displaying the criteria used per country rather than per instrument. For example, it shows that the relatively high proportion of the size criterion in figure II.11 is driven by Scotland. It also highlights Ireland’s original approach, regulating reusable bags, counter-current to England and Scotland, regulating non reusable bags. In Ireland, reusable bags must be charged a minimum 70 cents each⁸⁴².

The analysis of the criteria used to exclude objects from the regulation is also instructive. Following the same scheme as for included objects, figure II.13 represents all the criteria used to exclude, regardless of the type of instrument. Figures II.14 and II.15 respectively distinguish between bans and market-based instruments. Figure II.16 offers a country-based perspective.

The first difference between figure II.9 (included carrier bags per type) and II.13 (excluded carrier bags per type) lies in the number of objects. There are near to three times more objects excluded from the regulation than objects included. This can lie in the fact that legislators provide far more details on exclusion rather than on inclusion. The second stark difference is on the types of objects represented in each graph. Whereas the destination “what for” criterium is absent from included objects (graphic II.9), it is predominant for excluded objects (graphic II.13), representing 64% of criteria used to exclude. The rest is comprised of destination “where” (14%) and other criteria related to the physical characteristics of bags (material, reusability, size, and thickness).

The distinction between bans and market-based instruments is less striking here. For both, the destination “what for” criterion is the leader, followed by destination “where” and material. Market-based instruments additionally rely on other criteria related to the physical characteristics of bags (reusability and size) to exclude some bags from regulation.

⁸⁴² Article 5, Ireland Statutory Instrument n°605 of 2001, above mentioned.

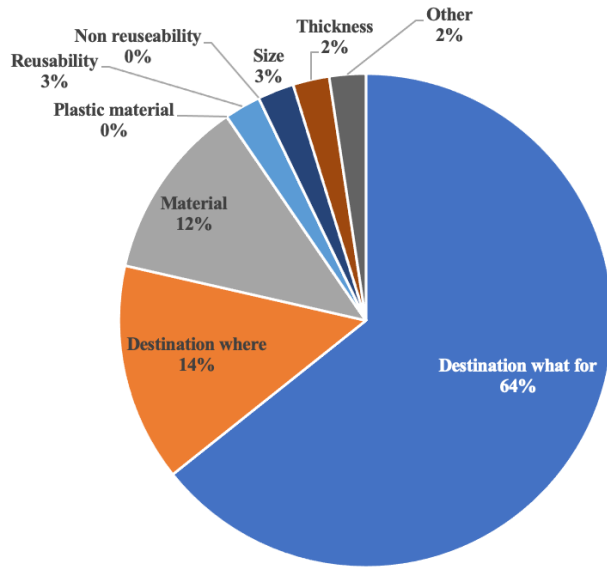


Figure II.13: **Excluded** carrier bags per type, in force articles. n=42

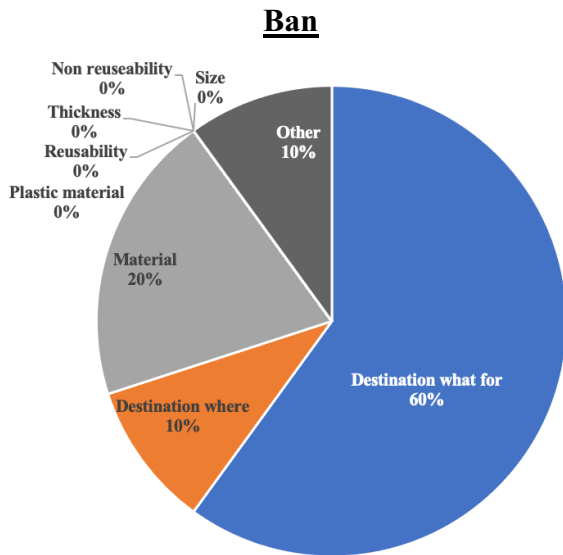


Figure II.14: **Excluded** carrier bags from ban per type, in force articles. n=10

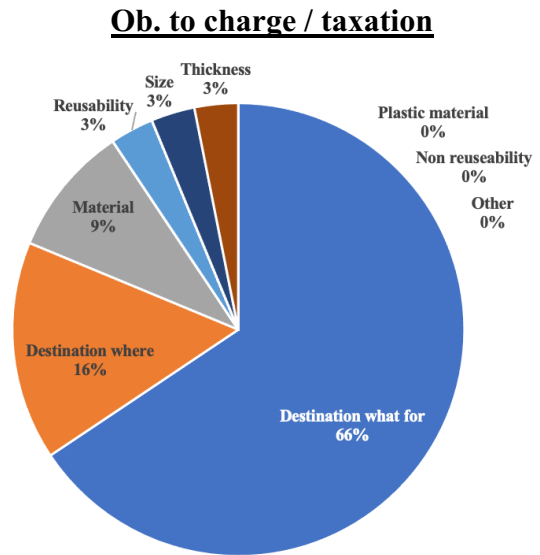


Figure II.15: **Excluded** carrier bags from obligation to charge / taxation per type, in force articles. n=32

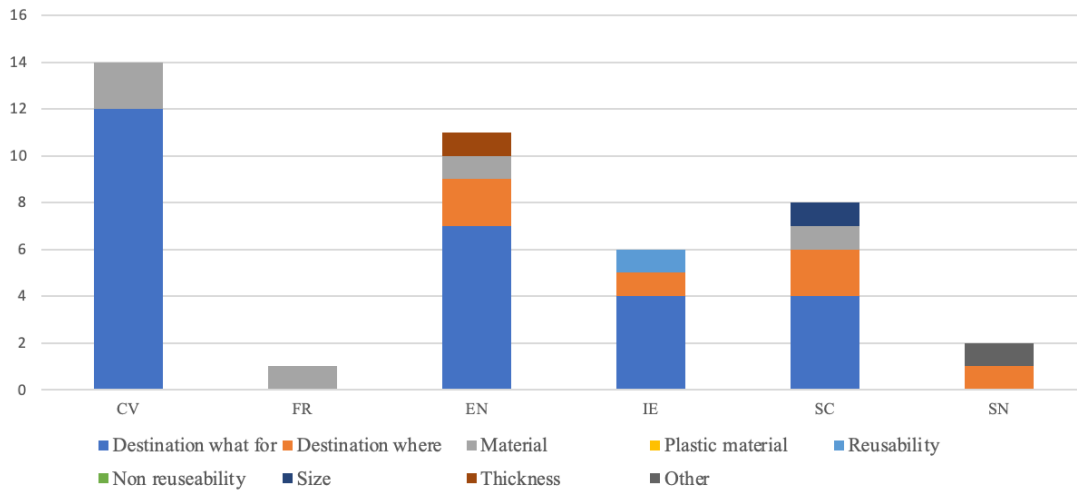


Figure II.16: Criteria used to **exclude** from regulation, per country

Just like figure II.12, figure II.16 enables to discriminate the criteria used per country. This time, the prevalence of the destination “what for” criteria in bans is driven by Cape Verde. Neither France nor Senegal relies on such criteria to exclude bags from the regulation. England, Ireland and Scotland nevertheless all contribute to the prevalence of the destination “what for” criteria in objects excluded from market-based instruments.

This quantitative approach to the criteria used to define bags concerned by or excluded from regulation offers a complementary perspective. It is nonetheless sensitive to the categorisation of the objects in different criteria. Given the relatively low number of case study countries, the high number of objects’ characteristics in a single country can greatly influence the multicriteria analyses which are not country based. Last, the precision of the destination “what for” criteria (*i.e.*, precisising which type of goods are concerned, such as fresh fish, meat or poultry) can lead to an over-representation of this criterion.

b. A sanction perspective: the relative predominance of fines

The same type of multicriteria analyses offer complementary perspectives to the analysis of sanctions. Three variables are here used: the type of sanction (*i.e.*, fine, jail and or fine, discretionary requirement, display, seizure, transaction, closure and confiscation), the type of instrument (*i.e.*, ban, obligation to charge or taxation) and the country.

Figure II.17 shows the predominance of fines (53%) in the case-study countries regardless of the type of instrument. Figures II.18 and 11.19 shows that fines are more largely used, in proportion of all sanctions, in market-based regulations (72%) than in ban-based regulations (42%). The variety of sanctions provided for in ban-based regulations is nonetheless largely driven by the Senegalese regulation of plastic bags (see figure 11.20).

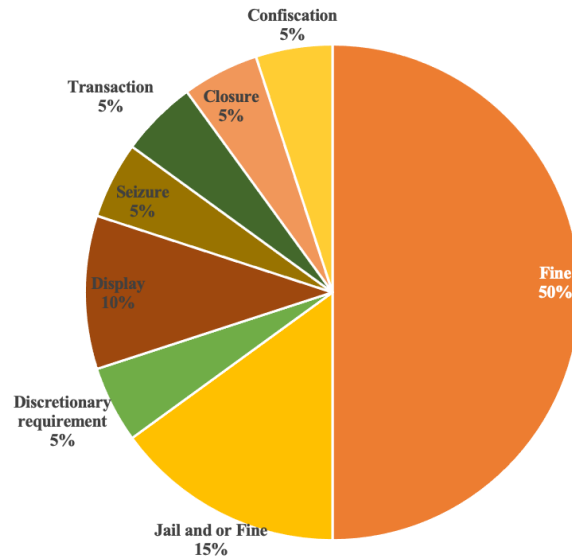


Figure II.17: Types of sanctions attached to bans and market-based instruments, in force articles. n=19

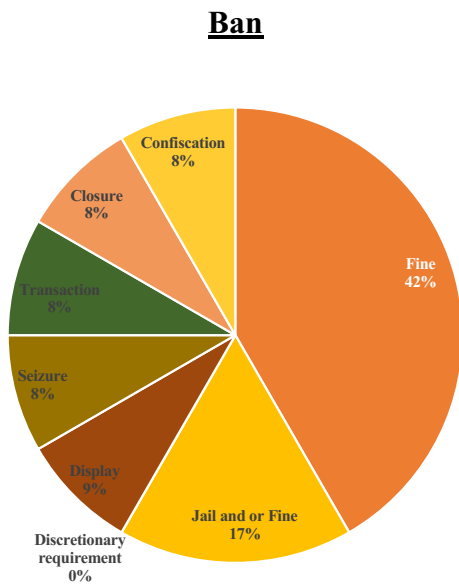


Figure II.18: Types of sanctions attached to bans, in force articles. n=12

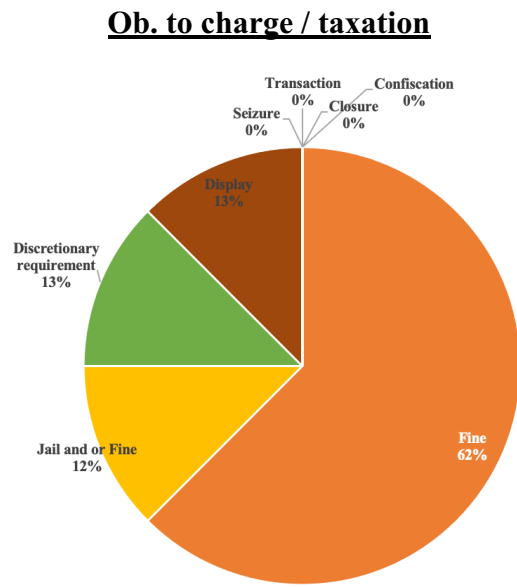


Figure II.19: Types of sanctions attached to market-based instruments, in force articles. n=7

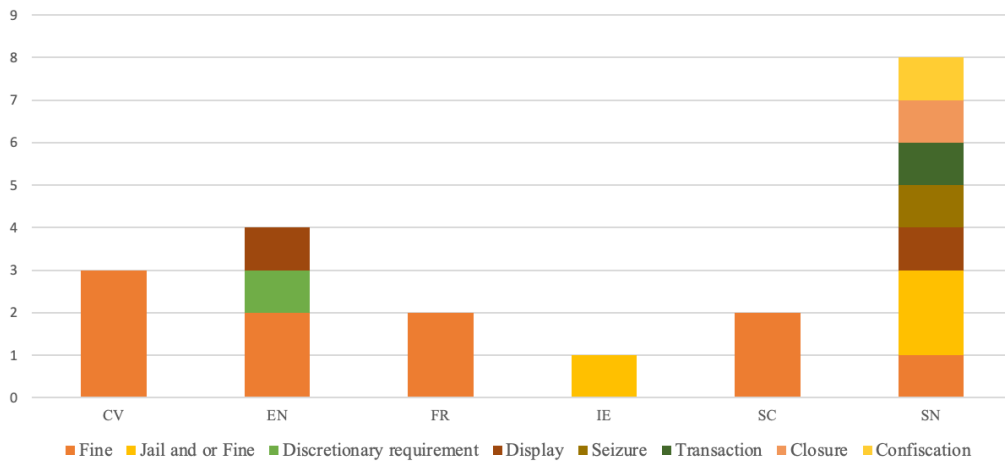


Figure II.20: Types of sanctions per country, in force articles

Contributions and limits of the database

The creation of variables requires an extraction of the data, the graphic creation options built-in in the database offer a too limited set of options. The database software facilitates the extraction, including the extraction of data corresponding to multiple criteria. Nevertheless, the production of the figures requires to work on the dataset to avoid double counting of the same elements. The data was extracted and treated on Excel.

Conclusion of Title 2

In all countries where plastic bags are banned or taxed, there are numerous exceptions to limit the impact of these regulations. Exceptions are common in law, as a way to adapt a general rule to a complex reality. However, by their recurrence or their amplitude, they can go against the validity of the rule or even become the rule⁸⁴³.

The quantitative only basis to analyse included/excluded objects is therefore insufficient to capture the complexity of the regulation and to conclude on the potential contribution of these texts to the protection of the environment. They must be completed by qualitative analyses, offering a perspective on the scope of the exclusion, complementary to their number⁸⁴⁴.

Related to plastic bags, an open question would be to determine whether the reduction of the prevalence of plastic bags enabled by the legal frameworks would be sufficient, a first step, or purely cosmetic.

The first hypothesis underpins that restriction of uses significantly curbs the production/use of plastic bags and thus the pollution curve attributable to plastics. This hypothesis is considered as unlikely due to the number of exceptions, and the fact that plastic bags represent a limited contribution to the issue of plastic pollution. Additionally, the criteria used to exempt from the regulation, mainly based on the use, should be “concerned with the measurement of any risk

⁸⁴³ BILLANT Odeline et BONNIN Marie, « Vers l’interdiction des sacs plastique en Afrique atlantique : une analyse numérique en droit de l’environnement », *Mondes en développement*, n° 193, De Boeck Supérieur, 2021, n° 1, p. 7-25.

⁸⁴⁴ Example: in a quantitative approach, an exception for bags used to transport axes counts the same as a bag used to transport fresh fruits. But more people transport fresh fruits than axes... An exception for ae-bags doesn’t have the same impact as an exception for fruit bags. Additionally, some entities, as England or Scotland provide extensive lists of specific exceptions, whereas others (such as Senegal) provide a small number of exceptions with a very large scope. Numbers only do not highlight this complexity.

associated with the consequences of the use of such products rather than any restriction on the product itself⁸⁴⁵. Evidence of the measurement of this risk is lacking.

For the second hypothesis, the restriction of the use of plastic bags would act be a first step in the mind of consumers and producers. The wake-up call stirred by the regulation of bags and the increase of the moral constraint to refuse plastic would question the preponderance of plastic in its single-use character. This thesis could be based on the concomitant / successive adoption of restrictions on the use of other single-use plastics (cotton swabs, cutlery, plates ...) for example in France or in Senegal.

For the third hypothesis, the current regulations would only be cosmetic, as the regulations could easily be circumvented to promote more harmful practices that weren't anticipated by the legislators, through the positive choice of some actors. Additionally, the regulation could have pervert effects which are not the result of a positive choice, but exist *de facto*.

Answering these hypotheses would require further research. Additionally, further research would be required to determine whether these regulations are enforced on the ground, and to which extent their enforcement contribute to the eradication of plastic pollution. Time restrictions didn't allow to pursue research in that direction. Meanwhile, multiple voices raise to call for a system change rather than a product change, and to move away from a single-use way of life⁸⁴⁶.

It is nonetheless possible to push the analysis of the regulatory frameworks provided by legal texts adopted in the case-studies, by analysing qualitatively and quantitatively their potential of protection.

⁸⁴⁵ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford; New York, Oxford University Press, 2006, 910 p., p. 246.

⁸⁴⁶ See for example HERBERZ Timo, BARLOW Claire Y. et FINKBEINER Matthias, « Sustainability Assessment of a Single-Use Plastics Ban », *Sustainability*, 12, Multidisciplinary Digital Publishing Institute, 2020, n° 9, p. 3746 ; Pew Charitable Trusts and Systemiq, « Breaking the Plastic Wave: a Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution », 2020, p. 55 and following; example STANTON Thomas, KAY Paul, JOHNSON Matthew *et al.*, « It's the product not the polymer: Rethinking plastic pollution », *WIRES Water*, 8, 2020, n° 1, p. e1490, p. 1496.

Title 3. A variable potential of protection: strengths and weaknesses of plastic bag regulations

The diversity and complexity of plastic bag regulation may hide the variable potential contribution of these legal frameworks to the protection of the environment. In addition, knowledge on the extent to which a regulation is likely to achieve its means based on the prime analysis of its features is central to estimate law's contribution to the protection of the oceans.

As defined in the introduction, indicators are a measure of a qualitative or a quantitative nature used to display information on the progress towards a specific goal through a process that simplifies raw data about a complex social phenomenon. By facilitating the aggregation of data of different nature, they offer a complementary approach to a complex phenomenon and facilitate comparisons between countries.

Here, the analysis of the studied legal frameworks' potential of protection is therefore built upon the translation of the identified strengths and weaknesses of the legal frameworks into indicators, enabling both the calculation of a country index and the comparison of the legal framework's features quantitatively.

As presented above, the context of this work is to explore the use of quantitative and computational tools and methods to analyse law. In this exploration phase, two indicator frameworks have been designed to test the results' robustness across methodological change, and to prospect for the most relevant methodological framework⁸⁴⁷. As a reminder, the difference between the two methods lies in the calculation of the score of three indicators: the targeted activity, the force of the instrument and the provision for sanctions. For these three indicators, whereas the second method relies on a 0 to 3 scale just as for the other indicators, the first sums up the different values of the indicator.

There are two complementary components to the analysis of the legal frameworks' potential of protection: their comprehensiveness and forcefulness. For both, three indicators have been designed, across the two methods⁸⁴⁸. For each of these indicators, the textual analyses of potential strengths and weaknesses of plastic bag regulation strategies will provide the basis to

⁸⁴⁷ See Part I, Title 3, Chapter 2, section 2, b.

⁸⁴⁸ See Part I, Title 3, Chapter 2, section 2, b.

determine a score across comprehensiveness (Chapter 1) and forcefulness (Chapter 2). It is then possible to aggregate the indicators into comprehensiveness, forcefulness (Chapter 3).

A precondition to undergo the evaluation process is the existence of a legal framework. Therefore, Florida, Texas, Pernambuco and Sao Paulo are here also excluded from the analysis.

Chapter 1. A comprehensiveness perspective: a critical analysis of the material scope of application

In their analysis of regulatory failure, Baldwin *et al.* highlight that “rules may fail for a number of reasons”, among which because “they are too vague or too long and complex to understand readily or to enforce; or because they prohibit desirable behaviour or they do not cover undesirable conduct”⁸⁴⁹. All of these reasons are related to the analysis of the comprehensiveness of regulation, which can be understood as a critical approach to the analysis of its material and geographic scopes of application.

As mentioned above, the geographic scope of application is of little interest here. On the contrary, the analysis of the material scope of application reveals three potential comprehensiveness caveats: the vagueness of some definitions of the object of the regulation (section 1), the important number of exceptions to the plastic bag regulation (section 2) and the types of activities targeted by the regulation (section 3). For each section, qualitative insights (a) feed the scoring of the attached indicator (b).

Section 1) Plastic bag definitions: avoiding blurry and porous contours, promoting comprehensiveness

The relevant definition of the object of the regulation, here plastic bags, plays a central role in the extent to which the regulation is likely to have the intended effect. Whereas vagueness of the definitions risks to induce porosity, complexity may blur the contours of the regulation. The comprehensiveness of the definitions in themselves is another key aspect.

a. Qualitative insights

The Senegalese definition of regulated plastic bags offers a good example of both vagueness and complexity. As a reminder, since 2020, plastic bags are banned at supermarket

⁸⁴⁹ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., p. 230.

checkouts⁸⁵⁰. Two categories of bags are excluded from this ban: bags found at *points de vente*⁸⁵¹ and bags made of a material “designed in such a way that it is not easy for the consumer to replace the component or components”⁸⁵². There are two caveats to this definition. First, the definitions given of bags at supermarket checkouts (banned) and of bags found at *points de vente* (excluded from the ban) are very close. Both mention that these bags are made available in the “*points de vente*”, to allow the transport of food products for the first, and the transit or handling of the goods in the second. The main difference between the two seems to lie in the types of goods transported. *Points de vente* bags are intended to protect and transport food, while checkout bags, which are prohibited, are intended to transport any good or product. If there is a distinction between both objects, the line is thin enough to be blurred by the lack of precision of these definitions. Second, the material-based exclusion is porous, as it seems to encompass any produced plastic bags.

The French plastic bag regulation also has recourse to a distinction between bags, based on their availability at supermarket checkouts or in *points de vente*. The distinction between the two is nonetheless not much clearer, as *points de vente* bags are not defined⁸⁵³, and checkout bags’ definition uses the term *point de vente*⁸⁵⁴. In any case, both types of bags are now banned⁸⁵⁵, contrary to the Senegalese example.

The Senegalese example is instructive on how a clear instrument – here a ban – can get profoundly confusing in its implementation and enforcement as it is difficult to delineate its

⁸⁵⁰ Checkout bags defined as “a bag supplied to consumers at the point of sale of goods or products and which is intended for the transport of said goods or products”. In the text « *sac fourni aux consommateurs dans les points de vente des marchandises ou des produits et qui sont destinés au transport desdits produits ou desdites marchandises* », article 3, Senegal loi n°2020-04, above mentioned.

⁸⁵¹ Retail bags defined as “plastic bags intended and used at retails to package foodstuffs in order to protect them, to allow their handling or transport from the producer or seller to the consumer, and to ensure their presentation.”. Translated. In the text: « *sacs plastiques destinés et utilisés dans les points de vente pour emballer des denrées alimentaires afin de les protéger, de permettre leur manutention ou leur acheminement du producteur ou du vendeur au consommateur, et d’assurer leur présentation* ». Article 5, Senegal loi n°2020-04, above mentioned.

⁸⁵² Translated. In the text: « *Sont exclus du champ d’application de la présente loi, les produits dont un ou plusieurs composants sont des produits constitués ou fabriqués à partir de matières plastiques à condition que le produit principal soit conçu de manière à ne pas permettre facilement le remplacement du ou des composants par le consommateur.* », Article 2, Senegal loi n°2020-04, above mentioned.

⁸⁵³ These bags are only mentioned at article 75 of the loi n°2015-992 as “*sacs en matières plastiques à usage unique destinés à l’emballage de marchandises au point de vente autres que les sacs de caisse*”.

⁸⁵⁴ Article 1, Décret n°2016-379 « “ *Sacs de caisse* ” : *les sacs mis à disposition, à titre onéreux ou gratuit, dans les points de vente pour l’emballage des marchandises des clients lors du passage en caisse ;* »

⁸⁵⁵ There is one year lag between the ban of the two types of bags. Checkout bags are banned since January 1st 2016, and *point de vente* bags since January 1st, 2017.

outline. For example, the control of compliance might be challenging, specifically in case of reuse of a retail bag for checkout purposes. The lack of comprehensiveness of the definition has in this case clear negative impacts on the enforceability of the provisions. The consequences of the definitional imprecision in the French regulation are more limited, as both bags, made of plastic, are banned since 2017.

Therefore, there are many issues arising to regulation which is imprecise in its definitions. First, under-inclusive regulations are likely to have limited protective effects, as they span over a limited proportion of issues. Second, compliance-avoiding strategies, or “creative compliance”⁸⁵⁶ often find their sources in imprecision. For example, Ireland, Scotland and Senegal do not provide any definition of the plastic material, opening the door to a variety of interpretations. Compliance-avoiding strategies may both be a cause and an effect of enforcement challenges, and of a certain discredit of the regulation in the eyes of the population.

Even though the plastic pollution concern is common across the Atlantic Ocean and the seven case-study countries, definitions of what is a plastic bag as a material or as an object (size and thickness) differ among countries. This is another comprehensiveness issue. On a public policy perspective, it hinders cooperation between countries in this common fight, and complexifies international trade. In addition, it poses the question of the scientific ground of these regulations. On a research standpoint, this definition dissonance complexifies comparative analysis of plastic bags regulation.

The comprehensiveness of the definition of regulated bags is another key aspect of the importance of the definition. For example, few countries consider biodegradable bags as bags to which a regulation should apply.

Biodegradable bags are often presented as a solution to the plastic bag environmental deadlock⁸⁵⁷ as they seem to address the most visible marine debris issues, such as the

⁸⁵⁶ “The practice of avoiding the intention of the law without breaking the terms of the law”, BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., p. 227, p. 110.

⁸⁵⁷ See for example ANTELAVA Ana, CONSTANTINOU Achilleas, BUMAJDAD Ali *et al.*, « Identification of Commercial Oxo-Biodegradable Plastics: Study of UV Induced Degradation in an Effort to Combat Plastic Waste Accumulation », *Journal of Polymers and the Environment*, 2020 ; GOLDBERG Olga, « Biodegradable Plastics: A Stopgap Solution for the Intractable Marine Debris Problem Note », *Texas Environmental Law Journal*, 42, 2011-2012, n° 3, p. 307-346.

accumulation of plastic in patches, the consumption of plastic by marine animals mistaking it for food, and plastic as a support for micro fauna⁸⁵⁸. Two countries of this case study, Cape Verde and France, explicitly push in that direction by exempting biodegradable bags from their plastic bag ban⁸⁵⁹. As a reminder, Cape Verde considers biodegradable plastic bags as “inoffensive for the environment”⁸⁶⁰. Nonetheless, scientific evidence emerges to raise the alarm against biodegradable bags, revealing they are not as green as what their name might indicate. First, the term “bio-plastic” can be misleading, as it can relate both to biodegradable and non-biodegradable plastic (i). Second, there are many limits to the biodegradability of plastic bags, which might have pervert effects (ii).

Bio-plastics: diversity of realities

The term bio-plastic is misleading, as it relates both to biodegradable bags, and bio-based plastics – plastics made for example from starch or maize⁸⁶¹. The fact that a plastic is bio-based “does not mean that bio-based plastic is also biodegradable”⁸⁶². As presented by Narancic *et al.*, “biodegradability is a feature related to the chemical nature of the polymer and the environmental conditions where the plastic is located. One hundred per cent bio-based polyethylene (bio-PE) and bio-based polyethylene terephthalate (bio-PET) are not biodegradable. Their chemical structure does not differ from oil-based PET and PE”⁸⁶³. Therefore, the chemical nature of the polymer has a greater impact on its biodegradability than the type of material used to produce it, be it fossil fuels “or recently grown bio mass”⁸⁶⁴. In the recital 11 of the Directive 2019/904⁸⁶⁵, the EU institutions also highlight the danger of bio-based plastics,

⁸⁵⁸ GOLDBERG Olga, « Biodegradable Plastics: A Stopgap Solution for the Intractable Marine Debris Problem Note », *Texas Environmental Law Journal*, 42, 2012 2011, n° 3, p. 307-346, p. 334.

⁸⁵⁹ See Title 2

⁸⁶⁰ Translated. In the text “*os sacos degradáveis e biodegradáveis cuja inocuidade para o ambiente*” Article 2, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁸⁶¹ UNEP, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », Nairobi, United Nations Environment Programme, 2015, p. 17.

⁸⁶² NARANCIC Tanja et O’CONNOR Kevin E., « Plastic waste as a global challenge: are biodegradable plastics the answer to the plastic waste problem? », *Microbiology*, 165, Microbiology Society, 2019, n° 2, p. 129-137, p. 132. See also ZHU Jingkun et WANG Can, « Biodegradable plastics: Green hope or greenwashing? », *Marine Pollution Bulletin*, 161, 2020, p. 111774.

⁸⁶³ NARANCIC Tanja et O’CONNOR Kevin E., « Plastic waste as a global challenge: are biodegradable plastics the answer to the plastic waste problem? », *ibid.*, p. 132.

⁸⁶⁴ UNEP, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », *op.cit.*, p. 17.

⁸⁶⁵ Directive 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (Text with EEA relevance), above mentioned.

which could be seen as viable alternatives to the plastic problem but in reality, remain as problematic as conventional plastic, being composed of the same molecules.

For example, in France, oxo-fragmentable plastics are strictly banned since 2015⁸⁶⁶. The French legislators justify this ban in the text of the *loi* itself: even if oxo-fragmentable bags are degradable (*i.e.*, do not stay in the state of a plastic bag), they cannot be digested by micro-organisms and are not compostable⁸⁶⁷. Oxo-fragmentable plastic bags in reality fragment in numerous micro-plastics⁸⁶⁸ which have demonstrated impacts on the environment⁸⁶⁹. Recital 18 of the Directive 2015/720 also highlights that oxo-biodegradable bags should not be considered biodegradable, as they contribute to an increase of pollution, by the dissemination of micro-plastics⁸⁷⁰

Plastic bags can be considered biodegradable under specific conditions. As defined by the United Nations Environment Programme, “environmental biodegradation is the partial or complete breakdown of a polymer as a result of microbial activity, into CO₂, H₂O and biomasses, as a result of a combination of hydrolysis, photodegradation and microbial action”⁸⁷¹. Specific additives can facilitate biodegradation⁸⁷², the presence in the environment of enzymes, living organisms such as bacteria, fungi or algae, or abiotic reactions such as oxidation, photodegradation, hydrolysis⁸⁷³. An adequate temperature, moisture, oxygen rate

⁸⁶⁶ Article 75 of France 2015 *loi* n°992, above mentioned

⁸⁶⁷ Article 75 of France 2015 *loi* n°992, above mentioned, « *Un plastique oxo-fragmentable est dégradable mais non assimilable par les micro-organismes et non compostable conformément aux normes en vigueur applicables pour la valorisation organique des plastiques.* ». In English “An oxo-fragmentable plastic is degradable but not assimilable by micro-organisms and not compostable in accordance with the standards in force applicable for the organic recovery of plastics.”

⁸⁶⁸ UNEP, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », *op.cit.*, p. 6.

⁸⁶⁹ GESAMP, « Sources, Fate and Effects of Microplastics in the Marine Environment: a Global Assessment », London, GESAMP (IMO/ FAO/ UNESCO-IOC/ UNIDO/ WMO/ IAEA/ UN/ UNEP/ UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, 2015.

⁸⁷⁰ For a detailed justification of this choice, see EUROPEAN COMMISSION, « Report from the Commission to the European Parliament and the Council on the impact of the use of oxo-degradable plastic, including oxo-degradable plastic carrier bags, on the environment », COM (2018) 35, Brussels, European Commission, 2018.

⁸⁷¹ UNEP, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », *op.cit.*, p. 6.

⁸⁷² NARANCIC Tanja et O’CONNOR Kevin E., « Plastic waste as a global challenge: are biodegradable plastics the answer to the plastic waste problem? », *Microbiology*, 165, Microbiology Society, 2019, n° 2, p. 129-137, p. 132.

⁸⁷³ NAPPER Imogen E. et THOMPSON Richard C., « Environmental Deterioration of Biodegradable, Oxo-biodegradable, Compostable, and Conventional Plastic Carrier Bags in the Sea, Soil, and Open-Air Over a 3-Year

and pH of the environment is thus key to the biodegradation process. Biodegradation is considered complete when “none of the original polymers remain”⁸⁷⁴.

Limits of plastic bag biodegradability

The set of conditions needed to guarantee biodegradability is the greatest limit of biodegradable plastic.

The process being abiotic and biotic conditions dependant, some plastics labelled biodegradable require “prolonged temperatures of above 50°C, to be completely broken down”⁸⁷⁵. Such environmental conditions are rarely if ever never met in natural environments, and even less in marine environments. Therefore, “any claim of compostability or biodegradability should be precise and clearly related to the conditions under which the properties apply”⁸⁷⁶. For the time being, national or provincial (rather than supra-national) biodegradability norms exist⁸⁷⁷, but not for every environment. For example, there is “no European standard for assessing biodegradability in water (...) because the very variable conditions in freshwater and marine environments make standardisation difficult”⁸⁷⁸. Therefore, the conditions for which these plastics have been certified for must match with real-life conditions.

Moreover, most biodegradable plastics do not degrade in marine environments⁸⁷⁹. According to Napper *et al.*, after 27 months under water, analysed oxo-degradable bags, biodegradable bags and conventional retained an average load of grocery items without breaking⁸⁸⁰. The

Period », *Environmental Science & Technology*, 53, American Chemical Society, 2019, n° 9, p. 4775-4783, p. 4781.

⁸⁷⁴ UNEP, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », *op.cit.*, p. 1.

⁸⁷⁵ *Ibid.*

⁸⁷⁶ EUROPEAN ENVIRONMENT AGENCY, « Biodegradable and compostable plastics - challenges and opportunities », Brussels, European Environment Agency, 2020, p. 6.

⁸⁷⁷ Such as ISO 18606, EN 13432, AS 4736. ZHU Jingkun et WANG Can, « Biodegradable plastics: Green hope or greenwashing? », *Marine Pollution Bulletin*, 161, 2020, p. 111774, p. 111776. The European Environment Agency highlights in 2020 that there is no European biodegradability standard given the variable conditions in freshwater and marine environments. See EUROPEAN ENVIRONMENT AGENCY, « Biodegradable and compostable plastics - challenges and opportunities », Brussels, European Environment Agency, 2020, p.5.

⁸⁷⁸ EUROPEAN ENVIRONMENT AGENCY, « Biodegradable and compostable plastics - challenges and opportunities », Copenhagen, European Environment Agency, 2020, p. 4.

⁸⁷⁹ BAGHERI Amir Reza, LAFORSCH Christian, GREINER Andreas *et al.*, « Fate of So-Called Biodegradable Polymers in Seawater and Freshwater », *Global Challenges*, 1, 2017, n° 4, p. 1700048, p. 1700053.

⁸⁸⁰ NAPPER Imogen E. et THOMPSON Richard C., « Environmental Deterioration of Biodegradable, Oxo-biodegradable, Compostable, and Conventional Plastic Carrier Bags in the Sea, Soil, and Open-Air Over a 3-Year Period », *Environmental Science & Technology*, 53, American Chemical Society, 2019, n° 9, p. 4775-4783, p. 4789. To the contrary, compostable bags were found to be deteriorated within a 3-months period.

authors highlight that underwater, a biofilm develops on the plastic bags (also known as fouling), which may “‘shield’ the plastic from UV light thus reducing the rate of photo-degradation” or make plastics negatively buoyant causing buoyant items to sink; hence further reducing irradiance”⁸⁸¹.

For these reasons, Narancic *et al.* highlight that “biodegradable plastics must be managed and cannot be seen as an easy solution to the current plastic pollution problems”, while controlling “uncontrolled release of biodegradable plastics into environments”⁸⁸². Additionally, defining a “time frame for biodegradation is critically important”, as “the limited biodegradability does not offer a benefit to the environment or the management of biodegradable waste”⁸⁸³. As such, it is “not clear that the oxo-biodegradable or biodegradable formulations provide sufficiently advanced rates of deterioration to be advantageous in the context of reducing marine litter, compared to conventional bags”⁸⁸⁴.

In addition, biodegradable plastics pose a number of life cycle issues. The sustainability of the production of raw material used to produce biodegradable plastics is one concern⁸⁸⁵, including in terms of pesticides and nutrients runoffs⁸⁸⁶. Regarding end of life, in a circular economy perspective, biodegradable plastics are not recycled into plastic material, and pose recycling issues when collected with conventional plastics⁸⁸⁷, especially if biodegradation has been triggered⁸⁸⁸. Biodegradable plastic bags aren’t necessarily more reused than conventional bags,

See also NAZARETH Monick, MARQUES Mônica R. C., LEITE Marcia C. A. *et al.*, « Commercial plastics claiming biodegradable status: Is this also accurate for marine environments? », *Journal of Hazardous Materials*, 366, 2019, p. 714-722.

⁸⁸¹ NAPPER Imogen E. et THOMPSON Richard C., *ibid.*, p. 4775-4783, p. 4794.

⁸⁸² NARANCIC Tanja et O’CONNOR Kevin E., « Plastic waste as a global challenge: are biodegradable plastics the answer to the plastic waste problem? », *Microbiology*, 165, Microbiology Society, 2019, n° 2, p. 129-137, p. 133.

⁸⁸³ *Ibid.*, p. 133.

⁸⁸⁴ NAPPER Imogen E. et THOMPSON Richard C., « Environmental Deterioration of Biodegradable, Oxo-biodegradable, Compostable, and Conventional Plastic Carrier Bags in the Sea, Soil, and Open-Air Over a 3-Year Period », *ibid.*, p. 4775.

⁸⁸⁵ ZHU Jingkun et WANG Can, « Biodegradable plastics: Green hope or greenwashing? », *Marine Pollution Bulletin*, 161, 2020, p. 111779.

⁸⁸⁶ GOLDBERG Olga, « Biodegradable Plastics: A Stopgap Solution for the Intractable Marine Debris Problem Note », *Texas Environmental Law Journal*, 42, 2012 2011, n° 3, p. 307-346, p. 344.

⁸⁸⁷ EUROPEAN ENVIRONMENT AGENCY, « Biodegradable and compostable plastics - challenges and opportunities », Brussels, European Environment Agency, 2020, p.8; See also UNEP, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », Nairobi, United Nations Environment Programme, 2015, p. 1.

⁸⁸⁸ YATES Madeleine R. et BARLOW Claire Y., « Life cycle assessments of biodegradable, commercial biopolymers—A critical review », *Resources, Conservation and Recycling*, 78, 2013, p. 54-66, p. 62.

being more fragile and having reuse limitations⁸⁸⁹. Last but not least, they could contribute to polluting the environment if littered, through their incomplete degradation, the release of additives or by products. Sanz-Lázaro *et al.* even highlight the risk that a massive input of biodegradable plastics in the ocean might pose, through the alteration of marine carbon and nitrogen geochemical cycles⁸⁹⁰.

For all the above-mentioned reasons, there is a risk that the increasing recourse to biodegradable plastic bags would have perversive effects. In a case-study in Brazil, La Fuente *et al.* found that “more than 50% participants associated the attributes “sustainable”, “ecological”, “recyclable”, “innovation” and “not pollutant””⁸⁹¹ to biodegradable bags, despite the prementioned limits of biodegradable bags. Additionally, there are “fears that consumers might misunderstand biodegradability or compostability claims as a ‘licence to litter’”⁸⁹² although it has been poorly studied until now. For this reason, it is interesting to observe that the Irish government explicitly makes no difference between biodegradable and other plastic bags, considering that “such bags will continue to form a visible nuisance, where discarded as litter”⁸⁹³.

The translation of these qualitative insights into indicators is the next step

b. A translation into indicators

As a reminder, two indicator frameworks have been designed to test the results’ robustness across methodological change. Both indicator frameworks here rely on the same method to score the indicator of the comprehensiveness of the object, based on the following scale:

0: there is no definition of the regulation's object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.
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⁸⁸⁹ LA FUENTE Carla I. A., TRIBST Alline A. L. et AUGUSTO Pedro E. D., « Knowledge and perception of different plastic bags and packages: A case study in Brazil », *Journal of Environmental Management*, 301, 2022, p. 113881, p. 113888.

⁸⁹⁰ SANZ-LÁZARO Carlos, CASADO-COY Nuria et BELTRÁN-SANAHUJA Ana, « Biodegradable plastics can alter carbon and nitrogen cycles to a greater extent than conventional plastics in marine sediment », *Science of The Total Environment*, 756, 2021, p. 143978.

⁸⁹¹ LA FUENTE Carla I. A., TRIBST Alline A. L. et AUGUSTO Pedro E. D., « Knowledge and perception of different plastic bags and packages: A case study in Brazil », *Journal of Environmental Management*, 301, 2022, p. 113886.

⁸⁹² EUROPEAN ENVIRONMENT AGENCY, « Biodegradable and compostable plastics - challenges and opportunities », Brussels, European Environment Agency, 2020, p. 8.

⁸⁹³ Department of the Environment, Climate and Communications, Irish government, <https://www.gov.ie/en/publication/28528-plastic-bags/>, accessed 26/01/2022.

Table II.2 summarizes the scores obtained in each entity, across methods 1 and 2, for the score of the comprehensiveness of the object. France here obtains the maximum score (3/3), as it regulates both conventional plastic and oxo-fragmentable plastics. Cape Verde and England obtain a score of 2 for their precise definition of plastic, but their uncomprehensive approach which does not regulate oxo-fragmentable plastics. Ireland, Scotland and Senegal obtain a score of 1, as the definition proposed is both vague and imprecise.

Methods 1 & 2		Comprehensiveness of the object	
Entity	Score	Justification	
CV	2	See article 3, <i>lei</i> 99-VIII of 2015. Oxo-fragmentable bags are not included.	
EN	2	See article 2, SI n°776 of 2015. Oxo-fragmentable bags are not included.	
FR	3	See article 1, <i>décret</i> n°379 of 2016. Oxo-fragmentable bags are included.	
IE	1	Plastic is not defined. See section 9, statutory instrument 36 of 2001.	
SC	1	Plastic is not defined. See regulation 3, Regulation n°161 of 2014.	
SN	1	Plastic is not defined. See article 3, <i>loi</i> n°4 of 2020.	

Table II.2 Methods 1 & 2 scores of the indicator of the comprehensiveness of the object.

The provision for exceptions to the regulation is closely related to the comprehensiveness of the object of the regulation.

Section 2) Exceptions to the regulation: high in number, large in scope

The number, type and scope of exceptions to the rule is another blow to the comprehensiveness of the regulation. The more exceptions there are and the largest in scope they are, the less comprehensive the regulation is likely to be. In other words, over-comprehensiveness of exceptions leads to under-comprehensiveness of regulation.

a. Qualitative insights

Exceptions are common in law, from environmental law to criminal law⁸⁹⁴. Even more, “even the most stringent of prohibitions appears to be subject to myriad exceptional circumstances in which the prohibited conducted is permissible”⁸⁹⁵.

Exceptions to the plastic bag regulation question the extent to which the regulation is likely to protect the environment from plastic bag pollution, by reducing the quantity of plastic bags

⁸⁹⁴ See the examples given in FINKELSTEIN Claire Oakes, « When the Rule Swallows the Exception », *Quinnipiac Law Review*, 19, 2000, p. 505-537.

⁸⁹⁵ *Ibid.*, p. 505.

produced and used. As a reminder, all the entities regulating plastic bags studied here provide for exceptions to their regulation⁸⁹⁶.

First, these exceptions are high in number. Across the seven case study countries and the six entities with an in-force plastic bag regulation, there are more than thirty exceptions to plastic bag regulations. Two-thirds of these exceptions are driven by uses for which the regulation does not apply.

Second, these exceptions are large in scope. These exceptions are of different types: related to the type of material⁸⁹⁷, the thickness of the material⁸⁹⁸, the size of the bags⁸⁹⁹, or related to the use of the bags⁹⁰⁰.

Concerning the type of material, exceptions to the regulation are based on the recourse to either biodegradable or paper bags. Interestingly, the Scottish regulation specifies that single use bags made of paper or another non plastic material should be taxed just like single use plastic bags. This decision highlights the fact that alternatives to plastic bags also have an impact and shouldn't be adopted with a blind eye. Changing habits from single-use (whatever the material) to multiple-use is here highlighted as the major challenge.

Concerning the thickness of the material, exceptions relate to bags made of plastic material with a wall thickness of more than 50 microns in France, England and Scotland. The purpose of this exception is to promote reusable plastic bags. The regulation of lightweight or thin plastic bags aims to guarantee the re-usability of the bags and avoid waste generation. Fragile, thin bags sometimes require to be doubled to transport a good without being ripped apart. Additionally, thin material offers poor recyclability options⁹⁰¹.

Orienting consumers towards thicker or reusable bags is to guarantee that these bags are indeed reused and not thrown away after single use or discarded in the environment, as these bags would be responsible for a pollution increase rather than decrease⁹⁰².

⁸⁹⁶ See Title 2, A. 2), C. Driving the exception: the use of plastic bags.

⁸⁹⁷ Cape Verde, England, Scotland, France. See Title 2 for details.

⁸⁹⁸ France, Scotland, England. See Title 2 for details.

⁸⁹⁹ Scotland, England, Ireland. See Title 2 for details.

⁹⁰⁰ Cape Verde, Ireland, Scotland, England, Senegal. See Title 2 for details.

⁹⁰¹ RAYNE Sierra, « The need for reducing plastic shopping bag use and disposal in Africa », *African Journal of Environmental Science and Technology*, 3, 2008, p. 3.

⁹⁰² See for example STANTON Thomas, KAY Paul, JOHNSON Matthew *et al.*, « It's the product not the polymer: Rethinking plastic pollution », *WIRES Water*, 8, 2020, n° 1, p. e1490, p. 1496: "Examples include the need to reuse a multiuse low-density polyethylene bag at least 10 times to see an environmental benefit over high-density polyethylene single-use plastic bags »

It nonetheless poses a comprehensiveness issue, as these bags require more plastic material to be produced, and would represent a higher threat to ecosystems if they found their way into nature. The promotion of these bags also requires the promotion and possibility of reuse to bridge the gap between a reusable and a reused bag.

Concerning the size of the bags, small bags benefit from exceptions to the regulation in Ireland, Scotland and England in relation to specific uses of bags. Are small bags potentially less harmful than larger bags? If their small size questions their reusability, it could also limit their recourse to the specific uses for which they have been exempted.

The use of the bags is the largest exemption in number but also in scope. The exempted uses range from the transport of blades to the transport of live aquatic animals to the use of plastic bags in hospitals, prisons and duty-free areas⁹⁰³. It is striking to observe that this type of exceptions is majorly provided in countries taxing or implementing an obligation to charge (*i.e.*, Ireland, England and Scotland) to the contrary of countries banning plastic bags, for which Cape Verde is the only country with such exceptions. If exceptions to a ban can be justified by the impossibility or complexity to find credible alternatives to some usages (for example for hygiene purposes⁹⁰⁴), economic incentives such as taxation or the obligation to charge doesn't deprive the users from the benefit of its object, being more a matter of incentive than constraint. Thereof, why shouldn't this incentive be applied to such objects?

b. A translation into indicators

Both indicator frameworks here rely on the same method to score the indicator of the scope of the exception, based on the following scale:

Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.
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Table II.3 summarizes the scores obtained in each entity, across methods 1 and 2, for the score of the scope of the exception.

⁹⁰³ See title 2.

⁹⁰⁴ For example, during the Covid-19 pandemic, plastic bags used to deliver online grocery shopping were exempt from the obligation to charge in England and Scotland. See Title 2. Another example is the transport of raw meat, fish or poultry as proposed by Cape Verde.

Methods 1 & 2		Scope of the exception
Entity	Score	Justification
CV	1	The exception on biodegradable bags is large in scope. Numerous use-based exceptions. All exceptions are clearly defined.
EN	1	All exceptions are clearly defined but they cover a wide array of situations.
FR	2	The exception of biodegradable / compostable bags is limited in scope.
IE	1	All exceptions are clearly defined but they cover a wide array of situations.
SC	1	All exceptions are clearly defined but they cover a wide array of situations.
SN	0	The exception based on the material criteria is obscure and overly comprehensive.

Table II.3 Methods 1 & 2 scores of the indicator of the scope of the exception

Senegal obtains the lowest score (0/3), due to its vague exception to the ban, for bags retail bags which definition is very close to banned checkout bags, bags made of a material “designed in such a way that it is not easy for the consumer to replace the component or components”⁹⁰⁵. Cape Verde, England, Ireland and Scotland obtain a score of 1 due to the important number of exceptions to the plastic bag regulation. France obtains a score of two, as the exception for compostable bags is precisely defined and limited in scope.

The last component of the comprehensiveness of the regulation is the activities targeted by the regulation.

Section 3) Activities targeted by the regulation

From the production to the use of plastic bags, a diversity of activities – and therefore of actors – can be targeted by the regulation such as production, import, export, distribution or commercialisation and use.

a. Qualitative insights

The activities targeted by each case study’s legal framework have been detailed above⁹⁰⁶.

It is here considered that the larger the range of targeted behaviours, the most comprehensive the regulation will be. In addition, it is assumed that the respective impacts of all these activities may diverge. When tackling a source of pollution, the regulation of its production upstream is likely to be more decisive than the regulation of its commercialisation downstream. This idea is embodied by the principles that preventive action should be taken, and that environmental

⁹⁰⁵ Translated. In the text: « Sont exclus du champ d’application de la présente loi, les produits dont un ou plusieurs composants sont des produits constitués ou fabriqués à partir de matières plastiques à condition que le produit principal soit conçu de manière à ne pas permettre facilement le remplacement du ou des composants par le consommateur. », Article 2, Senegal loi n°2020-04, above mentioned.

⁹⁰⁶ See Part II, Title 2, Chapter 1, Section 2, a.

damage should, as a priority, be rectified at source. It is therefore here considered that a regulation targeting upstream usages (production and import) is more comprehensive than a regulation targeting downstream usages (commercialisation, distribution and use). A regulation targeting all usages is the most comprehensive of all⁹⁰⁷.

b. A translation into indicators

The two indicator frameworks here diverge on the calculation method to obtain the score, based on the type of activity regulated.

Method 1 is based on the following basis: 4 points are attributed when production is regulated, 3 for importation, 2 for exportation / commercialisation / distribution and 1 for use. When several activities are targeted by the regulation, the relevant points are summed up. This method enables to value both the regulation of upstream stages and the regulation of the maximum of stages in the calculation of the score of this indicator.

Method 2 is consistent with the above-mentioned ratings along the following scale:

Rated on a 4 levels scale 0: there is no distinction as to the activity to which the regulation applies; 1: the regulation only applies to downstream activities (commercialisation and/or use); 2: the regulation applies to some upstream activities (production, import); 3: the regulation applies to all stages.

Its advantage is to guarantee homogeneity among the indicator scoring methods. Its inconvenient is to discriminate less than method 1 between different approaches.

Table II.4 presents the scores obtained for the indicator of targeted activities across case studies, following method 1. Cape Verde and France obtain the maximum score of 10/10, for their ban of the production, importation, commercialisation and use of plastic bags. England, Ireland, Scotland and Senegal obtain a score of 2, as the respective regulations only applies to commercialisation.

⁹⁰⁷ See Part I, Title 3, Chapter 1, Section 1, a. for more details.

Method 1		Targeted activities
Entity	Score	Justification
CV	10	Production, importation, commercialisation and use banned
EN	2	The regulation applies to commercialisation only.
FR	10	Ban on the production, importation, commercialisation and use
IE	2	The taxation applies to commercialisation only.
SC	2	The regulation applies to commercialisation only.
SN	2	The ban applies to commercialisation only.

Table II.4 Method 1 score of the indicator of targeted activities

The table II.5 displays the scores obtained for the same indicator and entities, following method 2. Cape Verde obtains the maximum score, as the regulation applies at all stages. To the contrary, France allows production for export for some plastic bags, and therefore obtains a score of 2. England, Ireland, Scotland and Senegal obtain a score of 1, as the respective regulations only apply to commercialisation.

Method 2		Targeted activities
Entity	Score	Justification
CV	3	The regulation applies to production, import, commercialisation and use.
EN	1	The regulation applies to commercialisation only.
FR	2	Ban on the production, importation, commercialisation and use. Production for export is allowed for some plastic bags.
IE	1	The taxation applies to commercialisation only.
SC	1	The regulation applies to commercialisation only.
SN	1	The ban applies to commercialisation only.

Table II.5 Method 2 score of the indicator of targeted activities

Out of the two methods, the second seems here more appropriate. It enables a more accurate analysis of the targeted activities, as shown by the French example. In addition, consistency in the quantification scale with the other two indicators of comprehensiveness facilitate aggregation.

In conclusion to this sub-section, the only fact that plastic bags are regulated doesn't mean that the protection is maximal. The most restrictive policy instrument is bound to have a limited protection potential if anything could be excluded from its scope. The definitions given of plastic bags, and the characteristics of the exemptions to the regulations are critical to better picture the potential contribution of the text to the protection of the environment. These analyses reveal how 'comprehensive' these regulations are. The potential of protection provided by the text also depends on its forcefulness: to which extent is it equipped to be enforced.

Chapter 2. A forcefulness perspective: providing for enforcement

The most comprehensive regulation would do little for the environment if it couldn't be enforced. Comprehensiveness and forcefulness operate in symbiosis, a high comprehensiveness and a high forcefulness contributing to environment protection.

As above mentioned, the study of forcefulness aims to characterise the means provided for in the legal texts to enforce the required system change to protect the environment. It is a measure of the potential of force of a legal framework, questioning whether the set of rules are supplied by the necessary tools to be enforced and instil change on the ground⁹⁰⁸. The numerical analysis of forcefulness unfolds along three lines. First, forcefulness may be influenced by the policy instrument choice and its design (section 1); second, by provisions for controls (section 2) and last, by provision for sanctions (section 3). For each section, qualitative insights (a) feed the scoring of the attached indicator (b).

Section 1) Policy instrument choice and design

a. Qualitative insights

The forcefulness of the policy instrument depends of its type and its design.

Concerning the type of instrument, these may be binding or non-binding – *i.e.*, obligatory or optional. There are two distinct approaches to binding instruments, embodied by command-and-control type instruments and market-based instruments. Whereas the first regulate the acceptable level of pollution, the second leverage the cost of pollution⁹⁰⁹.

Command-and-control instruments have the advantage to provide a clear strategy in front of a source of pollution. These types of instruments – such as the ban or the permit – enable to strictly frame the characteristics or uses of the plastic bags. For example, in this case-study, France strictly bans non-reusable plastic bags and oxo-degradable bags. Following the spirit of this regulation, there should be no remaining non-reusable plastic bags and oxo-degradable bags in France. To the contrary, market-based incentives do not aim to eradicate a specific type of bag, considered as particularly harmful, but to discourage actors from having recourse to these bags, through a cost attached to the use of this bag, such as in Ireland, England and Scotland. Following the spirit of these regulations, reduction rather than eradication is the

⁹⁰⁸ See generally Part 1, Title 3, Chapter 1.

⁹⁰⁹ *Nota bene*: the enforcement of these instruments is not discussed here, nor is their effectiveness. The mechanisms by which the instruments shape the access to plastic bags and the behaviours of actors is of sole interest.

objective. As such, command-and-control and economic-based instruments do not deploy the same power relationship with the actors; besides, market-based instruments influence demand rather than supply⁹¹⁰. In that sense, it is here considered that the forcefulness of command-and-control instruments is higher than that of market-based instruments.

A mix of binding and non-binding instruments may offer interesting enforceability perspectives, as shown here by the Cape Verdean example⁹¹¹. The 2015 *lei* n°99/VIII above mentioned articulates temporary obligation to charge with a ban, and awareness raising measures, including funding⁹¹². This recourse to informational instruments is unique in the case study countries' plastic bag regulation. The obligation to charge transition period works in symbiosis with the other two instruments. The ban is here designed to cut the tap of a pollution source. At the same time, legislators have in mind that such a constraint on people's habits and behaviours can be enforced only if people understand why, and are transitorily led to adopt alternative means, find alternative resources. Awareness raising and the obligation to charge here endorse this role. The enforceability of the Cape Verdean *lei* is increased by this attention drawn on awareness-raising. The enforcement of the regulation can only be facilitated if understood and accepted by the enforcees.

As a matter of design, it is interesting to compare the potential of protection of two market-based instruments – taxation and obligation to charge – as designed by Ireland, England and Scotland to regulate plastic bags. Based on what precedes, these two instruments would have similar forcefulness potentials⁹¹³. The Irish taxation is nonetheless more likely to protect the environment, as the revenues from the plastic bag levy are paid into an Environment Fund⁹¹⁴ which in turn funds environment protection actions⁹¹⁵. To which extent this allocation of the revenues of the charge represents a right to pollute or a pragmatic design remains an open

⁹¹⁰ RACHEL KARASIK Tibor Vegh, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020, p. 82.

⁹¹¹ A mix of policy instruments is sometimes presented as a leverage to fight marine litter. See VINCE J. et HARDESTY B.D., « Governance solutions to the tragedy of the commons that marine plastics have become », *Frontiers in Marine Science*, 5, 2018, p. 214, p. 220.

⁹¹² For more details, see Title 2, A. 1), c. 'Command, educate and incentive' a Cape-Verdean melody.

⁹¹³ The forcefulness of market-based instruments also depends on the amount of the charge. See Title 2, 1, b for the respective amounts of the charge in Ireland, England and Scotland.

⁹¹⁴ Article 9, Ireland Statutory Instrument n°36 of 2001, above mentioned.

⁹¹⁵ A list of utilisations of this fund is available on the Irish government's website : <https://www.gov.ie/en/publication/f6b84-environment-fund-accounts/>, accessed 26/01/2022.

question. In Cape Verde, the stance is clearer as it is the revenues of the sanctions rather than of the obligation to charge, which funds plastic-related awareness-raising and environment protection programmes⁹¹⁶. In Scotland and England, the revenues of the charge are received by the sellers. They are simply encouraged to transfer these profits to charities. As such, they are incentivized to apply the obligation to charge.

The provision for enforcement delays can, paradoxically, be another design feature positively influencing enforceability. The plastic bag regulations of Cape Verde, France and Ireland provide for enforcement delays, meaning that there is a lag between the date the text enters in force, and the date from which the instruments are enforceable. This delay varies from a country to another, or from an instrument to another. In Cape Verde, the delay for the enforcement of the production and importation ban is approximately of 10 months⁹¹⁷ whereas it is approximately of 16 months for the commercialisation and use ban⁹¹⁸. In France, the delay for the enforcement of the production and importation ban is approximately of 10 months⁹¹⁹, 4 months for the commercialisation ban on checkout bags, and 16 months for the commercialisation ban on retail bags⁹²⁰. In Ireland, approximately 3 months passed between the signature of the statutory instrument and the commencement of the taxation⁹²¹. These delays may indirectly and paradoxically contribute to enhanced environment protection. Producers may be more likely to comply if they have the feeling that their constraints have been taken into account⁹²². This variable is nonetheless difficult to include in indicator-based frameworks as the extent to which the existence and duration of enforcement delays positively or negatively impact the legal frameworks' potential of protection.

⁹¹⁶ Article 15, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁹¹⁷ Delay between the publication of the text in the *Bulletim Oficial* and the date from which the ban enters into force, provided by Article 5, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁹¹⁸ Delay between the publication of the text in the *Bulletim Oficial* and the date from which the ban enters into force, provided by Article 6, Cape Verde 2015 *lei* n°99/VIII, above mentioned.

⁹¹⁹ Delay between the publication of the text in the *Journal Officiel* and the date from which the ban enters into force, provided by Article 77 of the *loi* n°2020-105, above mentioned.

⁹²⁰ Delay between the publication of the text in the *Journal Officiel* and the date from which the bans enter into force, provided by France, article 75 of *loi* n°2015-992 above mentioned.

⁹²¹ Provided by Article 3, Ireland 2001 Statutory Instrument n°605, above mentioned.

⁹²² Article 12, Cape Verde 2015 *lei* n°99/VIII, above mentioned. The Cape Verdean *lei* enters into force in July 29th 2015. This leaves producers near to a year to find alternatives to the production of 'conventional' plastic bags. Producers are encouraged to progressively work towards this ban by a gradual reduction of the production / importation of plastic bags. A 60% reduction rate should be attained in 2015, to reach 100% by July 1st, 2016.

b. A translation into indicators

The two indicator frameworks here diverge on the calculation method to obtain the score, based on the type of activity regulated.

Method 1 is based on the following calculation method: 1 point is attributed to cooperative and informational instruments, 3 points to market-based instruments, and 4 points to bans. When several types of instruments are provided for, the relevant points are summed up. This method enables to value both the provision for different types of instruments and values the provision for command-and-control instruments over other types of instruments.

Method 2 is consistent with the above-mentioned ratings along the following scale:

Rated on a 4 levels scale
0: non-binding (informational or cooperative) instruments only are provided for;
1: market-based instruments are provided for;
2: command-and-control instruments are provided for;
3: several types of instruments are provided for.

Table II.6 summarizes the scores obtained in each entity, following method 1, for the indicator of the force of the instrument. Cape Verde obtains the highest score (5 / 8), for its provision for a ban and informational instruments. The ban, which is no longer in force, has not been taken into account. France and Senegal obtain a score of 4 for their provision for command-and-control instruments. Last, England, Ireland and Scotland obtain a score of 3 for their provision of market-based instruments.

Method 1		Force of the instrument
Entity	Score	Justification
CV	5	Provision for a ban, an obligation to charge (no longer in force) and of informational instruments
EN	3	Provision for an obligation to charge.
FR	4	Provision for a ban.
IE	3	Provision for a taxation scheme
SC	3	Provision for an obligation to charge.
SN	4	Provision for a ban, permit and standards.

Table II.6 Method 1 score of the indicator of the force of the instrument

Table II.7 presents the scores obtained for the indicator of the force of the instrument, following method 2. Cape Verde here obtains also the highest score (3/3) as several types of instruments are provided for. France and Senegal here obtain a score of 2 for their provision of a market-based instrument, and England, Ireland and Scotland a score of 1.

Method 2		Force of the instrument
Entity	Score	Justification
CV	3	Provision for a ban, an obligation to charge (no longer in force) and informational instruments
EN	1	Provision for an obligation to charge.
FR	2	Provision for a ban.
IE	1	Provision for a taxation scheme.
SC	1	Provision for an obligation to charge.
SN	2	Provision for a ban, permit and standard.

Table II.7 Method 2 score of the indicator of the force of the instrument

The difference between the two methods is less visible here than for the indicator of the targeted activity. For this specific indicator, there is no methodological preference at this point.

Section 2) The provision for controls

The provision for controls is a key feature of the enforceability of the legal frameworks, as they enable to detect non-compliance.

a. Qualitative insights

The differentiated provisions for control across case-study countries have been detailed above⁹²³. This analysis highlighted that provision for controls are variously precise from an entity to another. Whereas the identification of an administration in charge of the control can facilitate its implementation, the precision with which the process is defined is also a factor increasing the enforceability of the controls⁹²⁴.

b. A translation into indicators

Both indicator frameworks here rely on the same method to score the indicator of the provision for controls, based on the following scale:

<p>Rated on a 4 levels scale</p> <p>0: no control is provided for;</p> <p>1: controls are provided for, but no administration is explicitly in charge of such controls;</p> <p>2: controls are provided for, an or several administrations are in charge of the controls. The process is not defined;</p> <p>3: controls are provided for, the administration is identified, and the process is clearly defined.</p>
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⁹²³ See Part II, Title 2, Chapter 1, section 3, a.

⁹²⁴ See Part I, Title 3, Chapter 1, section 2, a.

Table II.8 summarizes the scores obtained in each entity, across methods 1 and 2, for the score of the scope of the exception.

England, Ireland and Scotland here obtain the maximum score (3/3) as the administration in charge of the controls and the process are clearly defined. Cape Verde, France and Senegal obtain a score of 2, as administrations in charge of the controls are clearly identified but the process is not defined.

Methods 1 & 2		Provision for controls
Entity	Score	Justification
CV	2	See article 15, <i>lei</i> 99-VIII of 2015 above mentioned. The process is not described.
EN	3	See part 3, SI n°776 of 2015.
FR	2	See art. 3, <i>décret</i> n°279 of 2016.
IE	3	See articles 9 and 17, SI n° 605 of 2001.
SC	3	See part 3, Regulation n°161 of 2014.
SN	2	Multiple administrations are in charge of the controls. See article 25, <i>loi</i> n°4 of 2020. The process is not defined.

Table II.8 Methods 1 & 2 scores of the indicator of the scope of the exception

The provision for sanctions is the last indicator of the forcefulness of the regulation.

Section 3) Beyond a binary analysis of sanctions

The provision for sanction offers means to answer to non-compliance. As such, they are a key element of the forcefulness of legal frameworks.

a. Qualitative insights

There are different ways by which it is possible to analyse the contribution of sanctions to the potential of environment protection of the texts. The first level of analysis relates to a binary analysis, verifying that sanctions are provided for in case of non-compliance with the policy instrument. In all the case study countries, every binding instrument is accompanied by sanctions in case of non-compliance.

Therefore, it is necessary to go beyond the binary analysis of the existence vs. absence of sanction to analyse the contribution of sanctions to the forcefulness of the regulation.

An analysis of the type of the sanctions provided for is a second level of analysis. This aspect has been explored above, resulting with the observation of the predominance of fines in the sanctions provided for in the case-study countries. The amount of the fines plays a determinant role in the dissuasiveness of these sanctions. Determining the optimum amount of the fine to

have a deterrent effect is out of the scope of this study as it directly relates to an analysis of the effectiveness of the regulation. First, a sanction will likely to be deterrent if it prevents infringement upstream and recidivism downstream. To do so, there must be a direct link between infringement and sanction, which passes by the effectiveness of controls and the pronouncement of the sanction. Additionally, the perception of the risk of controls *vs.* the real frequency of controls, known of salience of law enforcement, can influence the compliance of actors⁹²⁵. Second, evaluating the deterrence effect of sanctions would benefit from the analysis of the marginal cost of pollution *vs.* the marginal cost of compliance or adversity to risk⁹²⁶. Last, the risk the actor takes in case of control in terms of image can also contribute to the deterrence effect of sanctions. In other words, the analysis of the deterrent effect of sanctions requires to go beyond the analysis of the legal provisions, to investigate their interaction with the prementioned other variables of enforcement.

It is nonetheless possible to compare the forcefulness of fines provided by case-studies by comparing the amount of these fines. As the case study countries have different currencies and purchasing power levels, the amount of the fines is not directly comparable. Rating the amount of the fines against each country's minimum wage could be a solution.

	CV (CVE)	EN (£)	FR (€)	IE (€)	SC (£)	SN (FCFA)
Min. monthly wage ⁹²⁷	15000	1536,2	1 603,12	1774,5	1536,2	58 900
Minimum fine	50 000	100	3 000	/	100	50 000
Maximum fine	800 000	5000	15 000	1757,8 ⁹²⁸	200	10 000 000
Ratio min.	3,33	0,065	1,87	/	0,065	0,85
Ratio max.	53,3	3,25	9,35	1,008	0,130	169,8

Table II.9 Comparison of case-studies on the basis of minimum wage, minimum fine and maximum fine.

⁹²⁵ DUR Robert et VOLLAARD Ben, « Saliency of law enforcement: A field experiment », *Journal of Environmental Economics and Management*, 93, 2019, p. 208-220, p. 210.

⁹²⁶ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., p. 250.

⁹²⁷ Cape Verde, <https://take-profit.org/en/statistics/minimum-wages/cape-verde/>; France <https://www.service-public.fr/particuliers/vosdroits/F2300>; United Kingdom, France and Ireland <https://fr.countryeconomy.com/marche-du-travail/salaire-minimum-national>, Senegal <https://www.tradesolutions.bnpparibas.com/fr/implanter/senegal/les-conditions-de-travail>. All accessed 17/03/2022.

⁹²⁸ The fine is provided for in the Act n° 10 of 1996, above mentioned, in pounds. The maximum fine has therefore been calculated using the exchange rate between pounds and euro on 21/07/2022 – 1£=€1,17.

Table II.9 displays the minimum wage, minimum fine and maximum fine for each case-study. The ratio min. and ratio max. are calculated to reflect the number of minimum monthly wages needed to pay the fine. This standardised calculation enables to compare the amount of the fines provided for in case of non-compliance with the plastic bag regulations. As far as the ratio min. is concerned, England and Scotland are the case studies with the lowest minimum fine (0,065 equivalent minimum wages) and Cape Verde the higher (3,33 equivalent minimum wages). French and Senegalese ratios are around 1 (respectively 1,85 and 0,85). Discrepancies are higher for the ratio of the maximum score, ranging from 0,13 times the minimum wage in Scotland to 169,8 times the minimum wage in Senegal. As such, the forcefulness of a similar type of sanction can vary according to its design.

b. A translation into indicators

The two indicator frameworks here diverge on the calculation method to obtain the score of the indicator of the provision for sanctions.

Method 1 is based on the following calculation method: 0. Is attributed where no sanction is provided for, 1 point for display, 2 points for a low fine, 3 points for seizure, confiscation and temporary closure, 4 points for a high fine, and 5 points for prison. When several types of sanctions are provided for, the relevant points are summed up. This method enables to value both the provision for different types of sanctions and values the provision for severe sanctions.

Method 2 is consistent with the above-mentioned ratings along the following scale:

<p>Rated on a 4 levels scale</p> <p>0: No sanction is provided for;</p> <p>1: There are a limited number of sanctions which are limited in force;</p> <p>2: The sanctions provided for have a significant force;</p> <p>3: There are several types of sanctions, among which some have a significant force.</p>

Table II.10 summarizes the scores obtained in each entity, following method 1, for the indicator of the force of the instrument. Senegal obtains the highest score (13/15) as it provides for the largest array of sanctions, spanning over seizure, confiscation and temporary closure, fines and imprisonment. Ireland obtains a score of 9 for the provision for high sanctions and imprisonment, England a score of 5 (display and high fine) and both Cape Verde and France obtain a score of 4 (high fines). Scotland obtains the lowest score, (low fines).

Method 1		Provision for sanctions
Entity	Score	Justification
CV	4	Fines range from 50 000 to 400 000 escudos (see article 15, lei 99-VIII of 2015). The min. wage in CV is approx. 15000 escudos per month.
EN	5	The maximum amount for the fine is £5000. There is no minimum amount. A publicity notice may be given to a seller imposed with a civil sanction
FR	4	The maximum amount for the fine is either €3000 or €15000. There is no minimum amount.
IE	9	The maximum amount of the fine is 1500€, there is no minimum amount. To the maximum, a 12 months imprisonment can be pronounced.
SC	2	The fine cannot exceed £200. The discounted amount is of £100.
SN	13	Provision for the display of the sanction, for the seizure, confiscation and temporary closure, for fines and imprisonment. Fines range from 36000 to 30 000 000 FCFA.

Table II.10 Method 1 score of the indicator of provision for sanctions

Table II.11 presents the scores obtained for the provision for sanctions indicator, with method 2. Ireland and Senegal obtain the maximum score (3/3) as they provide for several types of sanctions, among which imprisonment and fines have a significant force. Cape Verde, France and England obtain a score of 2, for the provision for high fines. Last, Scotland obtains a score of 1 as it only provides for a low fine.

Method 2		Provision for sanctions
Entity	Score	Justification
CV	2	The fines which are provided for have a significant force. See article 15, lei 99-VIII of 2015 for amounts.
EN	2	The maximum amount for the fine is £5000. There is no minimum amount. A publicity notice may be given to a seller imposed with a civil sanction
FR	2	The maximum amount for the fine is either €3000 or €15000. There is no minimum amount.
IE	3	The maximum amount of the fine is 1500€, there is no minimum amount. To the maximum, a 12 months imprisonment can be pronounced.
SC	1	The fine cannot exceed £200. The discounted amount is of £100.
SN	3	Provision for the display of the sanction, for the seizure, confiscation and temporary closure, for fines and imprisonment. Fines range from 36000 to 30 000 000 FCFA.

Table II.11 Method 2 score of the indicator of the provision for sanctions

Method 1 here tends to over-value the recourse to different types of fines, as shown by the Senegalese example. It is nonetheless uncertain whether sanctions such as display and confiscation have such a determinant effect on the forcefulness of the legal framework. Whereas complementary studies on the enforcement and efficiency of plastic bag regulations should enable to refine method 1's rating, in the meanwhile, method 2's rating will be preferred. In addition, it enables to facilitate the aggregation of the different indicators into scores of comprehensiveness and forcefulness, and into a country index.

Summary tables of the scores of the indicators following methods 1 and 2 are provided in Annexes XII and XIII.

Contributions and limits of the database

The contributions and limits of the database are here very similar to those of the textual analyses developed in Title 2.

Rather than a game-changer, the use of the relational database is here a time-saver. The 'find function' facilitates the extraction of data offering food for thought, and the relational architecture displays the interlinkages between different elements of the database (e.g., instruments, objects and sanctions) in a manner which is invisible to paper analyses.

There are nonetheless limits to the use a relational database for textual research. The fragmentation of legal texts it entails can lead to misinterpretations, omissions or extrapolations. Verifications in the original legal text are sometimes required. Additionally, the 'find' function is very sensitive to the words used in the data categorisation and search processes. Homogeneity of data entry is crucial to guarantee the usefulness of the database.

Chapter 3. From indicators to a country index: quantifying the potential of protection

Now that indicators of comprehensiveness and forcefulness have been defined and scored, their aggregation into comprehensiveness and forcefulness scores (section 1) and into country-based indexes (section 2) offer additional comparative perspectives to the textual analyses of the potential contribution of law to the protection of the environment. In particular, they enable to compare the location and the breadth of legal frameworks' weaknesses.

Section 1) Aggregated indicators of comprehensiveness and forcefulness: a comparison of methods 1 and 2

The computation of indicators of comprehensiveness and forcefulness is the first step. The development of a double method to compare the sensitivity of the results to methodological choices impact the construction of aggregated indicators of comprehensiveness and forcefulness (a). The results obtained are also sensitive to this methodological change (b).

a. The construction of aggregated indicators of comprehensiveness and forcefulness

The construction of aggregated indicators of comprehensiveness and forcefulness requires to compute a unique score for each dimension, on the basis of pre-mentioned indicators. The design of the indicators therefore influences the construction of aggregated indicators.

The specificity of method 1 (in regard to method 2) is that it doesn't rate all the semi-quantitative indicators along the same scale. For example, the comprehensiveness of the object is rated on a 0 to 3 scale based on its characteristics – meaning that this indicator's value is either 0, 1, 2 or 3. The scope of the exception indicator and the provision for controls indicator are rated on a similar scale. The targeted activity indicator is calculated upon a different method: the regulation of production provides 4 points, of importation 3 points, of exportation / commercialisation / distribution 2 points and of use 1 point. The sum provides the indicator value. The forcefulness of the instrument and the forcefulness of the sanctions are calculated on a similar basis. Therefore, in method 1, the different indicators are not rated all on the same scale. As such, implicitly, they do not have the same weight. This element will have to be addressed during the aggregation phase.

The specificity of method 2 (in regard to method 1), is that all indicators are semi-quantitative and rated along a 0 to 3 scale. Therefore, the value of all indicators is 0, 1, 2 or 3.

The method followed to aggregate the indicators into comprehensiveness and forcefulness scores can have important effects on the value of the aggregated score.

The rate and the grade are two distinct aggregation methods. The rate is based on the calculation, for each indicator, of a rate of completion. For example, the maximum score for the targeted activity indicator in method 1 is 10. If a country scores 2 on this indicator, the rate of completion for this indicator is 20% (2/10). The rate of completion of the three indicators of comprehensiveness and forcefulness, are then averaged to obtain the comprehensiveness and forcefulness scores. The advantage of this aggregation method is to attribute an equal weight to each indicator of either comprehensiveness or forcefulness.

The calculation of the grade differs. The score obtained for each of the three indicators of comprehensiveness is added up, divided by the total maximum score, and multiplied by ten to obtain a grade out of ten. Therefore, this aggregation method implicitly attributes more weight to indicators scored on a large scale rather than to indicators scored on a smaller scale (e.g., the targeted activity indicator is scored out of 10, whereas the scope of the object is scored out of 3).

Method 1	CV	EN	FR	IE	SC	SN
Comprehensiveness aggregate scores						
Comprehensiveness rate (%)	67%	40%	89%	29%	29%	18%
Comprehensiveness rank (rate)	2	3	1	4	4	6
Comprehensiveness grade (out of 10)	8,1	3,1	9,4	2,5	2,5	1,9
Comprehensiveness rank (grade)	2	3	1	4	4	6
Forcefulness aggregate scores						
Forcefulness rate (%)	52%	57%	48%	66%	50%	68%
Forcefulness rank (rate)	4	3	6	2	5	1
Forcefulness grade (out of 10)	4,2	4,2	3,8	5,8	3,1	7,3
Forcefulness rank (grade)	3	3	5	2	6	1

Table II.12: Method 1 comprehensiveness and forcefulness aggregated (rate and grade)

Table II.12 provides an overview of the aggregate rates and grades obtained for each case-study, following method 1. It enables to compare the values obtained through each aggregation method, and the resulting rank of each country. The ranks of the countries are not influenced by the aggregation method for comprehensiveness, but are affected for forcefulness as Cape Verde, France and Scotland changed positions. The value of the score obtained through the calculation of the rate or of the grade are more affected. This difference is driven by the increased weight attributed to indicators rated on a larger scale, such as the targeted activity indicator (rated out of 10), the force of the instrument indicator (rated out of 8), and the provision for sanctions indicator (rated out of 15). The forcefulness aggregate score is more affected than the comprehensiveness aggregate score by the different aggregation methods as two indicators out of three (contrary to one indicator out of three) are indicators rated on larger scales. The different case-studies are also asymmetrically affected. Whereas Senegal’s

forcefulness score benefits from the calculation of a grade rather than a rate, due to its high score on the provision for sanction indicator, all the other case-studies are negatively impacted by the calculation of a grade as a forcefulness score.

As all the indicators of method 2 are scored on the same scale, the calculation of a score rather than a grade does not have an influence on the comprehensiveness and forcefulness scores, neither on the case-studies' relative ranks. Table II.13 provides the same information as table II.12, for method 2. As there is no scientific justification to the attribution of a more important weight to some variables, the following analyses will only rely on the aggregated scores calculated as rates.

Method 2	CV	EN	FR	IE	SC	SN
Comprehensiveness aggregate scores						
Comprehensiveness rate (%)	67%	44%	78%	22%	33%	22%
Comprehensiveness rank (rate)	2	3	1	5	4	5
Comprehensiveness grade (out of 10)	6,7	4,4	7,8	2,2	3,3	2,2
Comprehensiveness rank (grade)	2	3	1	5	4	5
Forcefulness aggregate scores						
Forcefulness rate (%)	78%	67%	56%	44%	56%	78%
Forcefulness rank (rate)	1	3	4	6	4	1
Forcefulness grade (out of 10)	7,8	6,7	5,6	4,4	5,6	7,8
Forcefulness rank (grade)	1	3	4	6	4	1

Table II.13: Method 2 indicators aggregated (rate and score)

Therefore, the choice of the aggregation method impacts the comprehensiveness and forcefulness scores obtained for method 1. The choice of the indicator-framework (method 1 vs. method 2) also impacts the obtained scores.

b. A sensitivity to methodological choices: comprehensiveness and forcefulness country analyses

The comparison of the scores (calculated as rates) obtained for comprehensiveness following method 1 and method 2 enable to illustrate the sensitivity of the results to methodological choices. The following figures reveal that the difference between the aggregated scores of comprehensiveness and forcefulness, calculated using method 1 or 2, can be analysed on the basis of differences in score, and differences in the relative rank of the countries, meaning that both are affected by the aggregation method

Figure II.21 represents, respectively for method 1 (circles) and for method 2 (squares), the forcefulness scores in function of the comprehensiveness scores obtained for each country through the calculation of the rate.

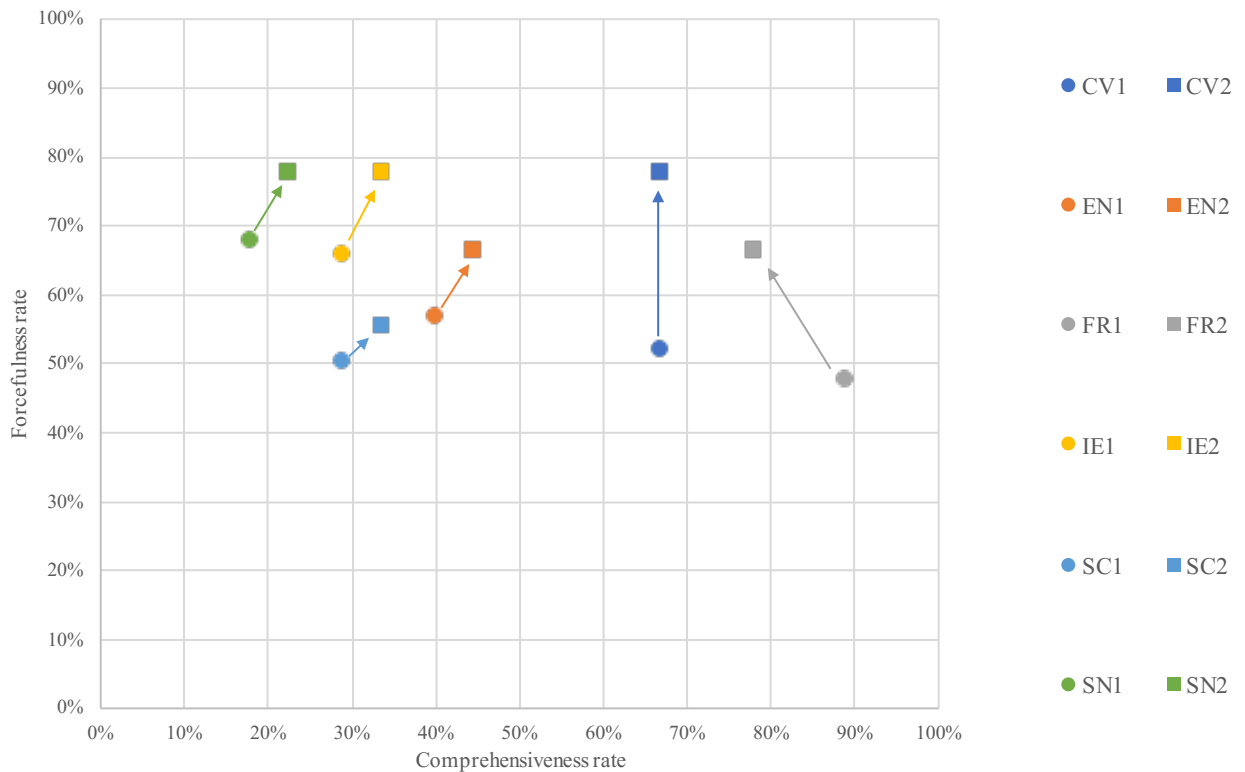


Figure II.21: Forcefulness by comprehensiveness rates: comparison of methods 1 and 2

The arrows show, for each case-study, the evolution of the score from method 1 to method 2. An evolution along the horizontal axis shows an evolution of the comprehensiveness score, whereas an evolution along the vertical axis shows an evolution of the forcefulness score. This representation shows that for most case-studies (Ireland, Senegal, Scotland and England), the scores of comprehensiveness are higher in method 2 than in method 1. Scores for forcefulness are higher in method 2 than in method 1 for all case-studies. The most dramatic changes in score are observed on the comprehensiveness dimension in France (-11,1 percentage points) and on the forcefulness dimension for Cape Verde (+ 25,8 percentage points). On average, countries gain 1,1 percentage points with method 2 compared to method 1 on the dimension of comprehensiveness, and gain 13,61 points on the forcefulness dimension.

Differences in ranks can be considered more important than differences in scores, the value of which is a methodological construction. Table II.14 displays the ranking of case studies for comprehensiveness and forcefulness scores, for method 1 and 2. It reveals that case-studies are asymmetrically impacted by methodological choices. Whereas the comprehensiveness ranking is stable across method 1 and 2, the forcefulness ranking is impacted by methodological choices. While Cape Verde gains 3 places, England loses 1 place, France gains 2 places, Ireland gains 1 place and Scotland loses 1 place from method 1 to method 2. Senegal is the only entity to remain stable.

	CV	EN	FR	IE	SC	SN
<u>Comprehensiveness rank (method 1)</u>	2	3	1	4	4	6
<u>Comprehensiveness rank (method 2)</u>	2	3	1	4	4	6
<u>Forcefulness rank (method 1)</u>	4	3	6	2	5	1
<u>Forcefulness rank (method 2)</u>	1	4	4	1	6	1

Table II.14: Ranking of case studies for comprehensiveness and forcefulness scores, calculated following method 1 and method 2

The pursuit of country-based analyses of the potential contribution of law to the protection of the environment through the regulation plastic bags requires to choose a single method of analysis. Method 2 will be preferred, for several reasons. The larger indicator rating scales used in method 1, obtained through the addition of sub scores attached to regulatory characteristics, greatly impacts the scores of forcefulness, under the influence of the provision for sanctions indicator. Senegal is the only country to provide for a large array of sanctions, benefiting from a high score under this method, whereas all the other countries obtain approximately the main forcefulness scores even though forcefulness disparities exist between these countries. The qualitative analysis induced in the scoring of the provision for sanctions indicator in method 2 enables a more subtle analysis of the provision for sanctions.

The selection of an indicator-framework (method 2) and of an aggregation method (the calculation of a rate) enables to compare the comprehensiveness and forcefulness scores from a country to another.

c. Comprehensiveness and forcefulness scores: a country-to-country analysis

Prior to the aggregation of the obtained indicators into a single country index, the comparison of the scores of comprehensiveness and forcefulness can reveal differentiated potential for protection across the case-study countries.

Figure II.22 represents the comprehensiveness and forcefulness scores obtained for each case-study, following the above-mentioned methodology (method 2, rates). It reveals that all case-study countries – to the exception of France – have a forcefulness score higher than their comprehensiveness score. This characteristic shows that on average the analysed entities tend to provide significant means for the regulation to be enforced, but tend to have a limited approach – rather than a holistic approach – to the issue of plastic pollution. Besides, the distribution of scores of comprehensiveness is broader than the distribution of scores of forcefulness. This means that the differences between the case study countries tend to find their source in the developed approach to the issue of plastic pollution rather than in the means provided to trigger a behaviour change. Overall, France and Cape Verde are the two countries

with the most uniform legal framework – with the less difference between comprehensiveness and forcefulness scores. To the contrary, Senegal is the country with the most important divergence between comprehensiveness and forcefulness scores, with a difference of 56 points of percentage.

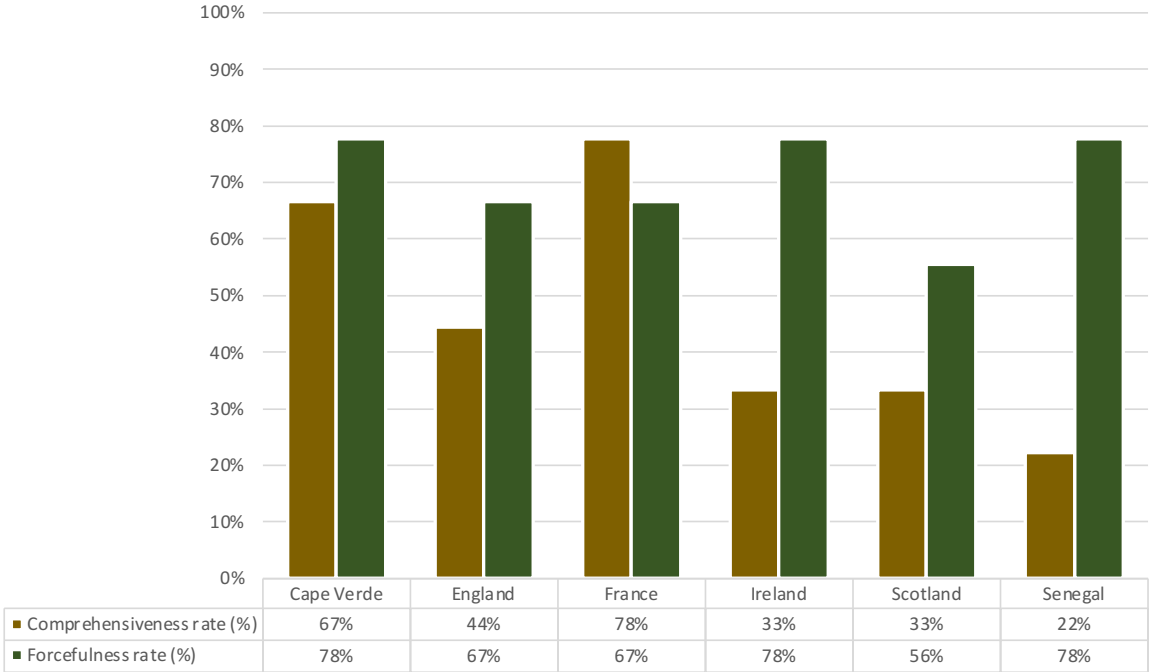


Figure II.22 Comprehensiveness and forcefulness scores obtained per entity

The fact that several countries obtain similar scores – Ireland and Scotland for comprehensiveness and Cape Verde, Ireland and Senegal for forcefulness – calls for further comments. First, it could highlight resemblance between the adopted legal frameworks. Here, the identical comprehensiveness score of Ireland and Scotland finds its sources in very similar regulations. To the contrary, the identical forcefulness scores of Cape Verde, Senegal and Ireland hides differentiated approaches, as the first two rely on a ban whereas the last relies on taxation. Their scores for the indicators of the provision for controls and sanctions also differ, as shown on table II.15, but the average of all scores lead to the same result. This feature highlights the need to interpret the aggregate scores in the light of the scores of the individual indicators.

Method 2 scores	CV	EN	FR	IE	SC	SN
Comprehensiveness aggregate scores	67%	44%	78%	33%	33%	22%
Targeted activity	3	1	2	1	1	1
Comprehensiveness of the object	2	2	3	1	1	1
Scope of the exception	1	1	2	1	1	0
Forcefulness aggregate scores	78%	67%	67%	78%	56%	78%
Force of the instrument	3	1	2	1	1	2
Provision for controls	2	3	2	3	3	2
Provision for sanctions	2	2	2	3	1	3

Table II.15 Comprehensiveness and forcefulness aggregate scores and indicators

As above mentioned, the legislation of all case studies – except France – is less comprehensive than forceful. England, Ireland, Scotland and Senegal, obtain a low score on the targeted activity indicator as production or importation of plastic bags is not regulated. The French exception to the production ban for export justifies that it does not obtain the maximum score on this indicator. The ‘comprehensiveness of the object’ is also a particularly weak point for Ireland, Scotland and Senegal, which do not provide a definition of “plastic”, potentially opening avenues for creative compliance. France obtains the maximum score for its comprehensive definition of plastic bags, including oxo-fragmentable plastics. Last but not least, all case studies provide for over-comprehensive exceptions, large in number and in scope. Senegal obtains the worst score on this indicator, due to its exception with blurry contours, provided for bags made of a material “designed in such a way that it is not easy for the consumer to replace the component or components”⁹²⁹.

As for forcefulness, weak points are located around the ‘force of the instrument’ indicator for England, Scotland and Ireland, as these case studies’ approach rest on taxation or an obligation to charge, which does not strictly limit the production and use of plastic bags. Last, the ‘provision for sanctions’ indicator reveal high discrepancies between countries. Whereas Senegal obtains the maximum score for its large array of sanctions, Scotland obtains the minimum due to the provision of fines of a maximum amount of £200 for non-compliance with the obligation to charge.

Last, it is interesting to analyse figure II.22 in the light of the common law and civil law divide. If we have already mentioned above that common law entities (*i.e.*, England, Ireland and Scotland) have developed approaches based on economic incentives to the contrary to civil law

⁹²⁹ Translated. In the text: « *Sont exclus du champ d’application de la présente loi, les produits dont un ou plusieurs composants sont des produits constitués ou fabriqués à partir de matières plastiques à condition que le produit principal soit conçu de manière à ne pas permettre facilement le remplacement du ou des composants par le consommateur.* », Article 2, Senegal loi n°2020-04, above mentioned.

countries (*i.e.*, Cape Verde, France and Senegal) which provide for ban, Ireland figures in the top three countries with the highest forcefulness aggregate score, along with Cape Verde and Senegal. Besides, Senegal obtains the lowest score for the comprehensiveness aggregate score. Therefore, in the context of this restricted geographical and thematic case study, no specific pattern emerges across common law and civil law countries.

The last step in the design of analytical tools based on indicators is to aggregate the indicators into a country index.

Section 2) Aggregated country indices of the potential of protection

The aggregation of the indicators into country indices of the potential for protection requires to design and test different aggregation methods (a). The completion of these two levels enable to compare our aggregated indicator with other commonly country-based indicators, opening up comparative perspectives (b).

a. Testing aggregation methods: country indices

There are several ways by which it is possible to aggregate the scores obtained for individual indicators into a single country index. One of them is to average scores obtained for indicators of both comprehensiveness and forcefulness. Figure II.23 illustrates the country indices obtained for each entity on this basis.

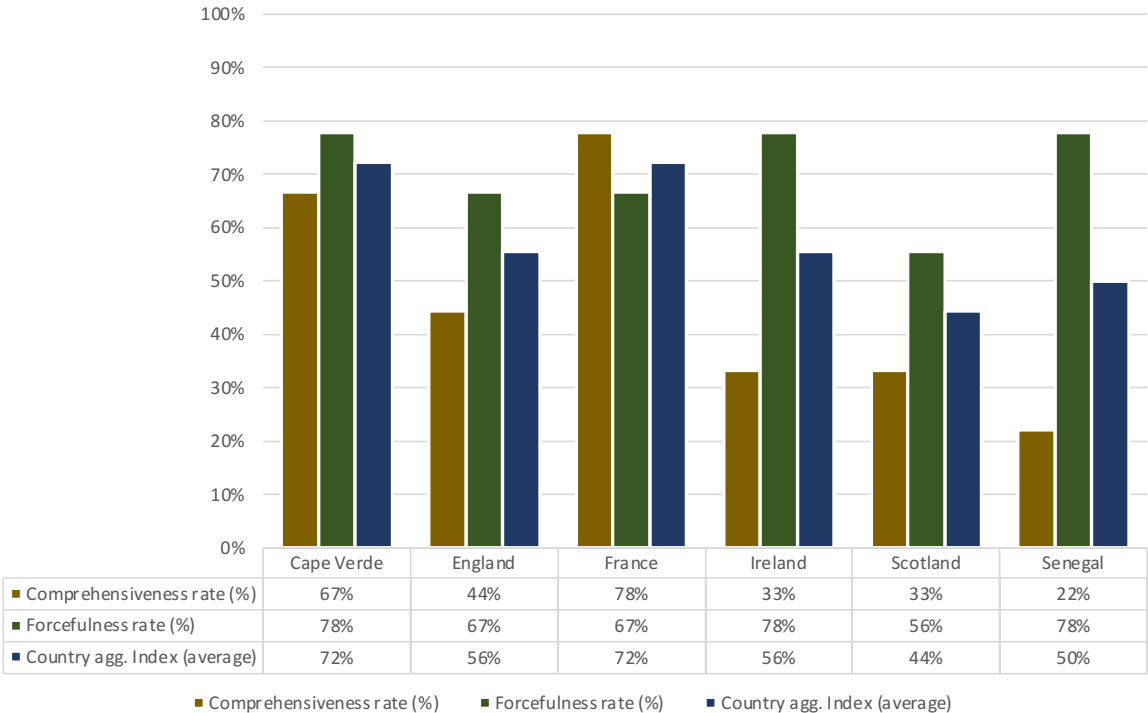


Figure II.23: Comprehensiveness, forcefulness and country indexes (average) per entity

According to this aggregation methodology, Cape Verde and France are the case studies with the highest legal potential of protection related to plastic bag regulation, followed by England and Ireland, Senegal, and last, Scotland. The weak points of the legislations nonetheless differ from a case study to another, as above mentioned.

In regard to the rank of the countries, it is interesting to observe that countries providing for a ban are ranked 1, 2 and 5, whereas countries providing for market-based instruments rank 3, 4 and 6. This observation requires several comments. First, the provision for a ban is here accounted as a contribution to enhanced environment protection, but is not sufficient to obtain high country score as shown by the Senegalese example. Senegal obtains a high forcefulness score (due to the provision for a ban and for numerous sanctions), but lags behind the other case study countries in matter of comprehensiveness. The Senegalese regulation of plastic bags is here an example of a regulation lacking comprehensiveness to offer a high potential of protection. Second, the countries providing for a market-based instrument score lower on country scores than countries providing for a ban. This is due both to the scoring of the force of the instrument and of the targeted instrument, as countries providing for a market-based instrument here tend to regulate only at the commercialisation stage. Nevertheless, these countries also score low on comprehensiveness due to the important number and scope of exceptions. As a reminder, these measures are derived from the analysis of the legal texts only, and therefore are not measures of the enforcement of these provisions on the ground. The latter requires further research.

Choosing to average individual indicators of both comprehensiveness and forcefulness nonetheless has a few drawbacks. First, it mingles indicators of comprehensiveness and forcefulness, which measure distinct components of legal frameworks. Second, it tends to rub out potential discrepancies between comprehensiveness and forcefulness scores, such as in the Senegalese example. As a consequence, it might tend to overestimate the potential protection provided by legal frameworks. Would the enforcement of a legal framework be of any interest if its comprehensiveness score is equal to zero? Similarly, a legal framework with a high comprehensiveness score and a low forcefulness score would likely be poorly protective in practice. In answer to these concerns, a solution is to choose, as a country index, the lowest value of comprehensiveness or forcefulness - the 'minimum'.

Figure II.24 represents, for each entity, the country indices calculated using the 'average' and the 'minimum' methods, along with scores of comprehensiveness and forcefulness.

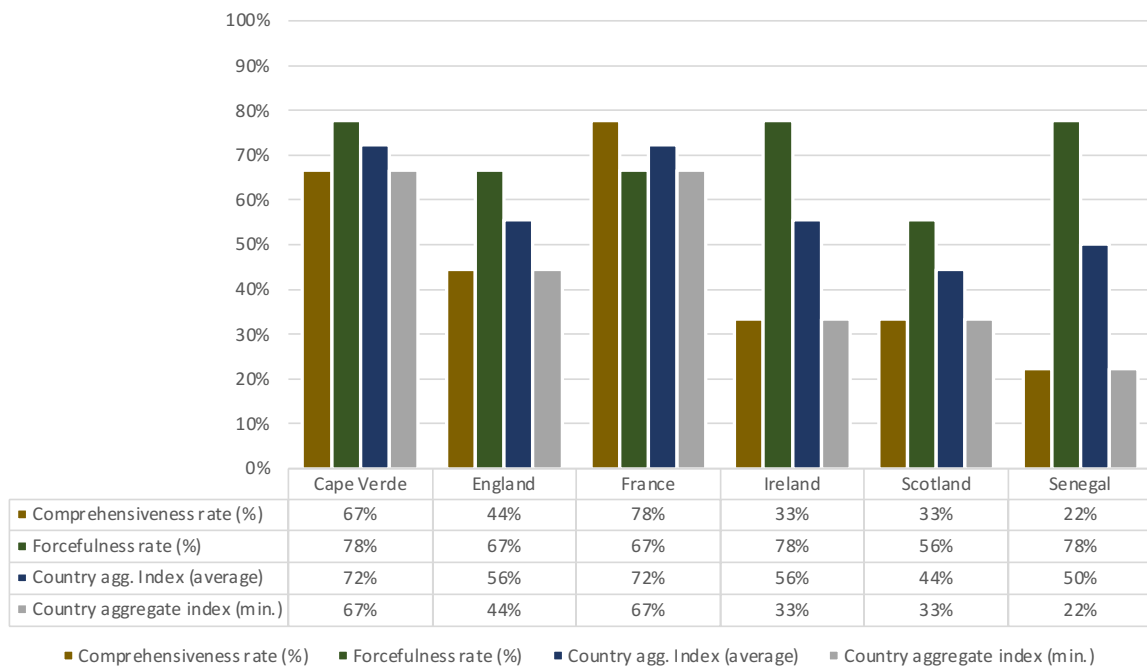


Figure II.24: Comprehensiveness, forcefulness and country indices (average and minimum) per entity

Using the ‘minimum’ aggregation method has an important influence on the ranking of the countries, already established for the ‘average’ aggregation method. If France, Cape Verde and England remain at the same rank, Ireland obtains the same score as Scotland and Senegal obtains the lowest score of all. The value of the indices are also asymmetrically impacted from an entity to the other, in reflection with the existing gap between comprehensiveness and forcefulness scores. Contrary to the ‘average’ aggregation method, the ‘minimum’ aggregation method could tend to under-estimate the potential of protection offered by countries’ legal frameworks.

Contributions and limits of the database

The reliance on semi-quantitative indicators (rather than quantitative indicators) requires a transformation of the data contained in the database into indicators, through a qualitative analytical process. Therefore, there is no built-in indicator-creation solution in the database. The database nevertheless facilitates the production of indicators, by offering a structured view of the data.

b. A comparison with other country-based indicators: an exploration of comparative indicator potentialities

The aggregation of the comprehensiveness and forcefulness indicators into a country score enables the comparison with other commonly used indices⁹³⁰. In order to compare the potential of protection index with other indices, such as the Gross Domestic Product of the Human Development Index, the aggregation method here used will be the one calculated as the minimum of the comprehensiveness and forcefulness scores. This method might tend to underestimate the potential of protection. The objective here is to explore comparative possibilities opened by the calculation of aggregate indicators, and avenues for further research. The limited number of countries, and the specificities of plastic bag regulation does not enable to draw conclusions wider than this limited case study. As such, plastic bags do not offer a representative sample of the state of environmental law.

Five commonly used indicators have been chosen to illustrate the comparative potentialities opened up by the aggregation of a score of the potential of protection: the Gross Domestic Product, the Human Development Index, the Gini index, the Rule of Law Index, and the Environment Performance index.

The Gross Domestic Product (GDP) is an indicator used to quantify the “value added created through the production of goods and services in a country during a certain period”⁹³¹. Therefore, it is an indicator of economic activity. The figure II.25 represents the potential of protection score obtained for the case study countries by the Gross Domestic Product. This representation shows that there seems to be no correlation between the potential for protection score and the GDP. Countries such as Senegal and the United Kingdom on the one hand, and France and Cape Verde on the second have similar potential of protection scores despite high disparities in the level of the GDP. Here, the scores of England and Scotland are compared to the GDP of the United Kingdom, which represents an important bias.

⁹³⁰ The indices referred to in this section are rated nationally. In order to compare the potential of protection of England and Scotland with values calculated for the United Kingdom, the scores of Scotland and England have been averaged to obtain a potential for protection for the United Kingdom.

See the country factsheets in Annex II for more details on the indices presented in this section.

⁹³¹ OECD, <https://data.oecd.org/gdp/gross-domestic-product-gdp.htm>, accessed 18/03/2022.

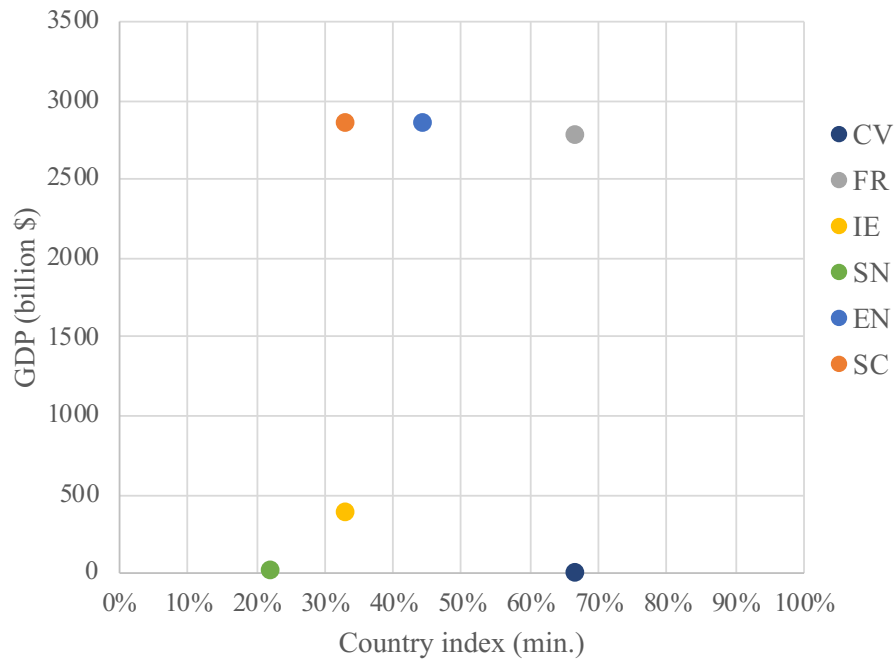


Figure II.25: Potential of protection score by Gross Domestic Product (GDP), per country

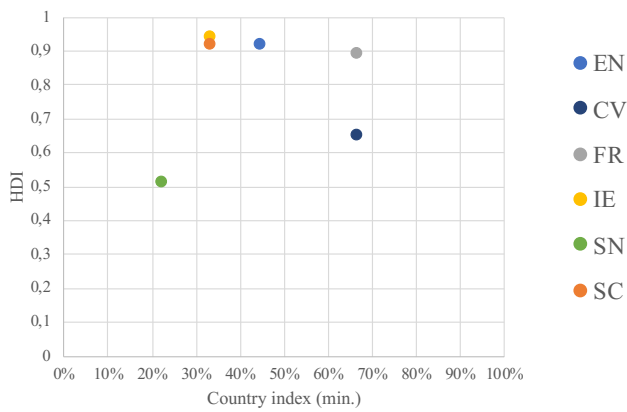


Figure II.26: Potential of protection score by Human Development Index (HDI), per country

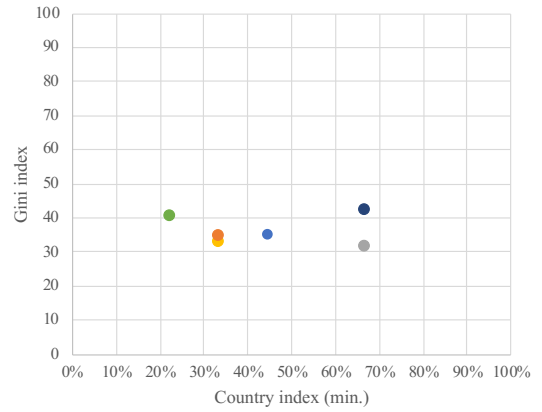


Figure II.27: Potential of protection score by Gini index, per country

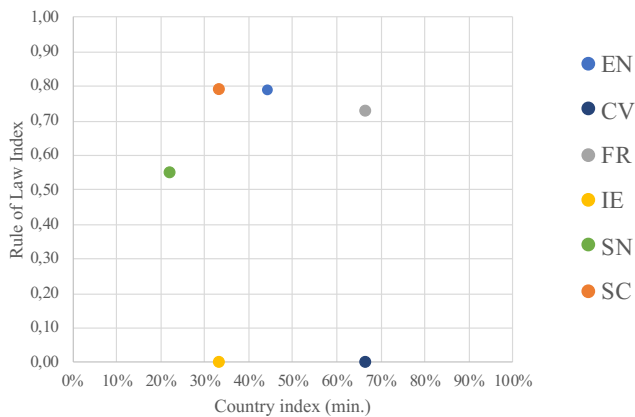


Figure II.28: Potential of protection score Rule of Law Index (RLI), per country

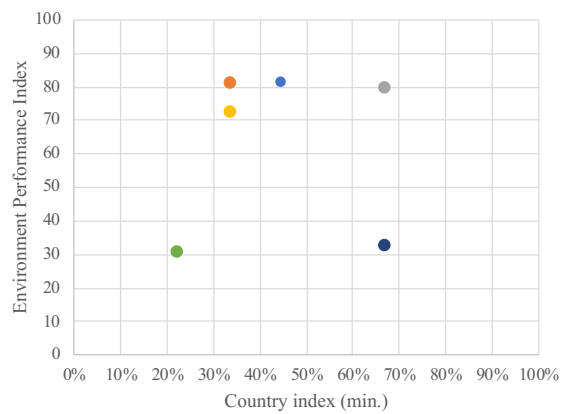


Figure II.29: Potential of protection score by Environment Performance Index (EPI), per country

The Human Development Index (HDI), is “a summary measure of average achievement in key dimensions of human development”⁹³²: a long and healthy life, being knowledgeable and have a decent standard of living. The comparison with the potential of protection indicator, provided by Figure 26, shows that Cape Verde scores for the first are in line with the second, whereas all the other countries have much greater scores on the HDI scale than on the potential for protection scale.

The Gini index, is a measure of income inequality in a country (the higher the Gini index, the more unequal the country is). The results of a comparison with the potential of protection, displayed in figure II.27, would indicate a low correlation between the two variables.

Last, comparison with the Rule of Law Index (RLI) (figure II.28) and the Environmental Performance Index (EPI) (figure II.29) above-mentioned, reveals first that all the countries for which the RLI is provided score higher on the RLI than on the potential of protection index⁹³³; second, Cape Verde score better on the potential of protection index than on the Environmental Performance Index, to the contrary to the other case study countries. This may be due to the fact that the EPI does not measure the key characteristics of the content of the law, but “how close countries are to established environmental policy targets”⁹³⁴. As such, differences between the EPI and the potential of protection index may be due to an enforcement gap between the provided measures and on the ground enforcement, or to a lag between the enforcement of regulation and on the ground measures of the effects of law enforcement. Additionally, the potential of protection here only measures the comprehensiveness and forcefulness of plastic bag regulation; the EPI’s scope is much broader. Plastic bag regulation specifics might influence these results.

These results highlight two limits to these analyses. First, these figures are representations of correlation rather than causality, meaning that there is no proof that one indicator has a direct effect on the value of the other indicator. The correlation between both might be accidental, or related to a common causal underlying variable. Second, the potential of protection is measured on one key question: the regulation of plastic bags. A greater number of countries and of key questions would be required to push the analyses further and observe correlation or un-

⁹³² These comprise a long and healthy life, being knowledgeable and have a decent standard of living. United Nations Development Programme, <https://hdr.undp.org/en/content/human-development-index-hdi>, accessed 18/03/2022.

⁹³³ The Rule of Law Measure is not available for Ireland and Brazil.

⁹³⁴ Environment Performance Index, <https://epi.yale.edu>, accessed 18/03/2022.

correlation. This is nonetheless the opportunity to showcase the potential analytical outcomes of this method. Third, the minimum aggregation method into country scores provides an uncomplete summary of the data. To push further the value of these analyses, an avenue could be to keep both the scores of comprehensiveness and forcefulness, without further aggregation into country scores. Figure II.30 provides an example of this representation mean based on the comparison with the Environment Performance Index.

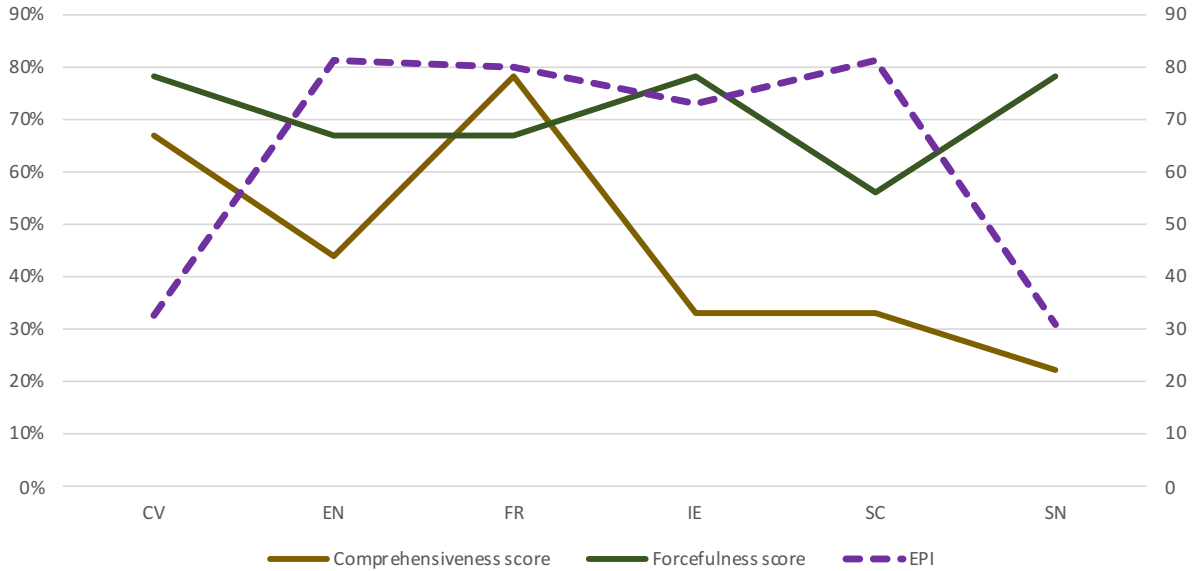


Figure II.30 Comprehensiveness and forcefulness score by Environment Performance Index (EPI), per country. It shows, for example, that Cape Verde is the only country for which comprehensiveness and forcefulness scores are higher than the EPI score; in Senegal, the forcefulness score is way higher than both the EPI and the comprehensiveness scores. These results could be of interest if the all three indicators were applied on a common object. Here, the scope of the EPI is much broader than the analysis of plastic bags. This exploration of comparative possibilities across indicators nonetheless opens avenues for further research, through the expansion of the areas of law for which the comprehensiveness and forcefulness would be analysed.

Conclusion of Title 3

The qualitative and quantitative analyses of the potential of protection offered by the case-studies' regulation reveal the necessity to adopt a holistic approach to the assessment of both comprehensiveness and forcefulness. Here, qualitative analyses enable to precisely question the respective strengths and weaknesses of the regulations, whereas the aggregation of the data into

indicators provide a more global insight, and facilitate comparison between countries and with other indicators.

The aggregation of comprehensiveness and forcefulness indicators into a unique index remains a challenge, as none of the proposed methodology (average and minimum) provide a fair representation of the entirety of the data. Therefore, the comparison of the obtained scores of the potential of protection with other indicators remain exploratory rather than explanatory.

Another risk attached to the design of indicators, and more over of aggregate indicators, is the over-simplification of the legal facts, offering a distorted representation of the reality. This risk is highlighted by Wulf, underlining that “the results of such research can have little relevance for legal science”, unless it is preceded by the presentation of the legal issue to be examined “in its full complexity”⁹³⁵. This is precisely the complementary role played by the qualitative and quantitative analyses presented above.

Conclusion of Part II

This second part results from the application of the tools and methods developed above, to the case study of plastic bag regulation in six entities (Cape Verde, England, France, Ireland, Scotland and Senegal). The combined use of the relational database and the application of the methodology’s conceptual framework has enabled to present the entities’ plastic bag legal frameworks in all their diversity and complexity, with several outputs.

First, the application of the method, as facilitated by the relational database, has enabled to delve deeper in plastic bag legal frameworks than past initiatives, by analysing the different components of plastic bag regulations (object, instrument, control, sanction), in relation with each other. This step has revealed the intricacy of the developed legal frameworks, where a single object can be simultaneously included in an instrument and excluded from another, or different sanctions can be applied to different instruments. In addition, the analysis of the potential of protection has enabled to push further than the description of the legal frameworks, by characterising their content in regard to the protection of the environment and by identifying their relative strengths and weaknesses.

⁹³⁵ WULF Alexander J., « The Contribution of Empirical Research to Law », *Journal Jurisprudence*, 29, 2016, p. 29-49.

Therefore, the analysis of comprehensiveness and forcefulness provide for two different avenues to promote the protection of the environment through law. The first highlights the necessity to provide for a holistic approach to plastic pollution, whereas the second underlines the need to provide for means to trigger a behaviour change. The analysis of the case studies' legal frameworks illustrates the diversity of comprehensiveness and forcefulness settings, and therefore the relevance of comparative analyses on this basis. In addition, the comparison of the approaches developed by countries on the basis of the regulations' characteristics has revealed that none of the countries have developed a common approach to the regulation of plastic bags, despite the commonality of the issue to regulate.

Besides, the design and aggregation of indicators has shown the potentialities of such tools, but also their limits. The results are highly sensitive to the method used to design and aggregate the indicators. In particular, none of the tested aggregation methods offer a representative image of the reality. If further research could enable to overcome this obstacle, a solution could also be to have directly recourse to the two dimensions of the potential of protection – comprehensiveness and forcefulness – when comparing countries with each other or with other commonly used indicators. A critical approach to the methodology design and to the obtained results (Part III), will enable to identify further avenues for research

Part III. Casting a critical eye: discussion of the inputs and limits of the proposed approach

The developed methodology is an attempt to qualify and quantify law's potential contribution to the protection of the ocean. Its application to the analysis of plastic bag regulation in seven countries has enabled to identify the major inputs, but also the limitations of the methodology and tools as designed, revealing that this analytical framework can deliver benefits, under certain conditions (Title 1). Meanwhile, the analysis of plastic bag regulations through the lenses of the developed methodology has enabled to push further our understanding of plastic bag regulation strategies, revealing the challenge of an international regulation of single-use plastics through the adoption of an international agreement. The analysis of law's potential contribution to the protection of the environment is nonetheless insufficient to fully characterise where, when and how law protects the ocean from plastic pollution. Further research will be needed to better identify the hindrances and levers of a fully protective law (Title 2). The application of the method is nonetheless not bound to the analysis of plastic bag regulation. Its transferability to the analysis of the regulation of other sources of land-based pollution, such as pesticides and wastewater can be questioned (Title 3).

Title 1. A critical analysis of the methodology: benefits under conditions

Discussing the validity of models, the statistician George Box, states that “all models are wrong; the practical question is how wrong do they have to be to not be useful”⁹³⁶. The same remark could be applied to quantitative analyses of law. Just like models, they do not pretend to offer an exact copy of reality, but rather a representation which facilitates analysis. Therefore, per definition, they simplify the reality. Doing so, there are both technical and theoretical limitations to the developed analyses of the potential contribution of law to the protection of the environment through the exploration of their comprehensiveness and forcefulness (Chapter 1). The counterpart to these limitations is to offer new perspectives to the analysis of law

⁹³⁶ BOX George E. P. et DRAPER Norman R., *Empirical Model-Building and Response Surfaces*, 1st edition., New York, Wiley, 1987, 688 p., p. 74, cited by SILVER Carole et ROCCONI Louis, « Learning from and about the Numbers Journal of Legal Metrics », *Journal of Law*, 5, 2015, n° 1, p. 53-84, p. 56.

(Chapter 2). As such, it paves the way for the development of further research on this theme, by identifying the pillars but also the barriers to be lifted down that road.

Chapter 1. Raising the alert: specific and intrinsic Achilles' tendons

Empirical research, originated in the natural sciences, is often seen as objective and value-free⁹³⁷. Despite all efforts made by researchers to be objective, biases such as motivated reasoning “whereby information is filtered on how closely it matches with existing beliefs”⁹³⁸ or the challenge of objectivity in the specific context of social sciences – where the researcher is part of the object⁹³⁹ – may arise. This is why Salais highlights the importance to decompose quantitative data or indicators, to pay attention to their construction, to the choices they reflect, to what they allow us to “see” as well as to what they prevent us from seeing⁹⁴⁰.

This is precisely the purpose of validity and reliability testing, both commonly used to in regard to studies using quantitative data⁹⁴¹. Validity is defined as “a measure of the extent to which the researcher has captured an accurate reflection of a phenomenon” and reliability as “the extent to which the measurement procedure or instrument (such as a survey) would produce the same data were it to be administered at a different time or by someone else”⁹⁴².

These two concepts are at the crossroads of indicator criticism⁹⁴³. As presented by Davis, the two main lines of debates over quantitative measures of law evolve around questioning their validity – when there is disagreement “about whether the indicators measure the concepts their

⁹³⁷ WULF Alexander J., « The Contribution of Empirical Research to Law », *Journal Jurisprudence*, 29, 2016, p. 29-49, p. 41.

⁹³⁸ PELLICER Miquel, WEGNER Eva et CAVATORTA Francesco, « Is There Strength in Numbers », *Middle East Law and Governance*, 7, 2015, n° 1, p. 153-168, p. 158.

⁹³⁹ WULF Alexander J., « The Contribution of Empirical Research to Law », *op.cit.*

⁹⁴⁰ SALAIS Robert, « La donnée n'est pas un donné - Pour une analyse critique de l'évaluation chiffrée de la performance », *Cahiers Droit, Sciences & Technologies*, PUP, 2014, n° 4, p. 15-36, cited by LECLERC Olivier, « Statistiques et normes : jalons pour une rencontre interdisciplinaire », *Cahiers Droit, Sciences & Technologies*, 2014, n° 4, p. 37-44, p. 38.

⁹⁴¹ WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 935.

⁹⁴² KIRK Jerome, MILLER Marc et MILLER Marc L., *Reliability and Validity in Qualitative Research*, Beverly Hills, SAGE Publications, Inc, 1986, 96 p., pp. 41-42, cited by WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 935.

⁹⁴³ See Part I, Title 1, Chapter 2.

names suggest they measure” – and their reliability – when there is “disagreement about the extent to which those measurements contain errors”⁹⁴⁴.

The specific context of quantitative approaches to legal systems enhances the need for assessments of validity and reliability, but also challenges their assessment. First, Davis stresses that “there are typically many plausible ways to simplify a complex system”⁹⁴⁵ such as a legal system, into legal indicators – leading to many plausible ways to construct any legal indicator. Nonetheless, Hull highlights the “dangerous assumption”⁹⁴⁶ in simplification, which “inevitably results in loss of information, giving rise to error” or secretly reflecting “the unstated biases of their creators”⁹⁴⁷. Second, Davis stresses that the analysis of legal texts are most often “open to multiple interpretations”⁹⁴⁸, complexifying the evaluation of reliability.

Validity and reliability testing calls to answer a series of questions, among which “are the indicators measuring satisfactorily? are the selected indicators valid and reliable proxies? Are the right things being measured, with the right sources?”⁹⁴⁹. These questions must first be answered internally, before opening the door to indicator contestation.

The identification of the weak points of the developed methodology is an important, but sometimes neglected aspect of quantitative approaches to the analysis of law. This mandatory methodological introspection questions the validity and reliability of the results of the research, revealing the technical (section 1) and theoretical limitations of the methodology (section 2). This approach values transparency of the methodological choices, before opening the door to external indicator-contestation (section 3).

⁹⁴⁴ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52, p. 41.

⁹⁴⁵ *Ibid.*

⁹⁴⁶ HULL N. E. H., « The Perils of Empirical Legal Research Review Essay », *Law & Society Review*, 23, 1989, n° 5, p. 915-920, p. 917.

⁹⁴⁷ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *op.cit.*, pp. 38-41.

⁹⁴⁸ DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *op.cit.*, p. 41.

⁹⁴⁹ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 324.

Section 1) Technical limitations of the methodology

There are two types of technical limitations to the developed methodology. The first relates to the scale at which the analysis is conducted, revealing concerns from the subnational to the international scales (a). Second, several challenges emerge from the construction and use of the relational database (b). Given the pivotal role of the relational database, these challenges must be kept in mind. Third, there are intrinsic limitations to the use of indicators (c).

a. An issue of scale: from micro to macro concerns

In a specific country, legal texts regulating a source of pollution can be adopted at various geographic scales, from the scale of a municipality to the scale of a whole country, passing by State law in the context of federal countries. The distribution of the power to regulate in each country and for each regulated object is the first factor influencing at which scale legal texts are likely to be adopted. In case of shared competences, political will and the importance of civil society organisations may be deterministic steps leading to the adoption of a regulation.

In the context of this research, time did not allow to reach down to the analysis of municipal law (i). As for federal countries, time did not allow neither to analyse the regulation adopted by each state (ii). Last, time did not allow to analyse to test the methodology on an extensive number of countries, leaving an unexplored adequacy with the legal systems of many countries (iii).

i. Municipal law: blind spot of the analysis

The choice to exclude municipal law from the analysis was driven by time constraints in the context of this research. The analysis of plastic bag regulation in only seven countries has nonetheless revealed that this choice is responsible for a blind spot in the analysis.

As a reminder, the methodology can only be applied to the analysis of in force law. In the case of federal countries with a share of competence at the state level, two states have been selected for each federal country⁹⁵⁰. Out of the seven case study countries, the methodology has not been applicable to two federal countries - Brazil and the United States of America – for which the selected states were respectively the states of Sao Paulo and Recife, and the states of Florida and Texas. No regulation has currently been adopted and or is currently in force at the federal nor at the state level. Nevertheless, this state focus hides local peculiarities.

⁹⁵⁰ See ii. Federal countries, a truncated representation of the regulation

In Brazil, the city of Sao Paulo bans the use of non-reusable plastic bags since 2011⁹⁵¹ and the city of Recife privileges the use of biodegradable bags since 2008⁹⁵².

The case of the Florida and Texas is different, as the adoption of plastic bag regulations by local authorities in both states has been ruled unconstitutional. Several cities in Texas, such as Laredo and Austin, adopted a regulation to ban plastic bags. In 2018, the Supreme Court of Texas ruled that Laredo's local ban on plastic bags violates the Texas Solid Waste Disposal Act pre-empting the local governments to "prohibit or restrict, for solid waste management purposes, the sale or use of a container or package in a manner not authorized by state law"⁹⁵³. In Florida, the state adopted an Act in 2008 pre-empting local authorities from adopting plastic bag bans⁹⁵⁴. As such, the adoption of plastic bag regulations by local authorities in Florida and Texas would be unconstitutional.

From a functional perspective, the regulations adopted by local governments regulating plastic bags should be analysed as they contribute to the legal response to the phenomenon of plastic pollution. The inclusion of local legal initiatives would be even more determinant in the case of cities such as Sao Paulo with a population of 12 million people⁹⁵⁵ – almost as much as Senegal and more than twenty times the population of Cape Verde⁹⁵⁶.

The problematic exclusion of municipal law from the analysis is not limited to the analysis of plastic bags' regulation. Opening up to other themes, such as the regulation of pesticides and sewage, will reveal that the exclusion of municipal law may constitute a blind spot of the analysis.

⁹⁵¹ See Lei No 15.374 de 18 de Maio de 2011, Dispõe sobre a proibição da distribuição gratuita ou venda de sacolas plásticas a consumidores em todos os estabelecimentos comerciais do Município de São Paulo, e dá outras providências, Publicado no DOM - São Paulo em 19 mai 2011 and Decreto N° 55827 de 06/01/2015, publicado no DOM - São Paulo em 7 jan 2015.

⁹⁵² See Lei no 17.475/2008 Dispõe sobre as sacolas e sacos plásticos utilizados pelos estabelecimentos comerciais e órgãos municipais no âmbito do município do Recife, Publicado no DOM em 07 jun 2008.

⁹⁵³ See TEXAS HEALTH & SAFETY CODE § 361.0961(a)(1). Cited in *City of Laredo vs. Laredo Merchants Association*, No. 16-0748, Texas Supreme Court.

⁹⁵⁴ Section 96, Florida Energy, Climate Change, and Economic Security Act of 2008, approved by the Governor on 25/06/2008.

⁹⁵⁵ Instituto Brasileiro de Geografia e Estatística, <https://www.ibge.gov.br>, accessed 06/04/2022.

⁹⁵⁶ See country factsheets, Annex II.

ii. *Federal countries: a truncated representation of the regulation*

The limited timeframe of this research project did not allow to analyse the legal frameworks of all of the states of federal countries. Therefore, the selection of a limited number of states in federal countries is another technical limitation to the methodology due to issues of scale.

As presented above, out of the seven case-study countries, two are federal countries (the United States and Brazil) and the United Kingdom, through devolution, is closer to federal countries than to unitary countries⁹⁵⁷. For each of these case studies, the analysis of the power to regulate in the field of environmental law and in particular on the theme of plastic bags has revealed that the competence lies in the hands of the states or the devolved entities.

Time did not allow to analyse the plastic bag regulations of the fifty States of the United States, the four countries of the United Kingdom, and the twenty-six states of Brazil. Therefore, the methodological choice to choose two subnational entities per federal or federal-affiliated country (*i.e.*, the United Kingdom) offers a truncated representation of the regulation of plastic bags in each of these countries.

The example of plastic bag regulation in the United States is interesting here. Early 2021, ten States had adopted state-wide plastic bag bans, and one state and the District of Columbia provided for fees of taxes⁹⁵⁸. This leaves eighteen states with enacted or ruled state pre-emption, and twenty-one states with no statute applicable to plastic bags. Therefore, the selection of two States, whatever the selection, could not have offered a representative view of plastic bag regulations in the United States. In a study on the geographic, political, socio-economic and environmental factors influencing the adoption of plastic bag legislation in the United States, Bell *et al.* found that States regulating plastic bag are in majority located in the Northeast or West of the country, are governed by a Democrat rather than a Republican, and have not adopted pre-emption laws⁹⁵⁹. In addition, they found no contribution of the shoreline mileage or the Democratic control to the adoption of plastic bags. Besides, the adoption of pre-emption laws would have a strong negative effect on the adoption of plastic bag regulations⁹⁶⁰.

⁹⁵⁷ See Part I, Title 2, Chapter 1, section 1.

⁹⁵⁸ National Conference of State Legislature, <https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx>, accessed 06/04/2022.

⁹⁵⁹ BELL Liza et TODORAN Gina Scutelnicu, « Plastic bag legislation in the United States: influential factors on its creation », *Journal of Environmental Studies and Sciences*, 2022, p. 8.

⁹⁶⁰ *Ibid.*

This example shows that federal states may hide a high variability of state-wide regulations, and that external factors may contribute to the adoption of plastic bag regulations. Ideally, federal countries with a power to regulate in the hands of states must benefit from an analysis of the regulation adopted by each state.

iii. An unexplored adequacy with the legal systems of many countries

The last methodological issue of scale is related to the limited number of chosen case-study countries. Even though the seven case-study countries have been chosen to test the methodology in different political, legal, socio-economic and environmental contexts, a number of countries with different characteristics could not be analysed.

At first, Cuba and Mexico had been selected to be added to the case-study countries' cohort. They have both been abandoned for different reasons.

Cuba has been abandoned first, due to a difficulty to access to adopted legal texts online. As online searches on the subject of plastic bag regulation adoption in Cuba did not reveal the probable existence of a legal text, travelling to Cuba has not been considered as an option.

The abandon of Mexico as a case study intervened later. As a federal country, the states of Yucatan and Tamaulipas had been selected as focuses. Each of these two states provide an online access to adopted legislation, which enabled the access to plastic bag regulations. Nevertheless, difficulties in the understanding of the functioning of regulation in Mexico, in addition to the absence of local contacts who could have facilitated this comprehension, Mexico has been abandoned as a case study. This situation is the occasion to highlight the importance to be able to rely on the help of local law specialists to facilitate the comprehension of countries' specific features. In addition, the review of the scoring done for each country by a country law specialist could contribute to enhance the validity and reliability of the assessment done.

Besides, the adaptation of the methodology to the analysis of the approaches developed by countries of different legal traditions remains unexplored. Whereas it has been assumed that the approaches to plastic pollution of common law and civil law countries were comparable due to the importance of statutory law on environmental matters⁹⁶¹, this hypothesis would have to be confirmed by further research. In addition, the adaptability of the developed methodology to

⁹⁶¹ See Part I, Title 2, Chapter 2.

countries belonging to other legal traditions, such as Asian law, Customary law, Russian Law, Muslim law or Scandinavian law will have to be explored.

The second type of technical limitations to the developed methodology are related to the database's design and use.

b. Limitations of the relational database

The relational database has been specifically designed for the purpose of this methodology. As such, it must be seen as a tool to facilitate the comparative analysis of regulations related to a specific object, through multicriteria analyses or by offering a spread-out view of the regulations, organized by type of regulatory features (*e.g.* per object, sanction, controls)⁹⁶². Therefore, the relational database is a tool in service of the methodology, spelling out the structure of the regulations. In itself, the relational database is not a tool which can be used to demonstrate an idea; it rather facilitates the access to the required elements to do so.

There are nonetheless several limitations to the design and to the use of the relational database. These challenges span over data entry (i), data extraction (ii) and over the update of the database (iii).

i. Data entry in the database: the importance of interpretation

The first step in the use of the database relates to data entry. This step requires a translation of the legal text as it has been adopted, into tables (such as article, sanction, control, object and instrument), each table being described by a series of attributes (*e.g.*, attributes of the article set would be the number of the article or its text)⁹⁶³. As such, it requires first to read the text, then to understand it, to identify the occurrences of the different elements fitting into distinct tables along with the interactions between these elements, to be then able to fit it in the database. This step is crucially important, as it determines both the validity and the reliability of the future results.

To facilitate multicriteria analyses and future searches in the database, some attributes require an interpretation of the legal text adopted. To continue on the example on the article table, a useful attribute is to identify the type of article, or the role the article plays in the functioning

⁹⁶² See Part II for applications.

⁹⁶³ See Annex V for a dictionary of the data, presenting the different tables and each related attribute.

of the regulation. For example, an article's role can be to provide for controls, sanctions, the creation of an administration, the definition of an object, an enforcement delay... It can also implement, repeal or amend an existing text or article. As such, an article can have several roles. The challenge in the design and in the use of such a database is to adopt descriptors which are as close as possible to the initial text, but also as uniform as possible to facilitate analysis. The first condition minimises mis-interpretations, as the descriptors serve as a guide to the analysis. The second condition guarantees the searchability of the database: if several descriptors are used to describe articles that have similar roles, searches in the database will probably omit some⁹⁶⁴. The difficulty in the design of the database, is to imagine all the required descriptors in advance. This design challenge impacts the use of the database, as it requires to adapt the set of descriptors progressively, increasing the risk of non-uniformity, and requiring sometimes to modify the descriptor adopted for a specific article ex-post.

A mitigation strategy would be to design a classification grid, attributing to each descriptor criteria for their use.

The entry of data in the database is a lengthy and sensitive process. Taken alone, the time required to add data to the database is a limitation to its use to analyse the legal strategies adopted by more countries on more themes⁹⁶⁵.

On the legal front, the asymmetric reliance on codification raises another challenge. Codification relates to the combination, consolidation and structuring of legal provisions related to a common theme into a unique document, named a code. Its aim is to facilitate access and understanding of legal provisions, organized in a coherent and logical way⁹⁶⁶.

The choice made, when the database was designed, to make reference exclusively to the legal texts as they were adopted rather than to their codification, raised a few challenges. First, in countries where texts are codified, the mention of the original text disappears in future texts,

⁹⁶⁴ At some point in the development of this database, to search the provision for controls, it was necessary to search for eight different expressions in several attributes. These eight expressions were “application control, record, registry (now deleted), denunciation (now deleted), review, role of local authorities, report, procedure and organises control”. The risk was high to omit one or several of these expressions in a search of the database. A review of all the articles for which these descriptors were used enabled to delete two descriptors, which were either not used, either attributable to another descriptor.

⁹⁶⁵ Current researches explore the opportunity to rely on an Artificial Intelligence to accelerate this process.

⁹⁶⁶ Legal information institute, <https://www.law.cornell.edu/wex/codify>, accessed 27/07/2022.

absorbed by the reference to the article of the code, including when amendments are made. The interpretation of the amendments therefore constantly requires to go back to the code, which is not available on the database. Doing so, it complexifies the lecture of successive amendments in the relational database, which must be interpreted in the light of the article of the code in its integrity. The inclusion of the codified article could therefore facilitate the follow-up of changes made to the legislation. Second, because the location in the code – and therefore the reference of the article – can change overtime. For example, in 2020, the article L.541-10-5, the French environmental code - compiling plastic bag legislation - is transferred to L.541-15-10 by an article making no reference to plastic bags⁹⁶⁷. An active watch of the adoption of plastic bag regulations did not allow to perceive this change, because the legal text in itself did not mention plastic bags as such. The watch should have also been programmed on the article of the code. Last, additional provisions, such as sanctions, can be provided for an entire section of the code, and therefore remain unnoticed if the only text analysed is the text as it has been adopted, rather than as it is compiled in the code. These issues were identified early in the run of this project, and therefore have a limited impact on the results. The application of the method to further countries or themes nonetheless require to find solutions to these challenges, as it is ineffective to juggle between the text as adopted and as compiled in the code.

When the database was designed, the choice had been to reference the legal texts adopted rather than their position in the code, for several reasons. First, countries of the world – or of this case study – rely asymmetrically on codification. Cape Verde does not compile its environmental regulations into an environmental code, contrary to France. In Ireland and in the United Kingdom, environmental statutes are not codified. Reliance on codification only would therefore have been problematic for countries with no codification. Second, reliance on the legal texts adopted facilitates the analysis of the evolution of the legislation by highlighting genealogic connections between the texts, and facilitates the monitoring the successive modifications of the regulation. Nonetheless, a high number of modifications complexifies the administration of the database, to keep track of both past modification and active provisions⁹⁶⁸.

⁹⁶⁷ Article 62, *Loi n° 2020-105* above-mentioned.

⁹⁶⁸ To facilitate the tracking of the successive modifications of the regulations, a built-in feature in the database enables to make relationships between articles and texts, precisising the type of relation (implement, amend, revoke). In addition, for each article and text, an attribute precisises the status (in force, no longer in force, not yet in force). This attribute is nonetheless not automatically filled in.

This choice nonetheless complexifies the analysis of the regulations of texts in countries relying heavily on codification, such as France.

Therefore, reliance on the original text adopted and on its codified version (where relevant) both presents benefits and drawbacks. A solution could be to have them both, but to systematically exclude one of them in searches or in multicriteria analyses to avoid double counting. An archive function should also be set, to provide access to successive versions of the codified article. A new version of the database could provide such features.

The last feature that could be added to the database is the possibility to enter data relative to international conventions. It would require to configure a new type of text (international convention), to add the possibility to define Parties to the Convention, and to qualify whether the countries have signed or ratified the convention. These minor changes to the database would enable to relate legal provisions adopted nationally to international provisions.

Besides, extraction of data from the database is sometimes required to run specific analyses. This sensitive operation should be facilitated in further uses of the database.

ii. Extracting data for numerical analyses: a sensitive operation

Numerical analyses requiring the creation of figures, or the compilation of indicators necessitate to extract data from the database, as there is no built-in feature to do so. Extracting data for numerical analyses is also a sensitive operation, due to the structure of the data and to the data-extraction feature of the database.

The database organises the data through relationships. For example, a single object (for example biodegradable bags), can be exempt from a ban but concerned by a taxation instrument. In addition, non-compliance with the same ban can be punished by different types of sanctions. Whereas the structure of the database enables to represent these multidimensional and intricate relationships, an Excel file, in which the data is extracted for analysis, does not. Therefore, the data as extracted by the database must be worked on before statistical analyses. For example, data contained in lists appear without spaces between the different words, and the code of the country is not repeated on the different lines. Further, an instrument related to three objects and to three different sanctions will be extracted on nine lines in the Excel file. Each country's regulation setting is different simply in terms of the combinations of instruments, objects and

sanctions. As such, statistical analyses directly based on the data extracted from the database would be biased, over-representing countries with a high number of occurrences. For example, in the database, sanctions are related to an instrument – the sanctions are pronounced in case of non-compliance with a specific instrument. Sometimes, the same sanctions are provided for different instruments. Therefore, statistical analyses require to work on the data to delete any double counting occurrence.

Data extraction for statistical analyses is therefore costly in time, and a risky operation due to the data manipulations which are required. In addition, the required data manipulations will be different depending on the object of the analysis. A statistical analysis of the relationships between instruments and objects will not require the same manipulations as an analysis of the relationships between instruments and sanctions. For example, a similar object can be related to several instruments (through its inclusion or exclusion). This information will be valued in analyses of relationships between instruments and objects. The same information would provoke double counting of the instrument-sanction relationship. In other words, the data of importance depends on the objective of the demonstration. The fact that a single object is included in two types of bans and one obligation to charge is important to mention when analysing the relationships between objects and instruments, but of a lesser importance when analysing whether this type of object is commonly regulated, or unregulated. For the latter, a single occurrence, out of the three, is sufficient.

iii. The challenge of an updated relational database

Last, a relational database designed to analyse in force law is useful only if it is updated. Updates are not automatic. An active watch is necessary to identify the adoption of new texts on the same theme. This watch has been conducted throughout this research project by supervising national press and conducting online researches on national legal databases. Nonetheless, the greater the number of analysed countries and themes, the more time-consuming the monitoring of the adoption of new texts will be. In the future, either the human resources will be available to guarantee a constant watch of adopted regulations, either an automatization of this task will be needed.

For example, an articulation of the relational database with national and international legal databases could facilitate this task. In this perspective, a test has been conducted on Ecolex, to see whether searches on this environmental law database could enable to find the legal texts used for the plastic bag analysis. The results of this test show that the Ecolex database is highly

sensitive to the key words provided in the search bar, which must be identical to the ones used in the legal text's title, as the database does not search in the text. For example, a search made for "produit plastique" in Senegal does not lead to the *Loi 2020-04* above mentioned, which makes reference to "produits plastiques" in its title. Nor does a search made for "sac plastique", contained in the law's text but not in its title. Searches on Ecolex therefore require to list a wide array of key words. For plastic bag researches, these would require to cover *sac, sachet, produits plastiques, saco, bolsa, carrier bag, plastic bag, single use bag, etc.* In addition, some of the legal texts analysed, such as the French *loi 2015-992* or the *loi 2020-105* above mentioned, do not make any reference in its title to plastic products, but respectively to energetic transition for green growth or the fight against waste and the promotion of a circular economy. These texts, regulating plastic bags, would therefore not have been identified on a unique search on Ecolex. This example highlights the need to search on several sources to guarantee that all relevant texts are identified.

Last, there are intrinsic limitations to the use of indicators.

c. Indicator-framework limitations

As indicators are summary data displaying information on the progress towards a specific goal of a phenomena which cannot be observed through directly measurable variables, the recourse to indicators in itself bring about limitations to the developed approach. These limitations are nonetheless not specific to the methodology developed here, as they had been identified at the outset, in the state of the art of past initiatives attempting to measure legal features. The development of the methodology and its application to the study of plastic bag legal frameworks nonetheless provide concrete illustrations of these limitations.

The first limitation relates to the challenge of choosing what and how to measure, which has important impacts on the obtained results (i). The second concern outlines the method used to calculate the aggregated index (ii). Last, the risk of indicator instrumentalization and misunderstanding must be underscored (iii).

i. The challenge of choosing what and how to measure

The struggle of choosing what and how to measure legal frameworks' provisions have been identified, from the start, as one of the major challenges to the development of legal

indicators⁹⁶⁹. The application of the method to the analysis of plastic bag legal frameworks has provided an accurate illustration of this challenge.

As above-mentioned, two indicator-frameworks have been designed and tested to compare their differentiated treatment of the same data⁹⁷⁰. Despite an important common ground between the two methods, the differentiated calculation of 3 indicators out of 6 had important impacts in terms of results, influencing both the obtained scores – with a delta reaching up to 25 percentage points – and the ranks between the countries.

This illustration shows that there are many ways to work with similar data. Even if indicators are commonly defined, the modification of their scoring method has important impacts.

In addition, another identified issue is the similarity of scores for countries with differentiated approach to plastic issues. This similarity could be due to the low capacity of the indicators, as rated on a 4-level scale, to provide a rating scale large enough to transcribe differences between approaches. The enlargement of the rating scale through the integration of additional criteria could be tested. Indicators must nonetheless enable to highlight the similitudes, in addition to the differences, between the approaches adopted by countries. Therefore, an equilibrium must be found in the definition of the range of the rating scale used to calculate indicators as all the studied legal frameworks, at some point, diverge.

Last, several indicators could be derived from the same data. As indicators show the progress towards an objective, they are biased by nature. Here, indicators aim to show the progress towards the protection of the environment, through the adoption of legal provisions. Therefore, the indicators developed here value the constraint on behaviours, restricting the occurrence of polluting behaviours. A set of indicators showing the progress towards the ease of doing business would likely have led to different results, by valuing for example the liberty of choice offered by economic incentives.

Besides, the aggregation of individual indicators into indices is another avenue for subjectivity.

⁹⁶⁹ See Part I, Title 1, Chapter 2, section 1.

⁹⁷⁰ See Part II, Title 2, Chapter 3, section 1. See also annex XII and XIII.

ii. Concerns on the aggregation method

The aggregation of individual indicators into indices enables the obtention of a unique score, summarizing a large set of data, which facilitates the comparison between themes and countries. The aggregation of the data nevertheless comes with a set of risks, identified above⁹⁷¹.

The first risk is to introduce a bias or subjectivity through the method used to aggregate. For example, the phenomenon measured by individual indicators may have a differentiated importance in the progress towards the identified objective. For example, the provision for sanctions may be more decisive than the type of instrument. The aggregation of the indicators should reflect this differentiated importance. Nevertheless, the measure of the indicators' respective weights in the progress towards the identified objective is difficult to run, as, by definition, the use of indicators is justified by the direct immeasurability of the studied phenomenon. The introduction of differentiated weights to indicators in absence of any scientific justification would also be a source of bias.

The second risk is to aggregate the measurement errors of individual indicators into the index, which value would be of a limited interest.

Several aggregation methods have been tested above, leading, once again, to different results. Comprehensiveness and forcefulness aggregate indicators have been calculated as the average of the completion rate of each individual relevant indicator. To obtain a country index, the first method used was an unweighted average of indicators of both comprehensiveness and forcefulness. The second method was to consider that the country index is equal to the lowest of the comprehensiveness and forcefulness scores. Both methods respectively have advantages and disadvantages. The advantage of the first is to provide a summary of the integrality of the data, whereas the second focuses on the dimension for which the score is the lowest. The method based on the average nevertheless indistinctively mingles two dimensions – comprehensiveness and forcefulness – which do not measure the same characteristics of legal frameworks. In addition, for countries such as Senegal, where there is an important value gap between the measures of comprehensiveness and forcefulness, the average does not render an accurate representation of the state of the legal framework. Moreover, an important gap between comprehensiveness and forcefulness values implies an important weakness in one of the two dimensions, which would be minimized through the calculation of an average. To the contrary,

⁹⁷¹ See Part I, Title 1, Chapter 2, Section 2, b., ii.

the calculation might tend to under-estimate the overall potential of protection. For example, a low comprehensiveness score could be compensated by highly scored forcefulness. In addition, it tends to uniformize the scores across the case-study, with a decreasing interest in comparison.

Other aggregation options will have to be explored, such as the factorisation of the comprehensiveness score by the forcefulness score, or the modification of the indicator rating scales in themselves to mingle measures of comprehensiveness and forcefulness from the start. In addition, for federal or assimilated countries, a specific method should enable to aggregate the scores obtained for each state. A weighted average based on the population of each state could be envisaged.

As highlighted by Barondes “The lesson is neither that quantitative and quasi-quantitative legal analyses are inevitably erroneous, nor that substantial simplifying assumptions used to make a legal issue receptive to quantitative analysis are necessarily improper. Instead, the value of simplicity in an analysis must be weighed in light of its effect on the accuracy of the results”⁹⁷². Therefore, in absence of an adequate aggregation method, both the scores of comprehensiveness and forcefulness could be sufficient to run comparative analyses.

The last major risk attached to the use of indicators is related to their necessary interpretation, which could be both instrumentalized and misunderstood.

iii. The risk of instrumentalization or misunderstanding

Instrumentalization and misunderstanding two facets of a similar stake when manipulating indicators: their fragile interpretation. As described by Murthy, out in the public sphere, “quantitative indicators may take a life on their own and represent more (or less) than originally intended”⁹⁷³, potentially introducing a knowledge bias.

Instrumentalization refers to the fact that actors, such as governments, private companies or NGOs, might manipulate the results provided by indicators to pursue objectives of their own⁹⁷⁴. For example, a country’s regulation might provide for a legal framework strictly corresponding

⁹⁷² BARONDES Royce de R., « The Limits of Quantitative Legal Analyses: Chaos in Legal Scholarship and FDIC v. W.R. Grace & Co. », *Rutgers University Law Review*, 1995, n° 161, p. 161-226, p. 224.

⁹⁷³ MURTHY Sharmila L., « Translating Legal Norms into Quantitative Indicators: Lessons from the Global Water, Sanitation, and Hygiene Sector », *William & Mary Environmental Law and Policy Review*, 42, 2018 2017, n° 2, p. 385-446, p. 402.

⁹⁷⁴ See Part I, Title 1, Chapter 2, section 3.

to the criteria used to rate indicators and therefore obtain an excellent score, without real progress on the ground due to an inexistent enforcement. This is the reason why this work should be completed by measures of the enforcement and effectiveness of analysed legal frameworks⁹⁷⁵.

Besides, misunderstanding is not voluntary and can be due to a lack of understanding of the subtleties, but also of the limits of quantitative analyses, by a public with poor statistical, mathematical or legal training⁹⁷⁶. For example, small differences in scores between two countries might be considered as meaningless by the indicator producers, but could be viewed as significant by the press or the public⁹⁷⁷. This is the reason why indicators should not be communicated by themselves, but accompanied by explanations of what they measure, what they do not measure, and how. In addition, in France the *Conseil d'Etat* highlighted that the existence of too many indicators to evaluate public policy are detrimental to their interpretation⁹⁷⁸.

Indicator producers must therefore consider the potential gap between what indicators may communicate and to whom, and how it differs with the intended message. To do so, they must “consider the indicator’s audience and how it is engaged by the indicator”⁹⁷⁹.

In addition to the technical limitations of the methodology, there are also theoretical limitations.

Section 2) Theoretical limitations of the methodology: objections to the comprehensiveness / forcefulness dichotomy

The soundness of the theoretical framework grounding the methodology is key to the validity of the results. The numerical exploration of the legal texts has an exploratory but non conclusive function. Results emerge from both the qualitative analysis of the legal texts and the interpretation of the results through the prism of theoretical knowledge.

⁹⁷⁵ See Part III, Title 2, Chapter 2.

⁹⁷⁶ EPSTEIN Lee and MARTIN Andrew D., “Quantitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., p. 902.

⁹⁷⁷ GREEN Maria, « What We Talk about When We Talk about Indicators: Current Approaches to Human Rights Measurement », *Human Rights Quarterly*, 23, 2001, n° 4, p. 1062-1097, pp. 1082-1083.

⁹⁷⁸ CONSEIL D'ÉTAT, « Étude annuelle 2020 : Conduire et partager l'évaluation des politiques publiques », Conseil d'État, 2020, p. 79.

⁹⁷⁹ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, « Indicators as a Technology of Global Governance », *Law & Society Review*, 46, 2012, n° 1, p. 71-104, p. 78.

Nevertheless, the theoretical dichotomy composed of the analysis of comprehensiveness and forcefulness, central to the analyses developed here, may present some limits (a). Other analytical frameworks could offer complementary insights to the analysis of regulations (b).

a. Comprehensiveness and forcefulness limits

The analytical frameworks of comprehensiveness and forcefulness, as defined and analysed above, both present some limitations.

As defined above, comprehensiveness “relates to “the quality of being wide-ranging and large in scope”⁹⁸⁰. Therefore, the study of comprehensiveness aims to characterise the breadth of the material scope of the studied legal provisions. A fully comprehensive text deals with the issue at stake – here for example plastic bag pollution –in a holistic manner”⁹⁸¹. The qualitative and quantitative analyses based on this definition therefore consider that the more a regulation is comprehensive, the more it is likely to protect the environment. Some authors have already raised their voices against this conception.

For example, Baldwin *et al.* point the risks of over-regulation, which might “reduce the possibilities for innovation and research”⁹⁸². Additionally, over-inclusiveness would require high costs to gain enough information “for perfectly-tailored rules”⁹⁸³. In addition, it is essential not to lose track of precision in search of comprehensiveness. The precision of rules is directly linked with the forcefulness of these same rules, as “loose standards are more difficult to enforce than precise rules”⁹⁸⁴. Therefore, there might be interlinkages between the measures of comprehensiveness and forcefulness, which the developed methodology tends to overlook.

As defined above, “Forcefulness relates to law’s quality of being “strong and assertive; vigorous and powerful”⁹⁸⁵. It is a measure of the potential of force of a rule, questioning the existence and force of enforcement provisions such as controls and sanctions, but also the

⁹⁸⁰ Oxford Dictionary, Lexico, <https://www.lexico.com/definition/comprehensiveness>, accessed on 14/02/2022.

⁹⁸¹ See Part I, Title 3, Chapter 1, Section 1. Comprehensiveness: characterising the material scope of the legal provisions.

⁹⁸² BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., p. 70.

⁹⁸³ *Ibid.*, p. 232.

⁹⁸⁴ KRAMER Ludwig, *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p., p. xxii.

⁹⁸⁵ Oxford Dictionary, Lexico, <https://www.lexico.com/definition/forcefulness>, accessed on 14/02/2022.

intrinsic force of the chosen policy instrument in curbing actors' behaviour toward the desired outcome⁹⁸⁶. Just like for the analysis of comprehensiveness, the developed methodology considers that the higher the forcefulness, the higher the potential contribution of law to the protection of the environment.

Nevertheless, the contribution of high sanctions to the attainment of high levels of compliance is debated in sociology, psychology or economy studies⁹⁸⁷. The differing contribution of economic incentives and command and control instruments such as bans to environment protection, also ground for debate, has been discussed above⁹⁸⁸. As for the existence of controls, the analysis of forcefulness does not able to go further than the analysis of the precision with which controls are provided for. The allocation of the necessary financial, technical and human resources to the realisation of these controls would be useful indicators of their capacity to detect and pursue non-compliance. These elements nonetheless go beyond the analysis of the legal framework regulating a source of pollution, and could not be developed in this methodology.

Besides, another legal element could have been added to the analysis of forcefulness. Legal texts sometimes refer to the ulterior adoption of another text to bring precisions to a definition or provide for enforcement means for example, *i.e.* of an implementing text. Without the adoption of this implementing text, the pending question remains unanswered: for example, no sanction is provisioned for. In the course of the development of the methodology, it has been considered that the fact that an implementing text had been adopted and the answer it gave to the pending question would flow in the analysis of the comprehensiveness and the forcefulness of the legal framework, thanks to the adoption of the functional approach. Nevertheless, adding an indicator tracking the rate of provisions calling for the adoption of an implementing text which has not been adopted could be added. This indicator would enable to explicitly highlight the existence of regulatory questions explicitly left unanswered by legislators or regulators.

The limitations of the comprehensiveness and forcefulness framework as developed here relate closely the analysis of the effectiveness of the regulation – *i.e.*, to which extent the regulation

⁹⁸⁶ See Part I, Title 3, Chapter 1, Section 2. Forcefulness: analysing the pre-requisites to enforcement.

⁹⁸⁷ LEROY Yann, « La notion d'effectivité du droit, The Concept of a Law's Effectiveness », *Droit et société*, 2011, n° 79, p. 715-732, p. 722.

⁹⁸⁸ See Part I, Title 3, Chapter 1, Section 2. Forcefulness: analysing the pre-requisites to enforcement.

reached its objectives. As such, these limitations lie out of the scope of this study. They are nonetheless key to keep in mind as they pave the way for further research. The comparison of the effectiveness of the regulations based on their comprehensiveness and forcefulness scores could move the debate forward.

Besides, other analytical frameworks could provide complementary perspectives on the potential contribution of law to the protection of the environment.

b. Complementary insights offered by an alternative analytical framework

In its “Better Regulation Checklist”, IMPEL assesses the practicability of the regulation, covering both “the suitability of the legislation for the purpose of its practical application by competent authorities in the Member States, taking into account (...) the infrastructure and resources needed in order to enable competent authorities to perform all their obligations (...) and to take the necessary implementing decisions, and “the suitability of the legislation in terms of the definition of the obligations of the regulated target group in the Member States and of the feasibility for these individual addressees of the legislation to spontaneously comply with their obligations as defined”⁹⁸⁹. Once adapted to a national context, assessment of practicability could offer interesting perspectives as it questions the feasibility of compliance with the regulation. A poorly practicable regulation would be a regulation for which requirements cannot be enforced, or for which compliance with requirements cannot reasonably be checked. These elements resound with the difficulties to implement the Senegalese *loi* n°2015-09 due to the impossibility to control compliance with the law⁹⁹⁰. Enforcees’ capacity to comply with the law would also be assessed through practicability.

The assessment of practicability would therefore offer complementary perspectives to the analysis of comprehensiveness and forcefulness. It would enable to explore the alternative means offered to enforcees, their understanding of the regulation, the acceptability of the regulation and the burden of compliance. Practicability of the regulation was not covered by

⁹⁸⁹ IMPEL-NEPA, « Better Regulation Checklist to assess practicability and enforceability of legislation », Brussels, Belgium, European Union Network for the Implementation and Enforcement of Environmental Law, 2010.

⁹⁹⁰In 2015 Senegal adopted a *loi* (Loi n° 2015-09 above mentioned) banning plastic bags thinner than 30 microns for their poor recycling capacities and solidity. Five years later, Senegal repealed this law and adopted another one (Loi n°2020-04 above mentioned) arguing in its preamble that banning plastic bags thinner than 30 microns and authorizing thicker plastic bags is unenforceable in practice, as control agents couldn’t distinguish a plastic bag from another without a micrometer. Therefore, the law 2020-04 doesn’t rely on a definition based on thickness to define banned plastic bags.

the developed methodology as it requires to reach beyond the analysis of the legal texts alone, into the fields of economy and sociology. It nonetheless paves the way for future research.

Section 3) Opening the door to indicator-contestation: an avenue for validation

External assessment of the validity and reliability of the method and results is complementary to an internal assessment. Donald highlights that academic debate on the methodology employed, and the replication of the experiment on different data samples by different researchers “should even precede the public release of quantitative research”, to “clarify and iron out any methodological flaws, as well as serve as a robustness check for any potentially problematic decisions”⁹⁹¹.

The transparency and availability of methodological choices⁹⁹² and of data sources⁹⁹³ is key to the usefulness and relevancy of external validation. As presented by Mitchell, “by publicly displaying her results, a researcher makes it possible for others to demonstrate publicly the error in those results or the robustness of the evidence offered. This mutual public dialogue should lead to increasing levels of trust in the surviving, evolving evidence”⁹⁹⁴. Therefore, opening the door to indicator-contestation would be the basis of a virtuous circle, eventually leading to the refinement of the methodology⁹⁹⁵.

Any of the different stages of indicator-development can be the focus of indicator-contestation, be it “the data used or not used in indicators, the criteria for weighting the indicators, or the embedded social and political theory of the indicator”⁹⁹⁶.

⁹⁹¹ DONALD David C., « Law in Regression - Impacts of Quantitative Research on Law and Regulation », *Columbia Business Law Review*, 2015, 2015, n° 2, p. 520-612, p. 598-599.

⁹⁹² BRADLEY Christopher G., « International Organizations and the Production of Indicators », in Davis Kevin E., Kingsbury Benedict et Merry Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 27-74, p. 60.

⁹⁹³ DONALD David C., « Law in Regression - Impacts of Quantitative Research on Law and Regulation », *Columbia Business Law Review*, 2015, 2015, n° 2, p. 520-612, p. 601. This includes public access to the database. See annex XIV on the public disclosure of the database developed and used here.

⁹⁹⁴ MITCHELL Gregory, « Empirical Legal Scholarship as Scientific Dialogue Essay », *North Carolina Law Review*, 83, 2005 2004, no 1, p. 167-204 p. 183.

⁹⁹⁵ MURTHY Sharmila L., « Translating Legal Norms into Quantitative Indicators: Lessons from the Global Water, Sanitation, and Hygiene Sector », *William & Mary Environmental Law and Policy Review*, 42, 2018 2017, n° 2, p. 385-446, p. 407.

⁹⁹⁶ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, « Indicators as a Technology of Global Governance », *Law & Society Review*, 46, 2012, n° 1, p. 71-104, p. 87.

Contestation and debate are nonetheless intrinsic to the analysis of law, be it qualitatively or quantitatively, given the importance given to interpretation. Therefore, a challenge would be to place the cursor of an acceptable level of contestation. Paradoxically, existence of a certain level of methodological contestation is a mark of a certain openness and transparency of the methodology or the results. The existence of contestation in itself doesn't mean that the initiative is useless, but rather that the developed approach is either imperfect, either that it doesn't purport to measure the same area than the person opposing a contestation. In this context, users "just ha[ve] to be aware of the risks"⁹⁹⁷. On the contrary, a high level of contestation could be the sign of major flaws of the proposed approach. Davis *et al.* add that "whether and when contestation be seen as a sign of success – or of failure – will therefore depend on how far a given indicator needs to provide certainty to users and targets", as "why would anyone want to use an indicator that put itself radically in doubt ?"⁹⁹⁸.

In the context of the methodology and of the results presented here, this manuscript can be seen as the step preceding external contestation. It presents the methodological choices, the sources of data, the data treatment processes, results on a specific issue and perceived validity and reliability flaws. The next steps, preceding the communication of the results to the public, would be to open the door to methodological contestation to refine the methodology and to expand its test on other objects of plastic of land-based pollution.

⁹⁹⁷ DARPO Jan et NILSSON Annika, « On the Comparison of Environmental Law Emerging Theories in Environmental Law », *Journal of Court Innovation*, 3, 2010, n° 1, p. 315-336, p. 336.

⁹⁹⁸ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 333.

Chapter 2. An enabling technology: expected benefits of the development of numerical environmental law

The critical analysis of the methodology also reveals the strengths and prospects opened up by both the development of a relational database specifically designed to analyse potential contribution of law to the protection of the environment (section 1), but also the research and public policy perspectives opened up by the construction of indicators and scores of the potential of protection (section 2). Both of these aspects are key elements at the center of the development of numerical environmental law.

Section 1) Analytical potential opened by a relational database's design

The design of a comprehensive relational database is one of the major contributions of this work. Although data entry and extraction may be cumbersome⁹⁹⁹, its structure enables to access data for multiple research purposes without requiring resort to data extraction. Its two main features are the possibility to navigate in the meanders of a country's legislation by accessing to data under different forms, but also to answer to specific research questions by accessing to data on demand (a). Both open new avenues for legal research (b).

a. Navigating the meanders of the legislation: benefits of access to data on demand

The relational database is a portal facilitating access to the data it contains. As above mentioned, the database is organised in tables of similar data, with relationships between different tables¹⁰⁰⁰. Trackability of the data entered in the database is ensured by the automatic register of the name and date of the data entry and modification. This feature enables to spot sections of the regulation which wouldn't have been updated since an evolution of the legislation, as long as this evolution has been observed.

There are two ways by which it is possible to access the data contained in the database: through consultation and searches.

The consultation mode is the most direct way to access data in the database. The structure of the database enables to present the data under many different layouts, to offer a horizontal spread-out view of the regulation over different tables (*e.g.*, articles, instruments, and sanctions

⁹⁹⁹ See Part III, Title 1, Chapter 1, section 1, b. Limitations of the relational database.

¹⁰⁰⁰ See Part I, Title 3, Chapter 2, Section 1. Production of a relational database: an enabling framework. See also Annexes VII, VIII, and XIX.

related to a common object) through the creation of reports, or a vertical representation of similar data in different countries (*e.g.*, characteristics of the instruments used in different countries) through list views. In addition, the database has been designed to facilitate the navigation between the different layouts and between elements between which relationships exist through the configuration of specific buttons. Specific layouts (*i.e.*, ways to represent the data) can be developed on demand, without requiring any manipulation of the data.

The search mode is called, in the Filemaker software, the “Find” mode. This tool is directly accessible from the database, and enables to select one or several criteria to be simultaneously met or to be omitted in the research. This tool enables to make searches in the database tailored to specific needs. It guarantees a flexible access to the database to answer to a diversity of research questions.

Data extraction allows to go further than the visualisation of these internal relationships, by allowing complementary statistical analyses on the recurrence of similar relational patterns across countries, but also the development of indicators.

b. Horizons opened up by database development

These different characteristics open research perspectives in the field of law, but also beyond.

In a legal perspective, the database’s features are particularly useful in comparing the legal strategies adopted by different countries in front of a same problem (*e.g.*, plastic bag regulation), by offering complementary analytic features to textual analysis of texts. For example, it is possible to directly search in the database which countries regulate the commercialisation and the export of plastic bags, or which countries rely on thickness to characterise the regulated bags. Searches can also be combined along different criteria, for example by searching which are the countries banning, AND regulating both commercialisation and export, AND relying on a thickness criterion. Therefore, the database facilitates the comparison of the legal approaches developed by a larger set of countries. The database’s features would also be useful in comparing the similitudes and differences of the same countries in front of different problems (*e.g.*, plastic bag and pesticide regulation).

The database here serves as an intermediary between the text and its analysis, by offering access to a structured version of the text. In other words, the ‘find function’ facilitates the extraction of data offering food for thought, and the relational architecture displays the interlinkages between different elements of the database (*e.g.*, instruments, objects and sanctions) in a manner which is invisible to paper analyses. The structuration of the data in a database therefore

facilitates the pursuit of qualitative and quantitative analyses, be they to score indicators or to analyse the regulation through numerical descriptors.

Beyond the study of law, the database could be seen as a portal offering a facilitated access to legal information to non-lawyers, be they researchers from other disciplines or stakeholders exterior to research interested to access legal data on a specific field. The horizons opened by cooperation with researchers from other disciplines are large. For example, crossing data on the adoption of legal texts against plastic pollution with data measuring the prevalence of this pollution in ecosystems could advance research on law's contribution to the status and trend of the state of the environment. On the political front, the database could facilitate the access to data to parties such as NGOs, empowering their action for a better protection of the environment. In other words, once the cumbersome data entry process is passed, the database provides unlimited access to structured data to be used in a variety of different settings, providing significant time gains to anyone interested by a specific thematic. There are nonetheless risks to misinterpret the data contained in the database, for non-lawyers and for lawyers. Contact with referent lawyers should therefore be facilitated.

Section 2) Research and public policy perspectives opened by legal indicators' development

The design and calculation of indicators and scores assessing the potential contribution of law to the protection of the environment is the second major contribution of this work. The development of comprehensiveness and forcefulness indicators is facilitated by the development of a relational database, which provides access to a structured view of the data. The research and public policy perspectives opened by these legal indicators' development are nonetheless distinct, given the communication facilities offered by indicators in general, which are powerful communication and soft power tools (a). Legal environmental indicators could thus facilitate the monitoring of law's contribution to the protection of the environment (b) as long as one takes precautions in the communication of the indicators (c).

a. Legal indicators: powerful communication tools

Indicators in general – be they legal or non-legal – are powerful communication tools due to their intrinsic characteristics. Indicators' concise format and reliance on numbers make them

appear as objective and incontestable¹⁰⁰¹. Their construction in itself intends to grasp in a single sound bite a complex and sometimes multidimensional concepts. When produced by a renowned university or institution, indicators additionally benefit from an aura of combined “scientific authority and organizational strength”¹⁰⁰². Therefore, indicators can act as both informational tools and empowerment tools. It must nonetheless be kept in mind that “quantitative indicators will never be able to convey the complexity of a problem”¹⁰⁰³. They are complementary rather than a substitute for contextual and qualitative information.

By condensing complex concepts into simply understandable figures, indicators are a way to construct the understanding of a given phenomenon. By there, they can then be used to communicate this knowledge, “develop or test scientific hypotheses”, or “form conclusions that provide a basis for decision and action”¹⁰⁰⁴. In addition, the translation of a concept into indicators based on numbers “provide a basis for accountability, comparability, and performance benchmarking”¹⁰⁰⁵, all of which can be sources of knowledge enhancement. Last, the visual representation of the information contained in the indicators can enable to communicate further to a range of people from different disciplines¹⁰⁰⁶.

The capacity of indicators to communicate information is decisive in their empowerment potential. The design and production of indicators can require technical, human and financial resources restrictive to many stakeholders, who nonetheless consider the use of the indicators in themselves. Once released, indicators can be used for a variety of purposes. Their displayed neutrality and basis for comparability can be used to influence other actors’ actions or objectives, in regard to the phenomenon measured by the indicator¹⁰⁰⁷. The aggregation of

¹⁰⁰¹ SALAIS Robert, « La donnée n’est pas un donné - Pour une analyse critique de l’évaluation chiffrée de la performance », *Cahiers Droit, Sciences & Technologies*, PUP, 2014, n° 4, p. 15-36, p. 21. See also OGIEN Albert, « Peut-on se déprendre du pouvoir du chiffre ? », *Droit et société*, n° 105, Lextenso, 2020, n° 2, p. 479-489, p. 487.

¹⁰⁰² DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, « Indicators as a Technology of Global Governance », *Law & Society Review*, 46, 2012, n° 1, p. 71-104, p. 100.

¹⁰⁰³ MURTHY Sharmila L., « Translating Legal Norms into Quantitative Indicators: Lessons from the Global Water, Sanitation, and Hygiene Sector », *William & Mary Environmental Law and Policy Review*, 42, 2018 2017, n° 2, p. 385-446, p. 444.

¹⁰⁰⁴ DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 1-23, p. 15.

¹⁰⁰⁵ MURTHY Sharmila L., *op.cit.*, p. 386.

¹⁰⁰⁶ DONALD David C., « Law in Regression - Impacts of Quantitative Research on Law and Regulation », *Columbia Business Law Review*, 2015, 2015, n° 2, p. 520-612, p. 599.

¹⁰⁰⁷ MURTHY Sharmila L., « Translating Legal Norms into Quantitative Indicators: Lessons from the Global Water, Sanitation, and Hygiene Sector », *William & Mary Environmental Law and Policy Review*, 42, 2018 2017, n° 2, p. 385-446, p. 401.

indicators into scores and ranks can also influence behaviour at a distance when one seeks to improve his score on the measured phenomenon.

As far as the results of the present research are concerned, the indicators are still in their development phase. Their diffusion modalities have therefore not yet been set. The conformity of the indicator with the needs and constraints of the intended user and the “the manner in which data are maintained and conveyed for use”¹⁰⁰⁸ are nonetheless found to be critical factors affecting indicator utility¹⁰⁰⁹. The communication of quantitative results must be made with caution, given the risks of misinterpretation or manipulation, as above mentioned.

Generally speaking, the communication of indicators and quantitative results offer knowledge and empowerment opportunities, but represent also risks. Even though the results of the present research are not yet ready to be communicated, this prospect opens interesting perspectives for the protection of the environment.

b. Showcasing and recognising the role of environmental law

The indicators developed here measure the comprehensiveness and forcefulness of legal frameworks regulating a source of pollution, with the aim to inform the potential of protection offered by the legal texts in themselves, prior to their enforcement. These results could serve a diversity of purposes, with the general objective to leverage the protection of the environment by making visible the role played by environmental law in its protection.

First, information on the state of the potential protection offered by currently in force legal texts, as provided by the developed indicators, is key to push for law reform, and the adoption of more comprehensive and forceful texts in the protection of the environment. This information, freely provided, will contribute to the information and the participation of the public, recognised as a pillar of environmental protection¹⁰¹⁰. The multiplication of the analysed thematics and key

¹⁰⁰⁸ MCEL FISH James M. Jr. et VARNELL Lyle M., « Designing Environmental Indicator Systems for Public Decisions », *Columbia Journal of Environmental Law*, 31, 2006, n° 1, p. 45-86, p. 46.

¹⁰⁰⁹ See also MITCHELL Gregory, « Empirical Legal Scholarship as Scientific Dialogue Essay », *North Carolina Law Review*, 83, 2005 2004, n° 1, p. 167-204, p. 204.

¹⁰¹⁰ Principle 10, Rio Declaration of 1992, above mentioned.

questions could additionally enable to highlight the existence of success or failure trends across thematics or countries.

Second, the systematic compilation and analysis of legal texts on a thematic will enable to monitor the evolutions of the content of environmental law, be it its progress or regression. Even though the “stand still” principle has been recognized as a principle of environmental law¹⁰¹¹, environmental law is frequently under attack for economic, sanitary or security motives.

Last, the measure of the potential contribution of law to the protection of the environment can be seen as a first step towards the measure of the enforcement of environmental law and of its effectiveness in answering to its objective¹⁰¹². Doing so will contribute to enhance the social utility of law by making visible its contribution to the protection of the environment, or to the contrary show the extent to which it is disconnected from reality.

Conclusion of Title 1

This work constitutes a first step towards the development of new approaches to the analysis of environmental law. As such, it has enabled to better identify why it is difficult to translate regulations adopted in different countries into numbers, and possible avenues to do so. It has also enabled to identify barriers needing to be addressed down that road, be they technical and theoretical, and highlighted the need to bring nuance to quantitative results through qualitative analyses. In the light of the exposed limitations of the developed methodology, one could ask if it is useful at all. The answer is yes. The identification of these limitations are as much avenues for further research, and the potential benefits of the development of indicators to analyse and communicate the content of law are promising.

Therefore, the application of this method to the analysis of plastic bag regulation has enabled to push further our understanding of the nooks and crannies of these regulations, to compare the legal approaches developed by six entities, but also to provide insights on their potential contribution to the protection of the environment. The scope of the method is nonetheless insufficient to offer a wider picture of the extent to which law protects the ocean from land-based pollution, requiring a critical analysis of plastic bag results.

¹⁰¹¹ Paragraphs 19 and 20, The Future we Want, Resolution adopted by the General Assembly of the United Nations, July 27th 2012, A/RES/66/288, United Nations.

¹⁰¹² See Title 2, Chapter 2, Regulatory shadows left unexplored

Title 2. A critical analysis of plastic bag results

Plastic bags legal frameworks have been chosen as the first case study on which to test the developed methodology. This trial has enabled to put forward both the strengths and limitations of the developed methodology, which have been developed above.

In addition to the contribution to a better knowledge of the advantages and disadvantages of the development of numerical and computational tools to analyse law, the application of the methodology to the analysis of plastic bag regulations allowed to push further the understanding of plastic bag regulation dynamics in a timely manner, on the eve of the negotiation of an international treaty on plastic pollution (Chapter 1).

The focus of the methodology, set on the analysis of the legal frameworks as designed by countries' institutions, nevertheless left aside two major facets of law's contribution to the protection of the environment: enforcement and effectiveness. The concomitant study of these different areas of law research along with the pursuit of the current analyses would enable to draw a more accurate picture of law's contribution to the protection of the environment in the area of plastic bags regulation (Chapter 2).

Chapter 1. A better understanding of the plastic bag regulation dynamics on the eve of the negotiation of an international treaty on plastic pollution

The use of the database along with the application of the comprehensiveness and forcefulness analytical framework enables a relative holistic approach to the analysis of plastic bag regulations which was so far left unexplored.

There are two major inputs to plastic bag regulation scholarship, stemming from the application of the methodology. First, the integrated approach to plastic bag regulation strategies enabled by the database reveals a high variability in regulation strategies as a whole, through a diversity of combinations of objects, instruments and sanctions (section 1). Second, the analyses of the comprehensiveness and forcefulness of plastic bag regulations casts a complementary light by qualifying and quantifying the potential contribution of law to the protection of the environment (section 2). These two complementary aspects stress the challenge of an uniformized approach to plastic pollution on the eve of the negotiation on an international treaty on plastic bag pollution (section 3).

Section 1) Highlighting a high variability of plastic bag regulation strategies

The legal scholarship on plastic bag regulation strategies had highlighted the diversity of characteristics of regulated plastic bags¹⁰¹³, or of instruments used to regulate bags¹⁰¹⁴. The use of the relational database enables to go further, by facilitating the analysis of these characteristics in relationship with each other. Not only does it facilitate the analysis of the characteristics used to define the objects of the regulation, but it also enables to relate this information to the type of instrument and its design, and to the sanctions provided for. These results show that variability can also be found at the level of the regulation strategy as a whole. Out of the six entities studied here, none have developed a similar approach to the regulation of plastic bags.

In addition, the combination of qualitative and quantitative analyses enables the emergence of different types of results. Qualitative analyses are key to apprehend the subtleties of law, specifically in the definitions of the object of the regulations, or in the modulation of the design of instruments and of the provision for both controls and sanctions. Quantitative analyses enable to take a step back, and to consider the regulations no longer in their full complexity, which impedes comparability, but through their characteristics. Multicriteria analyses can therefore facilitate the emergence of trends or highlight patterns found in several countries.

Beyond the analysis of the law, the characterisation of its potential contribution to the protection of the environment is the second major input to the plastic bag scholarship.

Section 2) Qualifying and quantifying the potential contribution of legal frameworks to the protection of the environment: inputs of comprehensiveness and forcefulness analyses

There are several inputs related to the characterisation of law's potential contribution to the protection of the environment through the analysis of comprehensiveness and forcefulness.

¹⁰¹³ See for example UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018.

¹⁰¹⁴ See for example KARASIK Rachel, VEGH Tibor, DIANA Zoie *et al.*, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020; XANTHOS Dirk et WALKER Tony R., « International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review », *Marine Pollution Bulletin*, 118, 2017, n° 1, p. 17-26.; or SCHNURR Riley E. J., ALBOIU Vanessa, CHAUDHARY Meenakshi *et al.*, « Reducing marine pollution from single-use plastics (SUPs): A review », *Marine Pollution Bulletin*, 137, 2018, p. 157-171.

The reliance on this framework highlights that the adoption of a regulation doesn't guarantee, in itself, the protection of the environment, nor does its enforcement. The content of the regulation and its relevancy are essential factors to its potential contribution to the protection of the environment. The impacts of a regulation are in part determined by its content, upstream from its enforcement.

The analysis of comprehensiveness and forcefulness intends to fill this gap between the analysis of the existence of a regulation and its enforcement, by providing inputs to the analysis of the content of the regulation. Moreover, it enables to move beyond the description of the content of the texts, by characterising their potential contribution to protection, both qualitatively and quantitatively through the development of indicators and aggregate scores.

These comprehensiveness, forcefulness and country scores, calculated periodically, would allow to monitor the evolutions of legal frameworks across time, and to determine whether environment protection follows an upward or downward trend across time and space. The diffusion of these aggregate indicators – and therefore of the regulations' weaknesses – could also encourage the adoption of more stringent regulations by countries lagging behind.

Last, remains the question as to whether country scores or comprehensiveness and forcefulness scores are the most interesting to analyse and communicate. Country scores provide a synthetic signal on law's potential contribution to the protection of the environment, which is both easy to grasp and to compare with other indicators. Nevertheless, aggregate indicators of comprehensiveness and forcefulness provide more information on the characteristics of each country's regulatory forces and weaknesses. On this perspective, comparisons of the scores obtained on law's potential contribution to the protection of the environment between countries would be more interesting based on the comprehensiveness and forcefulness scores than on the country scores.

These inputs to plastic bag regulation scholarship could usefully inform the stakes of a global regulation of plastic.

Section 3) The challenge of an uniformized approach to plastic pollution

As introduced at the outset of this work, there are, to date, no international treaty specifically dedicated to fight plastic pollution. Rather, several international treaties regulate specific areas of plastic pollution, such as the trade of hazardous material, among which some plastics are cited (*cf.*, above mentioned Basel Convention) or the composition of plastic, through the

regulation of Persistent Organic Pollutants (*cf.*, above mentioned Stockholm Convention). Besides, the dumping of plastic at sea is prohibited by the MARPOL and London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, both above mentioned. These international legal frameworks are nonetheless insufficient to provide for a holistic approach to plastic pollution, from cradle to grave, given the prevalence of land-based sources.

An important step forward has been made towards the adoption of this long-awaited treaty in March 2022, with the adoption of the resolution “End plastic pollution: Towards an international legally binding instrument”¹⁰¹⁵ by 193 UN Member States, paving the road for the adoption of an international agreement. An intergovernmental negotiating committee, commencing its work during the second half of 2022, should complete the draft of the future treaty by the end of 2024.

Even if the pollution sources the treaty will have to address span way beyond plastic bags and our seven case study countries, insights offered by the application of the methodology to plastic bag regulation could contribute to identify the main obstacles the design and implementation of the Treaty should overcome.

First, this work has highlighted the diversity of approaches to plastic bag regulation, from the definition of regulated plastic bags to the scope of exceptions, passing by the variety of policy instrument designs and provision for sanctions. If the Plastic Treaty preliminary work as adopted in the Resolution seems to endorse flexibility in the approaches adopted by countries, the adoption of common definitions and standards will be key to address plastic pollution holistically and avoid implementation gaps due to unprecise definitions. Particular attention should be paid to the definition of biodegradable, oxo-degradable and compostable bags which misuse can represent sources of pollution¹⁰¹⁶, but also to reusability criteria such as thickness requirements, varying from country to country. In addition, the scope of exceptions, based on physical characteristics or specific usages, could also be delimited in the Treaty.

Second, this work demonstrates the importance of the analysis of both the comprehensiveness and the forcefulness of regulations, prior to their implementation, to identify gaps likely to impede their protective effect. The development of this methodological framework could be

¹⁰¹⁵ United Nations Environment Assembly of the United Nations Environment Programme, Resolution “End plastic pollution: Towards an international legally binding instrument”, UNEP/EA.5/L.23/Rev.1, 02/03/2022.

¹⁰¹⁶ See Part II, Title 1, section 2, a.

further developed and adapted in the context of an international regulation of plastic, to serve to both the future Secretary or Parties in the design of national contributions and regulations likely to mitigate plastic pollution.

The focus of this work, centered on the regulation of plastic bags at the source, account for a limited portion of the stakes relative to plastic pollution. The application of the methodology to a larger sample of single-use plastics, to the analysis of the legal frameworks of a larger set of countries, and to other stages of plastics' life cycles – such as collection and treatment – could be determinant to further guide the draft of the Treaty.

In addition, further research is needed to address the regulatory shadows left unexplored by the current methodology, enabling to go beyond the assessment of “the potential contribution of legal frameworks to the protection of marine environments”, by determining the extent to which these provisions materialise and have an effect on current levels of pollution.

Chapter 2. Regulatory shadows left unexplored

The analysis of the potential contribution of law to the protection of the ocean is not sufficient to characterise the extent to which law protects the ocean. Two complementary analyses, which are out of the scope of this study, are required. The first consists in determining to which extent the provisions, as set up in the legal texts, are implemented and enforced (section 1). In other words, the question is to explore whether the regulations have an effect. The second consists in determining the effectiveness of the regulation, which can also be understood as whether it has reached its objective (section 2).

Section 1) From implementation and enforcement to compliance: decisive processes for the protection of the environment

Implementation and enforcement are two steps by which the regulation, as defined in the texts, has an effect on its object by prompting compliance (a). There are nonetheless obstacles to implementation and enforcement, which might impede law's contribution to the protection of the environment (b).

a. Implementation and enforcement, two decisive steps for compliance with the law

The analysis of the comprehensiveness and forcefulness of legal texts regulating plastic bags has shown the importance of policy design in the appreciation of in force law's potential contribution to the protection of the environment. Nevertheless, a legal text must be complied with to have an effect on its object¹⁰¹⁷.

Compliance is a state by which a regulatee abides by the law. As a state rather than process, regulatees either comply, or do not comply. Taking the example of the entry in force of a ban of plastic bags, regulatees can comply by themselves¹⁰¹⁸ – even in absence of defined sanctions or provisions for controls – or be forced to comply, through enforcement which can be understood as the enforcement of compliance¹⁰¹⁹.

¹⁰¹⁷ KEANE A., JONES J. P. G., EDWARDS-JONES G. *et al.*, « The sleeping policeman: understanding issues of enforcement and compliance in conservation », *Animal Conservation*, 11, 2008, n° 2, p. 75-82, p. 75.

¹⁰¹⁸ Russel *et. al* identify potential drivers of what they call “self-enforcement” such as the desire to create a positive public image (if it is identified as valuable), or the will to avoid a “broader bureaucratic attack” such as auditing. See RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p. 4.

¹⁰¹⁹ ARDIA David S., « Does the Emperor Have No Clothes? Enforcement of International Laws Protecting the Marine Environment », *Michigan Journal of International Law*, 1998, p. 497-567, p. 3.

Therefore, enforcement is an on-going process, bringing regulatees to compliance and deterring them from moving away from compliance. As such, a same regulatee is subject to law enforcement at several occasions, both initially (when the rule is created) and continuously. Russel *et al.* distinguish “initial” and “continuous” compliance¹⁰²⁰. Initial compliance is referred to in the case of meeting standards embodied in permits on a one-off basis. Continuous compliance refers to meeting these terms on a day-to-day basis and over time.

There are two parts to the enforcement of law: the detection of a fraud through monitoring or control, and the punishment of this fraud. Therefore, enforcement requires a fraud to be detectable despite statistical, technological, legal, financial challenges. Russel *et al.* provide examples of these challenges in a context of pollution control, such as the right of access for monitoring purposes or measurement difficulties (*e.g.*, bias of sampling, measurement errors, fluctuation of discharges¹⁰²¹). As highlighted by Ardia, “in environmental law, the ultimate aim is the protection of the environment”; accordingly, the purpose of enforcement in this context is “to obtain compliance before violations occurs”¹⁰²², fueling what Westerlund calls “pro-active enforcement”¹⁰²³. Besides, Gunningham highlights that enforcement can take a variety of forms¹⁰²⁴.

Implementation of law is an intermediary step between its design and adoption (in a legal text) and its enforcement. Implementation is the operationalisation of the law¹⁰²⁵. As such, it requires specific resources and attention¹⁰²⁶, to verify that the rules are enforceable in practice, “and that their combined substance is in full compatibility with what it takes for full implementation”¹⁰²⁷. Nevertheless, as put forward by Emison, “no design, no matter how well conceived, can

¹⁰²⁰ RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p8.

¹⁰²¹ *Ibid*, p. 10.

¹⁰²² ARDIA David S., « Does the Emperor Have No Clothes? Enforcement of International Laws Protecting the Marine Environment », *op.cit.*, p.3.

¹⁰²³ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, Uppsala, Uppsala University, Department of Law, 2007, 664p., p. 309.

¹⁰²⁴ The seven forms identified by Gunningham are Rules and Deterrence; Advice and Persuasion; Criteria Based Regulation; Responsive Regulation; Smart Regulation; Risk-Based Regulation; and Meta-Regulation. See GUNNINGHAM Neil, « Enforcing Environmental Regulation », *Journal of Environmental Law*, 23, 2011, n° 2, p. 169-201, pp. 173-175.

¹⁰²⁵ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, *op.cit.*, p. 308.

¹⁰²⁶ EMISON Gerald, « The Potential for Unconventional Progress: Complex Adaptive Systems and Environmental Quality Policy », *Duke Environmental Law & Policy Forum*, 7, 1996, n° 1, p. 167-192, p. 190.

¹⁰²⁷ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, *op.cit.*

possibly anticipate all the opportunities and problems likely to be encountered in implementing the policy”¹⁰²⁸. Therefore, implementation is also an ongoing process, requiring to complement or amend adopted regulations, to facilitate its enforcement. The collision between the initial content of the rule or the enforcement tools initially provided and the reality of law enforcement repetitive failures can lead to the adoption of further implementation measures. The latter can provide for additional enforcement means or the adaptation of the material or geographic scope of the regulation. This backward loop between enforcement and implementation or ‘adaptive law-making’ can also be triggered by the observation of perverse effects of law, which need to be corrected.

As such, implementation can require the provision for additional enforcement means or the adaptation of the material or geographic scope of the regulation. Most frequently, implementation is pursued by executive bodies. Seldom, legislative bodies adopt a new statute or *loi* to amend or appeal a precedent one. In this case, legislative bodies can also be considered as actors of implementation.

Law can have an effect on the pursued objective even if full compliance is not reached. As highlighted here in European Union law, an important question is to determine acceptable levels of failure or non-compliance¹⁰²⁹. This question is also central in domestic law.

b. Potential obstacles to enforcement and compliance

Several obstacles to enforcement and compliance justify the need to specifically investigate these issues, to make a step further towards the determination of the extent to which law protects the ocean.

The fragmentation of the competence to enforce environmental regulations between different ministries or agencies is often mentioned as an obstacle to the enforcement of law. For example, in Senegal, six administrations are in charge of the enforcement of the *loi* 2020-04 above mentioned: the Ministry of Finance, of the Environment, of Health, of Industry, of Trade and the Police¹⁰³⁰. Owen highlights that this fragmentation can lead to “counterproductive

¹⁰²⁸ EMISON Gerald, « The Potential for Unconventional Progress: Complex Adaptive Systems and Environmental Quality Policy », *op.cit.*

¹⁰²⁹ ANDERSEN Stine, *The Enforcement of EU law: The Role of the European Commission*, Oxford, United Kingdom, Oxford University Press, 2012, 272 p, p. 42.

¹⁰³⁰ Article 25, *loi* n°2020-04, above mentioned.

regulation” due to uncoordinated action¹⁰³¹. On the other hand, well-coordinated shared enforcement competences between different administrations could lead to enhanced enforcement, in answer to the multiplicity of actors targeted by environmental regulation. On this aspect, Owen highlights that technology could contribute to raise informational and coordination challenges encountered in coordinating environmental law enforcement¹⁰³².

In addition, Fonbaustier highlights the lack of institutions such as police or courts specifically trained to enforce environmental law¹⁰³³. He also highlights the lack of budget, equipment and human resources of institutions in charge of controlling the enforcement of environmental law¹⁰³⁴, which can constitute disincentives to enforce environmental law¹⁰³⁵.

A third impediment to the enforcement of environmental law, raised by Westerlund, is the occurrence of corruption¹⁰³⁶.

To the other end of the spectrum, the study of the obstacles to compliance is impeded by rule breakers’ unwillingness “to reveal themselves or to discuss their motivations freely for fear of punishment”¹⁰³⁷. An analysis of the literature nonetheless provides a few insights. There are three main theories suggesting the mechanisms by which people comply – and therefore do not comply.

The first, based on an economic model called the “deterrence” model, “suggests that people obey the law when the perceived costs and probability of punishment outweigh the cost of compliance”¹⁰³⁸. Under this model, enforcement of the regulation is key, as “the calculus is affected by likelihood of detection (frequency of inspection) and by the speed, certainty, and

¹⁰³¹ OWEN Dave, « Mapping, Modeling, and the Fragmentation of Environmental Law », *Utah Law Review*, 2013, p. 219, p. 228.

¹⁰³² *Ibid.*, p. 232.

¹⁰³³ FONBAUSTIER Laurent, « L’(in)efficience de la norme environnementale », *Deliberée*, N° 8, 2019, n° 3, p. 19-25, p. 21.

¹⁰³⁴ *Ibid.*

¹⁰³⁵ KRAMER Ludwig, *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p., p. xxvi.

¹⁰³⁶ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, Uppsala, Uppsala University, Department of Law, 2007, 664p., pp. 311-312.

¹⁰³⁷ KEANE A., JONES J. P. G., EDWARDS-JONES G. *et al.*, « The sleeping policeman: understanding issues of enforcement and compliance in conservation », *Animal Conservation*, 11, 2008, n° 2, p. 75-82, p. 76.

¹⁰³⁸ BARNES Jeb et BURKE Thomas F., « The Diffusion of Rights: From Law on the Books to Organizational Rights Practices », *Law & Society Review*, 40, 2006, no 3, p. 493-524, p. 495.

size of the sanctions imposed”¹⁰³⁹. If the analysis of plastic bag regulations has enabled to showcase the provision for severe sanctions, such as in Ireland and Senegal, whether these sanctions have been pronounced could not be investigated, due to the difficulty to access data. The frequency of controls and convictions are key aspects of the deterrence model.

The “norms-based model”, from a social psychology perspective, suggests that “people comply when they find the law’s commands to be fair and appropriate”¹⁰⁴⁰. Here, awareness-raising would be key to enhance compliance, as provided for in the Cape Verdean plastic bag legal framework. The conduct of surveys could enable to poll the population’s perception of the fairness of legal provisions.

Third, “social motivation”, suggests that compliance stems from “the desire of the regulatee to earn the approval and respect of significant people with whom they interact”¹⁰⁴¹.

These three approaches are nonetheless based on a presumption that the enforcers have a perfect understanding of the existence and the meaning of the regulation, determining their will to comply. This hypothesis might not always be true, as regulatees may not be aware of the adoption of a regulation, may not understand it – regulations being sometimes too vague or complex – nor could they have the ability to comply for financial or technical reasons. For example, the shift from plastic bags to reusable or paper bags require the production and availability on the market of such bags. In addition, their increased cost can be an obstacle to compliance.

In addition, the legal frameworks can be unenforceable in itself, as shown by the Senegalese *loi* 2015-09 banning plastic bags below 30 microns for their poor recycling capacities and solidity. Control of compliance with the regulation, and therefore enforcement, was impeded by the under equipment of controllers who did not have micrometers – instruments to measure

¹⁰³⁹ WINTER Søren et MAY Peter, « Motivation for Compliance with Environmental Regulations », *Journal of Policy Analysis and Management*, 20, 2001, p. 675-698, p. 676.

¹⁰⁴⁰ BARNES Jeb et BURKE Thomas F., « The Diffusion of Rights: From Law on the Books to Organizational Rights Practices », *Law & Society Review*, 40, 2006, no 3, p. 493-524, p. 494. See also JACKSON Jonathan, BRADFORD Ben, HOUGH Mike *et al.*, « Why Do People Comply with the Law? Legitimacy and the Influence of Legal Institutions », *British Journal of Criminology*, 52, 2012, p. 1051-1071 for an analysis of perceived legitimacy as a factor of law compliance.

¹⁰⁴¹ WINTER Søren et MAY Peter, « Motivation for Compliance with Environmental Regulations », *Journal of Policy Analysis and Management*, 20, 2001, p. 675-698, p. 678, citing GRASMICK, H.G., & BURSİK, R.J. Jr., « Conscience, significant others, and rational choice: Extending the deterrence model », *Law and Society Review*, 24, 1990, p. 837-861.

the thickness of bags. The unenforceability of this law triggered the adoption of the *loi* 2020-04, which doesn't rely on a definition based on thickness to define banned plastic bags.

Enforcement must therefore be seen as one mean, among others, to stimulate compliance. Awareness-raising could also contribute to fuel compliance, by enhancing the knowledge of the regulation, of its rationale, and by fueling social pressure to comply¹⁰⁴². In addition, there might be financial and technical obstacles to compliance which should be identified. These insights into obstacles to enforcement and compliance prefigure the challenges of a measure of the enforcement of and compliance with a regulation. Nevertheless, a fully complied with regulation might not be sufficient to protect the environment. The analysis of its effectiveness is the last step.

Section 2) A required analysis of the effectiveness of regulations

In this context, effectiveness can be defined as “the extent to which the activity’s stated objectives have been met”¹⁰⁴³. The first step of an analysis of effectiveness would be to determine the objective pursued by the regulation. In the case of the regulation of plastic bags, the objective could be to protect the ocean from plastic pollution. Therefore, the analysis of effectiveness is key to measure the extent to which law protects the ocean.

So far, this work has highlighted a variety of reasons why a regulation might not achieve its objective. As adopted, the regulation might not be comprehensive enough to offer an adapted answer to the issue at stake and the design of the policy instrument determines the mechanisms by which the regulation influences behaviours¹⁰⁴⁴. This theoretical potential of protection must be tempered by the level of enforcement and compliance to the regulation. In addition, the enforcement of the regulation can fail to have an effect on its object or generate unforeseen perverse effects, driving down the effectiveness of the regulation (a).

Current initiatives pertaining to measure the effectiveness of plastic bag regulations are mostly centred on the analysis of the outcome – the level of plastic bag consumption for example –

¹⁰⁴² WINTER Søren et MAY Peter, « Motivation for Compliance with Environmental Regulations », *Journal of Policy Analysis and Management*, 20, 2001, p. 675-698, p. 675.

¹⁰⁴³ OECD, Glossary of Statistical Terms, accessed <https://stats.oecd.org/glossary/detail.asp?ID=4775>, accessed on 10/12/2021.

¹⁰⁴⁴ See Part II, Title 3, Chapter 1, A pre-requisite: casting a critical eye on plastic bag regulations.

through the lenses of the policy instrument choice¹⁰⁴⁵. Avenues for further research would be to combine analyses of the law's potential contribution to the protection of the environment – through the lenses of comprehensiveness and forcefulness - with analyses of enforcement and compliance, and with measures of the effectiveness. This work would enable to precisely determine the role law plays in the protection of the environment, and avenues for enhanced protection (b).

a. *A regulatory risk: regulatory failure and perverse effects*

Regulation can fail to achieve its objectives. Baldwin *et al.* summarize the issue this way: “regulation (...) is at least as much about unintended consequences as about intended outcomes”¹⁰⁴⁶. Perverse effects are a particular form of regulatory failure, occurring when the effects of the regulation's enforcement go against the achievement of the regulation's objectives.

For example, in the context of plastic bag regulation, regulatory failure can occur in the absence of suitable and available alternatives¹⁰⁴⁷. Several authors also identify perverse effects to the enforcement of plastic bag regulations. Homonoff *et al.* identify perverse effects to the enforcement of a narrowly defined plastic bag ban, leaving “close undesirable substitutes unregulated”¹⁰⁴⁸. The authors point out that a Chicago city ban achieves the elimination of lightweight plastic bags (as designed), but “led retailers to provide free thick plastic bags with a thickness roughly just over the 2.25 mils defined in the ban”¹⁰⁴⁹, provoking an increase in plastic consumption rather than decrease. These thicker bags were abandoned in the aftermath of the repeal of the ban. Here, the regulation's perverse effect finds its source in a lack of comprehensiveness of the adopted text. The authors conclude that a taxation of a wide range of products might be, in practice, more effective than a narrowly defined ban. Another California-based study shows that the elimination of plastic carryout bags entailed a dramatic increase of purchases of small, medium and tall trash bags which have increased by 120%, 64% and 6%

¹⁰⁴⁵ See Part II, Title 1, Chapter 1, section 2), a. Assessing policy effectiveness from an instrument perspective.

¹⁰⁴⁶ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p, p. 59.

¹⁰⁴⁷ MUPOSHI Asphat, MPINGANJIRA Mercy et WAIT Marius, « Considerations, benefits and unintended consequences of banning plastic shopping bags for environmental sustainability: A systematic literature review », *Waste Management & Research*, SAGE Publications Ltd STM, 2021, p. 1-14.

¹⁰⁴⁸ HOMONOFF Tatiana, KAO Lee-Sien, SELMAN Javiera *et al.*, « Skipping the Bag: The Intended and Unintended Consequences of Disposable Bag Regulation », *Journal of Policy Analysis and Management*, 41, John Wiley & Sons, Ltd., 2022, n° 1, p. 226-251, p. 226.

¹⁰⁴⁹ *Ibid.*, p. 228.

respectively¹⁰⁵⁰. Taylor shows that “basing the success of a regulation solely on reduced consumption in the regulated market overstates the regulation’s welfare gains”¹⁰⁵¹, as these gains can be lessened by consumption shifting to unregulated bags.

More generally, Sieber points out to seven mechanisms leading to the occurrence of perverse effects)¹⁰⁵²: the disruption of the functioning of the system, actors’ reliance on the regulation to achieve opposite effects, the fact that regulation fuels opposition rather than compliance, the value of non-compliance, the allocation of resources to unattainable objectives rather than on achievable objectives, the fact that the existence of a regulation and illusion of compliance might hide unanswered issues, and the risk that the regulation process turn attention away from the initial objective. Regulatory failure might also emerge from communication difficulties between law and other subsystems. As described by Baldwin *et al.*, “the instruments of law (speaking the language of ‘law’) do not directly translate into the language of the economy – therefore they require translation and ‘arrive’ in the economic subsystem not only in translated (distorted) form, but also with significant time delay”¹⁰⁵³. They illustrate that law can either be ignored by the other subsystem, inhibit the other subsystem’s functioning or be inhibited by the other sub-system’s domination.

The challenge in identifying and correcting regulatory failure is that there are “no common point of view on what constitutes failure and causes”, neither are there any rules on whether failure can be foreseen or is a surprise¹⁰⁵⁴.

In a nutshell, regulatory failure may be due to a weakness in one of the stages of the regulatory process. Table III.1 provides examples of weaknesses which can find their sources in the design, the implementation and the enforcement of the regulation.

¹⁰⁵⁰ TAYLOR Rebecca L. C., « Bag leakage: The effect of disposable carryout bag regulations on unregulated bags », *Journal of Environmental Economics and Management*, 93, 2019, p. 254-271, p. 255.

¹⁰⁵¹ *Ibid.*, p. 254.

¹⁰⁵² SIEBER Sam D., *Fatal Remedies: the Ironies of Social Intervention*, New York, Plenum Press, 1981, 234 p.

¹⁰⁵³ BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p., p. 61-62.

¹⁰⁵⁴ BALDWIN Robert, CAVE Martin et LODGE Martin, *ibid.*, p. 68.

Stage of regulatory process	Potential weaknesses
Rule design	<ul style="list-style-type: none"> - Lack of precision in definition leaves too much ground for opposite interpretation - Under-inclusiveness: undesirable conduct escapes constraint - Over-inclusiveness: desirable behaviour constrained - Over-regulation: reduces possibilities for innovation and research - Inadequate choice of policy instrument
Implementation	<ul style="list-style-type: none"> - Time constraints in revising the regulation - High implementation delays - Government turnover - Institutional overlapping - Legislation too vague or too complex to be put in practice - Unrealistic legislation
Enforcement	<ul style="list-style-type: none"> - Weak detection of undesirable behaviour (technical, legal, human challenges in detection) - Lack of intervention tools to deal with undesirable behaviours - Lack of sanctions provided for in the texts - Difficulty to impose sanctions (sanctions too high) - Lack of deterrence of sanction (sanction or probability of being caught too low) - Difficulty to apply over-precise regulation - Creative compliance –side-stepping rules, without breaking their formal terms

Table III.1 Potential weaknesses along the different stages of the regulatory process.

Source: adapted by the author from Baldwin et al. (2012): pp. 68-94 and Bell & McGillivray (2006): p. 100.

In any case, the regulatory system and its failures should be compared to hypothetical outcomes produced by another regulatory system or no regulation at all. Given the complexity of the analysis of the processes at hand, the analysis of effectiveness must find its sources in the analysis of the content of the law and its enforcement.

b. The analysis of the content of the law and of its enforcement, preliminaries to the analysis of its effectiveness

As detailed above, an analysis of the content of the law – including through the lenses of comprehensiveness and forcefulness – is not sufficient to characterise the extent to which law protects the ocean. As summarised by Gunningham, “for legislation to ‘work’ it must not only be well designed but also effectively implemented and enforced”¹⁰⁵⁵. One could add that its effectiveness should be verified.

Therefore, it is not a surprise to observe that a country such as Ireland, obtaining a medium score on the basis of the methodology developed here, due to the choice of taxation rather than a ban, to the large scope of exceptions to the regulation and to an imprecise definition of regulated plastic bags¹⁰⁵⁶ has often been mentioned as a good example of an effective plastic

¹⁰⁵⁵ GUNNINGHAM Neil, « Enforcing Environmental Regulation », *Journal of Environmental Law*, 23, 2011, n° 2, p. 169-201, p. 170.

¹⁰⁵⁶ See in general Part II, The method in motion: a contribution to the analysis of plastic bags regulations.

bag regulation¹⁰⁵⁷. First, the analysis of the Irish regulation's effectiveness ran by Convery *et al.* is only based on observed reduction rate of the consumption of plastic bags at checkouts, potentially missing the observance of shifting consumption patterns. The latter occurs when, for example, the regulation of plastic bags leads to a dramatic increase of consumption of trash bags. Second, as shown by the Senegalese example, a well enforced taxation may be *in fine* more effective than a poorly comprehensive and enforced ban.

On the other hand, the sole analysis and comparison of the effectiveness of plastic bag regulations, extensively developed in the literature¹⁰⁵⁸, is not sufficient to characterise and push forward the contribution of law to the protection of the environment. These comparisons, most often spanning over different countries at different times, overlook peculiar local regulatory, social or economic contexts¹⁰⁵⁹ which may influence the results.

Therefore, the compilation of analyses of the regulations' content with analyses of enforcement, compliance and with analyses of the regulations' effectiveness could provide large benefits. First, the analysis of the content of the text highlights, through the identification of weaknesses, the need for further implementation or specific areas of enforcement which will require specific attention. Second, the analysis of enforcement and compliance would also enable to identify the need for further implementation, in answer to enforcement challenges. The analysis of these first two steps would provide useful insights to the comparison of regulations' effectiveness. In addition, it would be possible to track back observed effectiveness differences to its content, enforcement or compliance sources. Taken as a whole, these analyses would provide a better understanding of law's contribution to the protection of the environment.

Further research is needed to design the methodology which would enable to reach such objectives. An avenue could be to explore the possibility to develop structural, process and outcome indicators each corresponding to a different step of the analysis: respectively analysing whether the legal frameworks are comprehensive / forceful; the extent to which they are enforced; and the extent to which they enable to reach the defined objectives.

¹⁰⁵⁷ CONVERY Frank, MCDONNELL Simon et FERREIRA Susana, « The most popular tax in Europe? Lessons from the Irish plastic bags levy », *Environmental and Resource Economics*, 38, 2007, n° 1, p. 1-11.

¹⁰⁵⁸ See Part II, Title 1, Chapter 1, section 2), a. Assessing policy effectiveness from an instrument perspective.

¹⁰⁵⁹ MUPOSHI Asphat, MPINGANJIRA Mercy et WAIT Marius, « Considerations, benefits and unintended consequences of banning plastic shopping bags for environmental sustainability: A systematic literature review », *Waste Management & Research*, SAGE Publications Ltd STM, 2021, p. 1-14, p. 10.

Conclusion of Title 2

The application of the designed methodology to the analysis of plastic bag regulation in seven case-study countries has enabled to highlight key characteristics of these regulations, such as their diversity and their complexity. Both of which should represent a challenge in the design of a future international Treaty regulating single-use plastics, among which plastic bags is the first object to be regulated, both in age and in number. It has also enabled to characterise their potential contribution to the protection of the environment, highlighting that the comprehensiveness and the forcefulness of regulations are key factors determining the level of protection offered by these texts.

These analyses are nonetheless not sufficient to determine to which extent law protects the ocean from a source of pollution. Analyses of the enforcement, compliance, and effectiveness of these regulations would enable to push further our understanding of the current levers of and obstacles to environment protection on the ground. Further research is needed to do so.

In the meanwhile, the current methodology could be refined and offer interesting comparative perspectives through its application to the analysis of the regulation of other single-use plastics, or of other downstream approaches to the regulation of plastic pollution such as recycling or extended producer responsibility¹⁰⁶⁰. In a complementary perspective, the opportunity and challenges to the application of the methodology to other sources of land-based pollution has been explored.

¹⁰⁶⁰ See for example HART Rachel, « Shifting the Burden of Plastic Bags: A Proposal for a Federal Extended Producer Responsibility Law Comments », *LSU Journal of Energy Law and Resources*, 9, 2021, n° 2, p. 531-562.

Title 3. Opening to other key questions of land-based pollution: questioning the transferability of the methodology

The developed methodology has been tested on a single dataset: the regulation of plastic bags. The regulation of plastic bags might be considered as a specific case in the field of environmental law for three reasons. First, national regulations have been adopted throughout the world in absence of an international convention. Second, the adoption of plastic bag regulations has been driven by countries in the Global South¹⁰⁶¹. Third, the adoption of these regulations is fairly recent.

Therefore, the application of the methodology on other datasets is an essential contribution to the assessment of its validity and reliability to measure law's potential contribution to the protection of the environment. As raised by Donald, the importance of this step in the analysis of the performance of a methodology justifies the need to run it prior to "going public" with quantitative research¹⁰⁶².

On a spatial basis, the challenges and opportunities raised by an assessment of the plastic bag regulations of a larger set of countries has been discussed above¹⁰⁶³.

The transferability of the methodology should also be tested on a thematic basis. Ultimately, the transferability of the methodology could be tested on the regulation of any threat posed to marine or non-marine environments. Given the range of possibilities, a focus on the two other major sources of land-based pollution is proposed here, to enable the development of an indicator of the potential contribution of environmental law to the mitigation of this issue¹⁰⁶⁴.

In addition to plastic pollution, the two other main sources of land-based pollution are pesticides and sewage. There are both challenges and opportunities to the transfer of the methodology to the analyses of pesticide (Chapter 1) and sewage (Chapter 2) regulations.

¹⁰⁶¹ KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead: What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, 2018, n° 6, p. 1994, p. 1997.

¹⁰⁶² DONALD David C., « Law in Regression - Impacts of Quantitative Research on Law and Regulation », *Columbia Business Law Review*, 2015, 2015, n° 2, p. 520-612, p. 599.

¹⁰⁶³ See Title 1.

¹⁰⁶⁴ The initial plan was to apply the developed methodology to the analysis of plastic, pesticide and sewage regulations, in nine countries. The number of case-study countries and of thematics had to be reduced, in answer to time constraints.

Chapter 1. Pesticides: conditions and challenges of a transfer of the methodology

Just like plastic pollution, pesticide pollution finds its source in a chemical substance created by mankind, and found in natural environments. Nonetheless, many of its intrinsic or regulatory characteristics differ from plastic bags and their regulation. Two main challenges emerge from these differences. On a methodological perspective, the identification of key questions, bases for the analysis, raises specific challenges (section 1). In legal terms, the power to regulate pesticides differs from the power to regulate plastic bags in the case study countries (section 2). Therefore, this section questions how these characteristics may influence the transposition of the developed methodology in this field, but also enable to foresee potential benefits in the application of the methodology to pesticide regulation.

Section 1) Specificities of pesticides as a field of study

In many aspects, pesticides are different from plastic as a field of study. Contrary to plastic, pesticides have been designed to be harmful to the living. In addition, each pesticide has specific impacts on the environment (a). These characteristics complexify the choice of key questions, essential to run the methodology (b). Last, the transfer of the method to the analysis of pesticides would require to run a few adjustments to the relational database (c).

a. Pesticides: an introduction to the notion

As defined by Hough, “the term pesticide refers to any substance used in the control of pests as defined by humans”¹⁰⁶⁵, therefore covering insecticides, herbicides, fungicides designed to eliminate insects, weeds or fungi, but also products not designed to control rather than eliminate, such as repellents or pheromones. If pesticides cover a wide range of potential usages, they also cover a wide range of products. Pesticides can be “natural”, meaning that they are directly extracted from plants; biological, through the use of living organisms which can be predators of the pest to control; inorganic, as derived from minerals or synthetic, products of the chemistry industry¹⁰⁶⁶. The latter are the most common.

¹⁰⁶⁵ HOUGH Peter, *The Global Politics of Pesticides: Forging consensus from conflicting interests*, London, Routledge, 2014, 244 p., p. 4.

¹⁰⁶⁶ HOUGH Peter, *ibid.*, p. 5.

The subject of pesticides is somewhat different from plastic, justifying a specific introduction to these products. If their large-scale production and use started during the XXth century¹⁰⁶⁷, reference to pest control has been found in writings from Ancient Greece and the Roman empire¹⁰⁶⁸. The advancements of chemistry at the beginning of the XXth century and after the Second World War increased the effectiveness of the products. Industrialisation, globalisation and the need to feed a growing population are responsible for the surge of the use of pesticides, long-considered as a technological breakthrough.

Three events contributed to raise awareness on this issue. First, the publication of *Silent Spring*¹⁰⁶⁹ in 1962 by Rachel Carson is often considered as the initiation of the pesticide-contestation movement. This general audience scientific book documents the harmfulness for the environment of the massive use of pesticides, and the power of the chemical industry. Second, debates on impacts of pesticides on human health emerged near to ten years later with the use of defoliants spread by American troops during the Vietnam War¹⁰⁷⁰. The Bhopal disaster, in 1984, is the third event that stirred public awareness on the harmfulness of pesticides. Thousands of people were killed by the leakage of chemicals in the neighbourhood of a production plant.

The high diversity of existing pesticides prevents any generalisation on their impacts on human health or the environment, which require a case-by case analysis¹⁰⁷¹. Whereas the evaluation of impacts is most often centred on the product's active substances, adjuvants or co-formulants which guarantee the good functioning of the product, may also be harmful. One of the keys to the understanding of the potential damaging effects of pesticides is the notion of residues. Once passed the desired treatment, the products do not disappear. They often remain in the environment under their original chemical composition, or transform into other compositions

¹⁰⁶⁷ In the USA, the Federal Insecticide Act is adopted in 1910. It is known as the first pesticide legislation enacted. Its adoption is a testimony of the use of insecticides at that time in the USA.

¹⁰⁶⁸ SMITH Allan E. et SECOY Diane M., « Forerunners of Pesticides in Classical Greece and Rome », *Journal of Agricultural and Food Chemistry*, 23, 1975, n° 6, p. 1050-1055.

¹⁰⁶⁹ CARSON Rachel, *Silent Spring*, Boston, Houghton Mifflin, 1962, 352 p.

¹⁰⁷⁰ HOUGH Peter, *The Global Politics of Pesticides: Forging consensus from conflicting interests*, London, Routledge, 2014, 244 p., p. 1.

¹⁰⁷¹ See for example AMARA Anis, *Evaluation de la toxicité de pesticides sur quatre niveaux trophiques marins : microalgues, échinoderme, bivalves et poisson*, Université de Bretagne Occidentale, 2012, 214 p., for an evaluation of the impacts of the impacts of three pesticides on marine environments.

named metabolites. Both can have impacts overshooting the precise function the product was used for, by impacting other species through time and space. One of the major challenges to the measure of the impacts of pesticide pollution is that the diversity of analysed substances remains limited, in comparison to the diversity of active substances on the market¹⁰⁷².

In addition, the dangers of pesticide lie not only in the products in themselves, but also in potential synergetic, accumulated and threshold effects¹⁰⁷³. Synergetic effects occur when the effects of two products “are bigger and/or of a different character than only a sum of the basic effects”. Synergetic effects can occur in the environment when different products are used, or through the use of a product composed of different chemical components. Accumulated effects occur through the continuous or repeated exposition of an organism to pesticides, with impacts different to a single exposition. Threshold effects are best expressed by the expression “the straw that breaks the camel’s back”. They cover a change of the impact when a critical value (of concentration for example) is exceeded. These three types of secondary effects complexify the *ex-ante* evaluation of their potential impacts, conditioning their authorisation. In addition, pesticides can be harmful at very low doses.

To date, there is no international convention addressing pesticides as a whole, but two international conventions, targeting dangerous chemical products, are relevant to some pesticides. The Rotterdam Convention¹⁰⁷⁴ is somehow the equivalent of the above-mentioned Basel Convention for chemical substances. It sets conditions to the international trade of “severely hazardous pesticide formulations” and “severely restricted chemicals”, and organises a consent procedure containing information on the substances prior to their trade. Concerned chemicals are listed in Annex III, in which a number of pesticides are listed. The Stockholm Convention¹⁰⁷⁵ intends to protect the environment and human health from persistent organic

¹⁰⁷² LEENHARDT Sophie, MAMY Laure, PESCE Stéphane *et al.*, « Impacts des produits phytopharmaceutiques sur la biodiversité et les services écosystémiques. Résumé de l’expertise scientifique collective », ESCo, INRAE, Ifremer, 2022, p.2.

¹⁰⁷³ WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, Uppsala, Uppsala University, Department of Law, 2007, 664p., pp. 43-44.

¹⁰⁷⁴ Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, signed in Rotterdam on the 10th of September, 1999 and entered in force on the 24th of February 2004.

¹⁰⁷⁵ The Stockholm Convention on Persistent Organic Pollutants, signed in Stockholm on the 22nd of May 2001, and entered in force on the 17th of May 2004.

pollutants, chemicals that remain in the environment¹⁰⁷⁶. Such chemicals can be pesticides, or be designed for other usages. It requires from Parties to prohibit the production and use of chemicals or their trade, according to lists provided in annexes A and B (article 3).

Given the diversity of active products, commercial formulations and pesticide uses, the application of the method to the analysis of pesticides will require to select specific key questions to focus on.

b. A methodological pre-requisite: selecting key questions

Just like the application of the method to plastic pollution required to focus on a specific aspect of its regulation – *i.e.*, the key question of plastic bags – its application to pesticides requires to choose a specific focus. This need is exacerbated by the fact that the regulation of pesticides is more ancient, more complex and broader than the regulation of plastic.

There are a variety of avenues by which it is possible to regulate pesticides. Specific rules may apply to their active substance, to their commercial product formulation, or to their conditions of use (type of users, required safety gear, specific environmental conditions to respect, *etc.*). Therefore, applying the methodology to the analysis of pesticides as a whole would not be possible, given that the applied legal frameworks vary from a pesticide to another. The identification of specific key questions - subtopics of pesticides' pollution – should enable to compare countries' legal answers to a common threat.

Selected key questions, as defined above¹⁰⁷⁷, must be chosen according to three different criteria: their recognised harmfulness for marine environments; their universality to enable comparisons between countries, and their balanced precision, as a key to the objectivity and legibility of the indicators, without endangering comparability. Selecting key questions for the theme of pesticides therefore requires to face several challenges.

Meeting the first criteria is the simplest of the three. Many scientific articles have been published these last years on the harmfulness of pesticides. Nonetheless, the risks posed to the ecosystems may vary from an ecosystem to the other. Data accessibility may here be an obstacle to the identification of threats posed by pesticides in specific ecosystems, as it may be challenging to access studies relevant for each case-study. In addition, choosing a specific

¹⁰⁷⁶ The Ocean Health Index provides a measure of the intensity of organic pollution due to pesticide runoff from land-based pollution. See <https://ohi-science.org/data>, accessed 26/07/2022.

¹⁰⁷⁷ See Part I, Title 2, Chapter 2, Section 2.

pesticide to study would require to determine the risks it poses by itself, and in synergy with other products.

The universality criterion is more difficult to meet. The use of a specific pesticide is determined by the type of pest to be killed, and what is to be protected. Pesticides use – be it the type or the quantity – is thus deemed to vary across time and space. Choosing a specific pesticide is also a challenge, as the use may be geography and agriculture dependant. The analysis of the results should therefore precise whether a pesticide is used in that country but unregulated, or whether it is not used, and therefore unregulated. Access to data on this subject may be challenging in some countries.

Regarding the precision criterion, should the key question be based on an active substance or the commercial product? A difficulty lies in the fact that pesticides commonly have several names. For example, the herbicide paraquat's chemical formulation - 1,r-dimethyl-4,4-bipyridinium ion - is marketed under other names, such as Pathclear and Gramoxone¹⁰⁷⁸. In the European regulatory framework, the active substance is authorised at the European level, whereas the marketing product is authorised at the national level¹⁰⁷⁹. Therefore, it might be necessary to keep both the name of the active substance and the marketed products to explore the regulatory characteristics of pesticides. An inventory of the names of the marketed products could be required.

In addition, the pesticide chosen as a key question might not be representative of the state of pesticide regulation globally. Some harmful pesticides (such as DDT) have been regulated for decades now. Others, such as neonicotinoids, have not. Choosing the first would enable to highlight the flaws of existing law, whereas choosing the second would point out the problematic absence of law. Whereas the methodology is best fit for the first purpose, it can also be used for the second.

Besides, the type of pesticide is not the only aspect of pesticide pollution which could be used as a key question. The restriction of use of some pesticides for non-professional users or non-

¹⁰⁷⁸ HOUGH Peter, *The Global Politics of Pesticides: Forging consensus from conflicting interests*, London, Routledge, 2014, 244 p., p. 5.

¹⁰⁷⁹ See 2) b. i., European Union: common means to reduce pollution at the source.

agricultural related uses could also be of interest. It is nonetheless difficult to access to data on the distribution of the use of pesticides on the basis of the type of user.

Preliminary research in the case-study countries revealed that European countries diversely transposed the European Union's requirement to "take all necessary measures regarding pesticides authorised for non-professional users to avoid dangerous handling operations"¹⁰⁸⁰ in different manners. For example, France banned, as from January 1st 2019 the detention and use of synthetic pesticides for non-professional users¹⁰⁸¹. This includes any product with glyphosate as an active substance. The iconic Roundup can still be used, in another formulation which does not contain synthetic pesticides. In the United Kingdom, synthetic pesticides, such as glyphosate can still be used by non-professional users¹⁰⁸², so long as the product is not specifically authorised for professional use only – and that the user holds a certificate¹⁰⁸³ - and that general information is provided by the seller on the risks for the environment and human health related to the use of this pesticides, on low-risk alternatives, and on conditions of use or storage¹⁰⁸⁴. In Ireland, the Statutory Instruments n°155 and restricts the sale of pesticides approved for professional uses only to professionals, who must hold a certificate¹⁰⁸⁵.

Last, the regulation of specific conditions of use, such as aerial spraying, could be considered as a key question¹⁰⁸⁶, or the distance of application to specific areas (wells, schools, water abstraction points, *etc.*)¹⁰⁸⁷.

¹⁰⁸⁰ "These measures may include use of pesticides of low toxicity, ready to use formulations and limits on sizes of containers or packaging". Article 13§2, Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides, Official Journal of the European Union L309/71, of 24.11.2009, p. 71-86.

¹⁰⁸¹ Art. 2, Loi n° 2014-110 du 6 février 2014 visant à mieux encadrer l'utilisation des produits phytosanitaires sur le territoire national, publiée au JORF n°33 du 8 février 2014.

¹⁰⁸² See the database of Pesticide Products with Great Britain and Northern Ireland Authorisation for use in the Garden, Health and Safety Executive, <https://secure.pesticides.gov.uk/garden/prodsearch.asp>, accessed 02/05/2022.

¹⁰⁸³ Regulation 8, Statutory Instrument n°1657 of 2012, The Plant Protection Products (Sustainable Use) Regulations 2012, made on June 20th 2012 and entered into force on 18th of July 2012.

¹⁰⁸⁴ Regulation 9, Statutory Instrument n°1657 of 2012, above mentioned.

¹⁰⁸⁵ Article 5, Statutory Instrument n°155 of 2012, signed on 17th of May 2012 and published in "Iris Oifigiúil" of 25th May, 2012.

¹⁰⁸⁶ See Regulation 15 and subsequent on the requirement of a permit obtention prior to aerial spraying of pesticides, Statutory Instrument n°1657 of 2012, above mentioned.

¹⁰⁸⁷ See for example Schedule 2, Ireland Statutory Instrument n°155 of 2012, above mentioned. In France, see Arrêté du 27 décembre 2019 relatif aux mesures de protection des personnes lors de l'utilisation de produits phytopharmaceutiques et modifiant l'arrêté du 4 mai 2017 relatif à la mise sur le marché et à l'utilisation des produits phytopharmaceutiques et de leurs adjuvants visés à l'article L. 253-1 du code rural et de la pêche maritime, publié au JORF n°0302 du 29 décembre 2019 ; and Décret n° 2019-1500 du 27 décembre 2019 relatif aux mesures

c. Required adaptations to the relational database

The relational database has been specifically designed to facilitate the incorporation of various key questions. The creation of a table OBJECT independently from other tables, enables to modify the type of object analysed (*e.g.*, plastic bag or pesticide) without any incidence on the rest of the database. The table OBJECT must nonetheless be adapted to the key questions analysed. For example, specific features of the plastic bag regulation were added to fill the type of material, the size or the thickness of regulated bags. Similarly, the adaptation to the analysis of pesticide will provide for fields to precise maximum concentrations, distance of application to specific areas, or the type of authorized users. This step requires first to have a strong knowledge of analysed legal frameworks and to have precised the analysed key questions, to avoid to run modifications in the database when data has already been filled in.

Another specificity of pesticide legal frameworks, in regard to plastic bag legal frameworks, may require additional modifications to the database. Annexes are frequently referred to, to list the products to which specific provisions apply. The current setting of the database does not enable to directly search inside a text, or to provide for successive versions of a similar text. The latter could be required for the effective use of the database in the analysis of pesticides.

Beyond the methodological challenge of the identification of key questions, and the technical challenge required by the modification of the database, the distribution of competence in the field of pesticide regulation is a legal challenge to the application of the methodology.

Section 2) A competence mismatch

The distribution of the power to regulate pesticides differs from that of plastic bag in all the case-study countries. Two criteria have been used in the analysis of the power to regulate plastic bags: whether the competence is federated or devolved, and whether the competence is shared with a supranational organisation¹⁰⁸⁸. The results, for each case-study and criteria, are compiled in table III.1. Just like for the plastic competence analysis, the correspondence, or non-correspondence, of each country to these two criteria is coded by 0 or 1. This simple analysis enables to group countries by degrees of resemblance.

de protection des personnes lors de l'utilisation de produits phytopharmaceutiques à proximité des habitations, publié au JORF n°0302 du 29 décembre 2019.

¹⁰⁸⁸ See Part 1, Title 2, Chapter 1. A comparative imbroglia: environmental competences in case study countries.

	State or devolved competence	Share of comp. with supranational org.
USA	0	0
BR	0	0
SN	0	1
CV	0	1
FR	0	1
IE	0	1
UK	1	0 ¹⁰⁸⁹

Table III.2 Case-study countries and environmental competence distribution along 2 criteria: pesticides

The United States of America and Brazil do not share the power to regulate pesticides with a supranational organization, but neither do they delegate this power to States (a). On the other hand, Ireland, France, Senegal and Cape Verde have in common the share of competencies, in the field of pesticide regulation, with a supranational organisation. The differences between EU institutions and African institutions in the field of pesticide regulation will nonetheless be addressed. The recent exit of the United Kingdom from the European Union, along with devolution, constitutes its specificity in this framework (b).

a. United States of America and Brazil: a federal pre-emption, mingled with State cooperation

In the United States of America (i) and in Brazil (ii), the power to regulate pesticides has been pre-empted by the federal government, through the adoption of a federal law on that matter. The federal government nonetheless cooperates with the states' administration to implement and enforce the regulation.

i. United States of America

Back in the 1980s, the Environmental Protection Agency already considered that pesticide regulation was an urgent matter, after pesticides residues were found in underground waters, which represent around half of USA freshwater resources¹⁰⁹⁰.

¹⁰⁸⁹ The case of the United Kingdom is particular, due to Brexit. As above mentioned, EU law implemented in the UK prior to Brexit has been retained in national law as long as further national regulations have not been adopted. Therefore, the current pesticide legal framework in force in the United Kingdom is strongly influenced by EU law, but the UK no longer shares competences with the EU in the field of pesticide regulation.

¹⁰⁹⁰ FINDLEY Roger W., JURGENSMEYER Julian C. et LAMBRECHTS Claude, « Etats-Unis : La législation sur les pesticides aux Etats-Unis », *Revue juridique de l'Environnement*, 12, 1987, no 2, p. 179-200, p. 179.

In the USA, the regulation of pesticides lies under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) was passed by Congress in 1947 and amended in 1972, 1978 and 1988¹⁰⁹¹. Under this Act, pesticide products are first regulated at the federal level, with a registration at the EPA. The act provides that the states may “regulate the sale or use of any federally registered pesticide or device in the State, but only if and to the extent that the regulation does not permit any sale or use prohibited by this Act”¹⁰⁹². For uniformity reasons, states may not impose additional labelling or packaging¹⁰⁹³. Nonetheless, states “may provide registration for additional uses of federally registered pesticides formulated for distribution and use within that State to meet special local needs” if this authorisation hasn’t been previously denied¹⁰⁹⁴. Moreover a “State shall have primary enforcement responsibility for pesticide use violations” so long as it respects the then listed preconditions¹⁰⁹⁵.

The Texas Department of Agriculture and the Florida Department of Agriculture and Consumer Services are the departments in charge of pesticide regulation enforcement in Texas and Florida.

ii. Brazil: an illustration of the complexity of the share of competences

Just as in the USA, the distribution of competences for regulation of pesticides (*agrotóxicos* in Brazilian), is different than for plastic bags. The *Lei* n°7.802/89, de 11 de julho de 1989¹⁰⁹⁶ organises the regulation of pesticides and the share of competences with States for that matter in Brazil. Under Article 9, the Federal government is responsible for the production, the register, interstate commerce, exportation, importation, transport, classification and control of products. Pesticides’ regulation is shared with states and the federal district for the use, the production, the consumption, the trade and storage of pesticides, as defined by article 10. Finally, the use and storage of pesticides may also be regulated by municipalities, under article

¹⁰⁹¹ In the USA, the first Act regulating pesticides was the Federal Insecticide Act, passed in 1910, then repealed by FIFRA.

¹⁰⁹² United States Code, Title 7, § 136v.

¹⁰⁹³ *Ibid.*

¹⁰⁹⁴ *Ibid.*

¹⁰⁹⁵ United States Code, Title 7, § 136w-1.

¹⁰⁹⁶ BRASIL. Lei n°7.802, de 11 de julho de 1989. *Dispõe sobre a pesquisa, a experimentação, a produção, a embalagem e rotulagem, o transporte, o armazenamento, a comercialização, a propaganda comercial, a utilização, a importação, a exportação, o destino final dos resíduos e embalagens, o registro, a classificação, o controle, a inspeção e a fiscalização de agrotóxicos, seus componentes e afins, e dá outras providências*, Brasília, DF, 11 julho 1989.

11 of the *lei*. In any case, the products must previously be registered and authorized at the federal level (article 3) by the *Agência nacional de vigilância sanitária*¹⁰⁹⁷ (ANVISA).

Just like for plastic regulation, the share of competences for pesticide regulation is intricate. This characteristic could be challenging when applying the methodology, as it requires to analyse simultaneously texts adopted by different institutions, and applicable at different geographic scales.

b. A supra national share of competence: from the European Union to African institutions

Two of the European and the two African case-studies share a common characteristic in matter of pesticide regulation: the share of competences with a supranational organisation. For France and Ireland, the European Union provides for common means to reduce pollution at the source (i), whereas for Senegal and Cape Verde, several African institutions are invested in the regulation of pesticides (ii).

i. European Union: common means to reduce pollution at the source

Three prevailing principles of European environmental policy go in the direction of the regulation of pesticides, among other environmental issues: the precautionary principle, the preventive action principle, and the principle that environmental damage should be taken at the source. This led the European Commission to require the register of all chemical product in the EU, through the ‘REACH’ system¹⁰⁹⁸. The European Chemicals Agency (ECHA) is in charge of administrating this system. In addition, plant protection products (*i.e.*, pesticides) are regulated by the Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market¹⁰⁹⁹. Under this regulation, the power to regulate active substances lies in the hands of the European administration, whereas the power to regulate the plant protection products as a whole lie in the hands of the Member States. This competence distribution is justified at the Recital 23 of the Regulation, arguing that “plant protection products (...) can be formulated in many ways and

¹⁰⁹⁷ ANVISA, <https://www.gov.br/anvisa/pt-br>, accessed 25/04/2022.

¹⁰⁹⁸ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, (OJ L 396, 30.12.2006, p.1).

¹⁰⁹⁹ Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC, published in the Official Journal of the European Union Journal n°L309 of 24/11/2009, p.1.

used on a variety of plants and plant products, under different agricultural, plant health and environmental (including climatic) conditions”. The authorization of a plant protection product thus requires “an administrative act by which the competent authority of a Member State authorizes the placing on the market of a plant protection product in its territory”¹¹⁰⁰. Adjuvants are also authorized by and in Member States¹¹⁰¹.

The power to regulate single use plastic and pesticides is shared between the EU institutions and the Member States. Nonetheless, the legal framework set at the European level is quite different, due to the different implications of Directives and Regulations. The plastic legal framework is much more flexible, leaving the choice of the means to the Member States to achieve common objectives, whereas the pesticide frameworks leave a narrow leeway to Member States. In both cases, Member States can adopt stricter and more protective regulations than those set at the European level. In the case of the pesticide regulation, the Member State must nonetheless “immediately inform the other Member States and the Commission thereof and give reasons for its decision”¹¹⁰².

As exposed *supra*, active substances are registered and authorised at the European level, whereas products are authorised by the competent administration of Member States. In France, *l’Autorité Nationale de Sécurité Sanitaire* (ANSES)¹¹⁰³ is responsible for the authorisation of products. In Ireland, this role is held by the Pesticide Registration and Control Divisions of the Department of Agriculture, Food & the Marine (DAFM)¹¹⁰⁴.

ii. Brexit: a United Kingdom specificity

The European REACH system has been adopted in 2009, about eleven years before the United Kingdom exit from the European Union. As detailed above, the REACH system establishes a share of competences between European institutions and Member States to organise respectively the approval of the active substances (by European institutions) and of products

¹¹⁰⁰ Article 3, §10 Regulation no 1107/2009.

¹¹⁰¹ Art. 58, §1, Regulation no 1107/2009.

¹¹⁰² Article 81 §2, , Regulation no 1107/2009.

¹¹⁰³ ANSES, <https://www.anses.fr>, accessed 25/04/2022.

¹¹⁰⁴ Pesticide Registration and Control, <https://www.pcs.agriculture.gov.ie>, accessed 25/04/2022.

(by Member States' institutions). In the United Kingdom, this administration is the Health and Safety Executive (HSE)¹¹⁰⁵.

After Brexit, effective on 01/01/2021, HSE becomes the national regulator for the whole of the United Kingdom, meaning that “new decisions taken under the EU regime will not apply”¹¹⁰⁶. Nevertheless, “all relevant EU law in relation to the regulation of plant protection products has been retained in GB law”¹¹⁰⁷, meaning that EU pesticide regulation prior to Brexit is still applied, so long as it is not overtaken by newly adopted UK legislation.

This time-bound share of competences between EU and the UK (prior to Brexit) may be challenging in the application of the methodology as it requires to monitor both the date of adoption of EU authorisations and the evolutions of UK law to determine applicable regulation.

iii. Senegal and Cape Verde: a multiple supranational share of competence

In Senegal and Cape Verde, the power to regulate pesticides is also shared with supranational organisations¹¹⁰⁸. The complexity of this share of competences lies in the fact that several supranational organisations are involved, respectively three for Senegal and two for Cape Verde. Figure III.1 presents these three institutions – the Permanent Inter-State Committee for the Prevention of Drought in the Sahel (CILSS)¹¹⁰⁹, the Economic Community of West African States (ECOWAS)¹¹¹⁰ and the West African Economic and Monetary Union (WAEMU)¹¹¹¹ - and their respective committees responsible for pesticide registration – the Sahelian Pesticide Committee, the *Comité Ouest Africain d'Homologation des Pesticides* (COAHP) and the

¹¹⁰⁵ Health and Safety Executive, <https://www.hse.gov.uk/index.htm>, accessed 26/04/2022.

¹¹⁰⁶ Health and Safety Executive, <https://www.hse.gov.uk/pesticides/brexit.htm>, accessed 26/04/2022.

¹¹⁰⁷ *Ibid.*

¹¹⁰⁸ This paragraph is based on the results of the Master thesis of David Schwob, tutored by Marie Bonnin and myself. See SCHWOB David, *La mise sur le marché des pesticides agricoles : étude comparée des législations brésilienne, française et sénégalaise*, Mémoire de Master 2, Université Paris Saclay, 2020, 73 p.

¹¹⁰⁹ Both Cape Verde and Senegal are Member States of the CILSS. Member States are: Benin, Ivory Coast, Gambia, Guinea, Guinea-Bissau, Mauritania, Senegal, Togo, Burkina Faso, Mali, Niger, Chad and Cape Verde.

The Senegal ratified its adhesion to the CILSS by the Loi n° 2002-28 du 9 décembre 2002 autorisant le Président de la République à ratifier la version révisée de l'Accord portant Réglementation commune aux États membres du CILSS, publié au Journal Officiel de la République du Sénégal n° 6084 du 25 janvier 2003.

The CILSS has been officially created by the Résolution N° 7/27/CM/92 de la 27ème session ordinaire du Conseil des Ministres du CILSS relative au contrôle phytosanitaire et à l'homologation des pesticides, révisé en 1999.

¹¹¹⁰ Both Cape Verde and Senegal are Member States of ECOWAS. Member States are: Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

¹¹¹¹ Cape Verde is not a Member State to WAEMU. Member States are: Benin, Burkina Faso, Côte D'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo.

Comité Régional des Pesticides de l'Union (CRPU). Cape Verde is not a Member State to the West African Economic and Monetary Union.

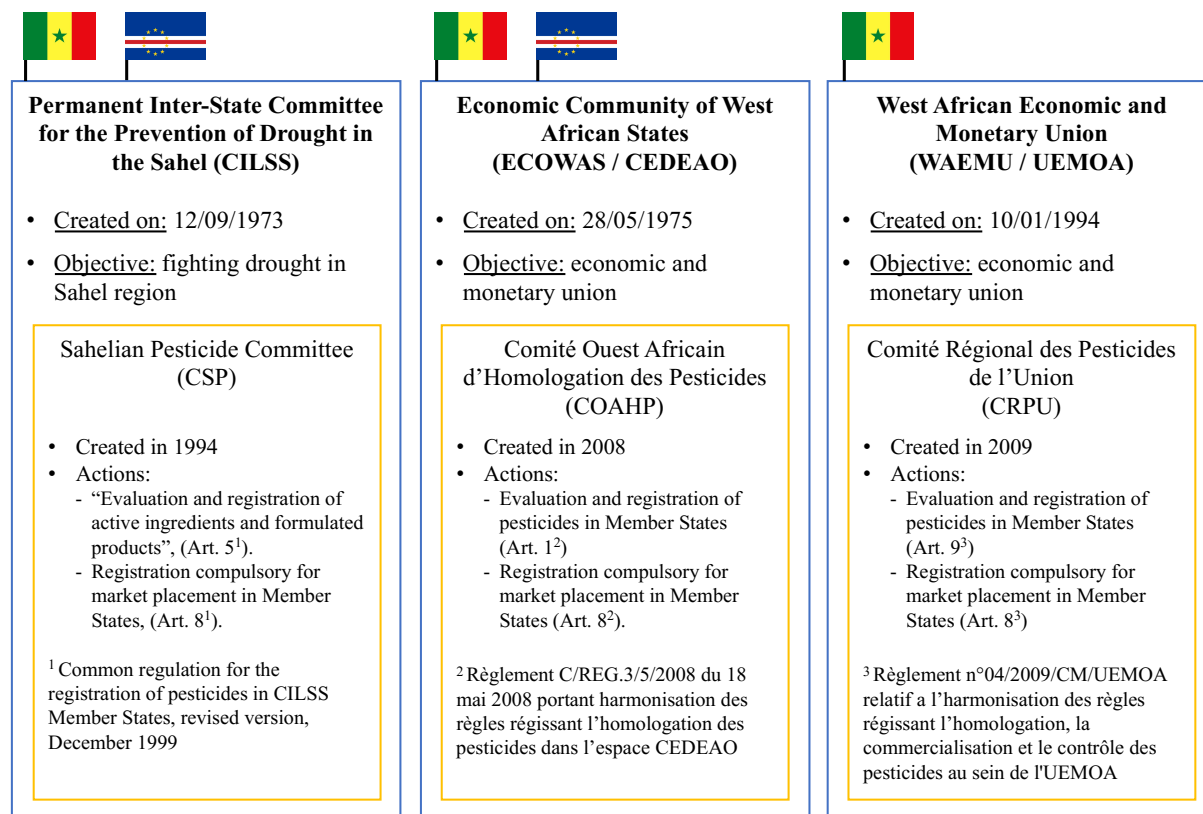


Figure III.1 Supranational framework regulating pesticides in Western Africa: Senegal and Cape Verde examples

These three committees' material and geographical scope of competences supersede, as they are all three responsible for the evaluation and registration of pesticides in Member States. In all three frameworks, the registration is compulsory prior to market placement in Member States, but countries can adopt more stringent regulations, under a limited set of conditions¹¹¹². In addition, for example under the CILSS framework, the control of importation, exportation, market placement, use and destruction of registered pesticides lies in the competence of the Member States¹¹¹³.

¹¹¹² See for example Article 8.2, Common regulation for the registration of pesticides in CILSS Member States, revised version, December 1999; Art. 10, Règlement C/REG.3/5/2008 du 18 mai 2008 for ECOWAS and Art. 48, Règlement N°04/2009/CM/UEMOA du 27 mars 2009 for WAEMU.

¹¹¹³ Article 5.2, *ibid.*

There is nonetheless a willingness to cooperate between these three institutions, made apparent by the similarities found for example in the definitions used¹¹¹⁴. This willingness to cooperate is also explicitly voiced in the Preamble to the *Règlement* n°04/2009/CM/UEMOA.

In summary, transferring the methodology to the analysis of pesticides poses methodological challenges through the identification of key questions. It also requires to adapt the level at which the analyses are run, as pesticide regulation is more centralised. Additionally, preliminary research has shown that pesticide regulation is more technical, ancient and broader than plastic bag regulation, which might complexify data entry in the relational database. Last, the role played by annexes – which contain lists of pesticides to which the regulation applies – could require to provide for an archive system integrated to the database guaranteeing access to all the successive versions of the annexes. The comparison of the successive versions of the annexes, along to the related provisions would enable to monitor the evolution of the regulation.

On the other hand, the transfer of the methodology to the analysis of pesticide-related legal frameworks could usefully enhance the results obtained on plastic bag regulation, by enabling the identification of common or differentiated strengths and weaknesses patterns. More specifically, it would be interesting to investigate whether local municipality regulation is also pre-empted at higher levels, and whether some products are banned locally but produced for export, such as the French ban on oxo-degradable plastic bags¹¹¹⁵. Achieving this objective will nonetheless require to overcome the above-mentioned methodological challenges.

¹¹¹⁴ SCHWOB David, *La mise sur le marché des pesticides agricoles : étude comparée des législations brésilienne, française et sénégalaise*, Mémoire de Master 2, Université Paris Saclay, 2020, 73 p., p. 17.

¹¹¹⁵ In France, since January 1st, 2022, the production of banned pesticides for export is forbidden. See art. 83, Loi n° 2018-938 du 30 octobre 2018 pour l'équilibre des relations commerciales dans le secteur agricole et alimentaire et une alimentation saine, durable et accessible à tous, JORF n°0253 du 1 novembre 2018. See GRIMONPREZ Benoît et BOUCHEMA Inès, « Pesticides – Exportation des produits phytosanitaires : un monde, une seule santé environnementale », *Droit rural*, LexisNexis SA, 2020, n° 482, comm. 73 for a description of the political and legal contexts of adoption of this ban.

Chapter 2. Sewage: conditions and challenges of a transfer of the methodology

Sewage (or wastewaters) constitutes the third major pollution source of marine environments. Contrary to plastics and pesticides, the purpose of sewage is to evacuate and purify effluents contaminated by households or industry. The mismanagement of sewage, or inadequate infrastructures, can lead to pollution dissemination in natural environments. Therefore, contrary to plastics and pesticides, the regulation no longer tends to restrict the uses of an object, but rather to limit the polluting impacts of human activities, requiring specific infrastructures.

Contrary to plastic and pesticides, sewage is designed as a depolluting process, requiring adequate collection and treatment infrastructures (section 1). These specificities impact the choice of key questions (section 2).

Section 1) Sewage: a depolluting process

Sewage (or wastewater) relates to any water which has been polluted through its use in homes, businesses or industries. This catch-all term can cover a wide range of realities as the type and quantity of pollutants vary depending on the past use of the water. Therefore, unmanaged or ill-managed wastewaters can carry for example chemicals, plastics, cosmetics, heavy metals, excrements or radioactive material to coastal and marine environments.

Societies' concern for the evacuation of wastewaters is ancient. The first networks designed to do so were found in the Indus Valley, and were built from -2500 to -1500 before Christ¹¹¹⁶. The Romans then contributed to spread this technology across the Empire. During the Middle Ages and until the XIXth century, wastewater evacuation infrastructures were near to inexistent, especially in the major cities, provoking the outbreak of epidemics of pest, typhus or cholera. Wastewater evacuation infrastructures were progressively constructed in European major cities at the end of the XIXth century¹¹¹⁷. If the evacuation of wastewater prevents pollution occurrence in cities, it does not enable to eliminate the pollution. Sewage treatment plants emerged during the second half of the XXth century.

¹¹¹⁶ Centre de l'information sur l'eau, <https://www.cieau.com/le-metier-de-leau/ressource-en-eau-eau-potable-eaux-usees/histoire-des-eaux-usees/>, accessed 03/05/2022.

¹¹¹⁷ *Ibid.*

In 2015, the United Nations recognized access to drinking water and sanitation as part of the human rights¹¹¹⁸. The sixth Sustainable Development Goal set by the United Nations is dedicated to ensuring clean water and sanitation to all by 2030. Nonetheless, 673 million people still don't have access to domestic waste water systems¹¹¹⁹. Additionally, the correct management of wastewater systems in countries which have developed sanitation infrastructures remains a challenge.

Section 2) Selecting key questions of the analysis of sewage

There are several challenges to the selection of key questions, allowing the transfer of the methodology to the analysis of sewage. As a reminder, the three criteria defined above¹¹²⁰ conditioning the selection of the key questions are: their recognised harmfulness for marine environments, their universality to enable comparisons between countries, and their balanced precision, as a key to the objectivity and legibility of the indicators, without endangering comparability.

The threats posed to marine environments by untreated wastewater have been recognised in 2012 on the international scene, when wastewater was designated as one of the three major sources of land-based pollution¹¹²¹. The first criterion is therefore satisfied. Considering the obligation to treat wastewater as a key question would nonetheless breach the precision criterion as there are a variety of characteristics to wastewater treatment.

A distinction must be made between the treatment of industrial and domestic wastewater¹¹²², which has a direct impact on the type of pollutants to be treated. For example, the treatment of heavy metals could be required in an industrial context, whereas in a domestic context the focus would be rather set on organic material. In addition, the definition of key questions could

¹¹¹⁸ General Assembly of the United Nations, Resolution n° 70/169, The human rights to safe drinking water and sanitation, adopted by the General Assembly on 17 December 2015.

¹¹¹⁹ <https://www.un.org/sustainabledevelopment/water-and-sanitation/>, accessed 13/07/2021.

¹¹²⁰ See Part I, Title 2, Chapter 2, section 2.

¹¹²¹ Manila Declaration on Furthering the Implementation of the global Programme of Action for the Protection of the Marine Environment from Land-based activities, UNEP/GPA/IGR.3/CRP.1/Rev.1, Intergovernmental Review Meeting on the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, Third session, Manila, 25-27 January 2012.

¹¹²² On the matter of domestic wastewater, regulation of collective sanitation differs from the regulation of non-collective sanitation. These differences must also be taken into account in the definition of key questions of wastewater.

require the identification of maximum levels of residues of pollutants in the water released in the environment.

Nevertheless, the impacts of untreated wastewater on natural ecosystems vary depending on the type and amount of pollutants, but also on the characteristics of the receiving environment. Eutrophication is one of the impacts of wastewater, by which organic matter contained in the water accumulates in a habitat, triggering a rapid growth of plants or algae which captures available oxygen from other species of fauna or flora. In extreme cases, this phenomenon can lead to the complete disappearance of oxygen in the ecosystem¹¹²³. An ecosystem's vulnerability to eutrophication must be analysed on a case-by-case basis, at a geographic scope inferior to national territory¹¹²⁴, questioning the satisfaction of the universality criterion.

Moreover, contrary to the regulation of plastic pollution at the source, the regulation of sewage requires massive investments in infrastructures to enable the collection and treatment of wastewater. Even if a parallel could be made with the infrastructures required for the recycling of plastic, the infrastructures required to collect wastewater imply larger work, as no existing infrastructures, such as roads, can be used. The construction of such networks is financially and technically challenging in large megapolis where sewage infrastructures are scarce. This specific context questions the interest of an analysis of the obligation to treat wastewater, where the construction of the required networks remain a major obstacle to the protection of the environment.

These characteristics of sewage question the relevancy of the application of the methodology to this source of pollution. If domestic sewage was chosen as a key question, the localised thresholds of allowed emissions of organic matter impedes the application of the methodology. The chosen key question would have to be broader, running the risk to be less in capacity to measure the potential contribution of law to the protection of the environment. The selection of a key question related to the rejection of industrial wastewater, with thresholds for the

¹¹²³ AMARA Rachid, « Impact de l'anthropisation sur la biodiversité et le fonctionnement des écosystèmes marins. Exemple de la Manche-mer du nord », *VertigO - la revue électronique en sciences de l'environnement*, 2010, Hors-série 8.

¹¹²⁴ See for example the Interactive Map of Eutrophication and Hypoxia developed by the World Resources Institute. The data has last been updated in March 2011. <https://www.wri.org/data/interactive-map-eutrophication-hypoxia>, accessed 04/05/2021.

concentration in heavy metals, could be easier to implement. Last, given the importance of infrastructure development to enforce wastewater regulation, the risk is high to observe a large enforcement gap, even though the regulation is both comprehensive and forceful.

The distribution of the power to regulate the field of sewage is an additional challenge to the application of the methodology.

Conclusion of Title 3

The transfer of the method to the study of pesticides and wastewater regulations requires further research, to lift the obstacles identified above. The identification of key questions for these two themes might be the greatest challenge. In addition, the use of the relational database will require its adaptation to new types of data, especially to describe the object of the regulation.

The transfer of the methodology to new fields of research is nonetheless promising. It would enable to explore comprehensiveness and forcefulness common patterns across countries and across themes. Thematic or spatial tendencies could also emerge, revealing specific challenges of designing environmental law likely to protect the environment. In addition, transferring the methodology to other issues than plastic bag regulations could enable to raise the alert on chronic dysfunction of environmental law.

Among the breadth of threats posed to marine environments by human activities, it could be interesting to apply the methodology to the analysis of the regulation of other single-use plastics – such as straws, cutlery, wrappings, cotton buds or plastic bottles – to better characterise the current approaches developed by States to fight this source of pollution, in the light of the current negotiation of an international treaty on plastic pollution.

Conclusion of Part III

The discussion of the opportunities and limits raised by the developed methodology is a necessary step towards its validity and reliability testing. Further research will be needed to address the technical and theoretical challenges that have been identified above, be they related to the design of the relational database, to the improvement of the methods to add data and keep the database updated, or to the inclusion of a larger set of case-study countries. Other limitations, such as the exclusion of regulations adopted at the municipal level, could be accepted as a compromise to keep the application of the method within a feasible scope.

The application of the methodology to the analysis of plastic bag regulations in seven countries has illustrated the inputs of this analytical framework to the understanding of the complexity and variety of plastic bag regulation strategies which could usefully inform the draft of an international agreement on plastic pollution. If plastic bags have emerged as an icon of single-use plastic, and have been the first single-use plastic object to be regulated in a wide array of countries, it nonetheless represents a limited volume among the wider range of single-use objects. It would therefore be required to analyse the comprehensiveness and forcefulness of the regulations addressing for example plastic bottles, plastic cutlery or cotton buds.

The transferability of the method to the analysis of other sources of plastic pollution raises a few challenges, notably in regard to the identification of key questions and in regard to the importance of local peculiarities. There are nonetheless a wider array of threats to the marine and coastal ecosystems which could represent avenues for the application of the method beyond the field of plastic pollution.

Conclusion

The development of this methodology and its experimentation on the regulation of plastic bags, as one of the regulatory solutions to mitigate land-based pollution, pursued distinct but complementary goals.

On the methodological front, the main objective has been to develop a methodology and tools enabling an objective analysis of the content of adopted frameworks, to analyse their adequacy with environmental objectives pursued. Many quantitative approaches to legal frameworks, such as the Rule of Law or the Corruption Perception Indexes, rely on expert views or perceptions. This work's focus has been set, from the start, on the analysis of the content of legal texts in themselves in pursuit of objectivity. Thereupon, the joint analysis of the comprehensiveness and the forcefulness of the legal frameworks emphasize the importance of the content of the legal texts in determining their potential of protection.

The use of the designed relational database has been decisive, as an enabling and facilitating tool to delve into complex and technical legal frameworks, where different provisions apply to a variety of objects all labelled 'plastic bags'. The use of this database also greatly simplified the comparison of different legal frameworks, by allowing to overcome definitional differences to focus on other diverging or converging regulatory characteristics. The central role of the relational database nonetheless highlighted the importance of qualitative analyses as a precondition to quantitative analyses, in addition to the interpretation phase. Indeed, simplification of a complex phenomenon can be considered as one of the greatest assets of quantitative analyses; but for this property to be useful, it must be closely framed by a deep understanding of the phenomena in themselves. Statistical, quantitative and qualitative analyses are facilitated through the flexibility offered by multicriteria searches in the database. It thus opens avenue for innovation in legal and interdisciplinary research.

Therefore, this work has uncovered the great potential of the use of quantitative approaches and indicators to the analysis of law, but also its surrounding limitations. The simplification of a complex phenomenon into indicators can enable to grasp its core substance, putting aside the inherent complexity of language. Doing so, it facilitates comparisons between countries, but also comparison with socioeconomic or biological data and indexes, also represented in a quantified form. The choice of indicators, their rating scales and criteria, and their aggregation

are nonetheless avenues for bias and subjectivity. Critical conditions for the recourse to numerical analyses of legal frameworks therefore lie in the transparency of the methodological choices made, to enable both validity and reliability testing.

If it may be difficult to eradicate subjectivity, its disclosure is the most effective weapon to allow readers to set the boundaries of the use of these indicators. Therefore, the open and readable publication of methodological choices, of raw data and both limits and biases of the work are necessary conditions to the value of the developed indicators. Nonetheless, as highlighted by Nelken, “indicators need to have some means of imposing closure at some point if they are to be of practical use (...) why would anyone want to use an indicator that puts itself radically into doubt ?”¹¹²⁵.

The second overarching objective is to contribute to a better understanding of the quality of ocean protection offered by legal frameworks, on the plastic bag case study in seven countries. As highlighted by Borelle *et al.* and illustrated in this work, “local and national actions have been the primary approach for mitigating plastic pollution”¹¹²⁶, preceding the adoption of a binding and comprehensive international treaty. According to WWF *et al.*, in 2020 137 countries had passed or planned to adopt plastic regulations by 2021, representing 6,6 billion people – 86% of the global population¹¹²⁷. It is therefore crucial and compelling to identify whether these legal frameworks are even likely to positively impact ocean plastic pollution.

The application of the methodology to the plastic bag case-study in seven countries has shown the interest of a quantitative and computational assisted analysis of the content of the legal texts, prior to their enforcement. Thanks to the development of open-access online databases such as Ecolex, the access to legal texts adopted throughout the world is greatly facilitated. Analysing the content of legal frameworks and identifying potential conception gaps is therefore much more straightforward and realistic in terms of access to data than the analysis of enforcement and effectiveness gaps globally. Even if the last two will be critical to guarantee law’s

¹¹²⁵ NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, p. 317-338, p. 333.

¹¹²⁶ BORRELLE Stephanie B., ROCHMAN Chelsea M., LIBOIRON Max *et al.*, « Why we need an international agreement on marine plastic pollution », *Proceedings of the National Academy of Sciences*, 114, Proceedings of the National Academy of Sciences, 2017, n° 38, p. 9994-9997, p. 9995.

¹¹²⁷ WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020, p. 12.

contribution to the protection of ecosystems, the analysis of the conception gap through the analysis of the content of the legal frameworks enables to identify the levers and hinders to push forward the protection of the environment, as shown by the analyses of plastic bag regulations. If no comprehensive or systematic study of enforcement or compliance was run throughout this project, illegal plastic bags were found at different occasions. These observations raise acutely the need for research on enforcement and compliance.

The present results have shown the diversity of legal frameworks adopted by seven countries to regulate plastic bags, both in term of their approach and of their potential of protection. These results highlight the fragmentation of the regulatory approaches to the regulation of plastic bags, at a small scale. At the global scale, the fragmentation of national policies is even greater¹¹²⁸. Applying the methodology to a wider range of countries would enable to sharpen the analyses already made at the global scale by UNE, by providing for an analysis of controls, sanctions and by deepening the analyses of objects and instruments. In other words, applying the methodology to a larger number of countries would provide a more extensive perspective on the state of current legal frameworks regulating plastic bags.

Nevertheless, plastic bags are just one aspect of plastic pollution, which is caused by a wide array of single-used products which are in majority unregulated¹¹²⁹. WWF *et al.* highlight that only 17 countries (representing 9% of countries with some form of plastic-related legislation) “have policies covering more than half of the waste items found in beach clean-ups”¹¹³⁰. Therefore, Dauvergne argues that “the gains from bottom-up, fragmented governance are not coming close to keeping pace with the rising environmental costs from the globalization of plastic”¹¹³¹, due to the fragmentation of national policies addressing a same object, and the missing regulation of single-use plastics that constitute large parts of marine litter. The application of the method to a larger set of single-use objects – such as cutlery, cotton buds or

¹¹²⁸ See UNE, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018.

¹¹²⁹ In beach clean-ups, plastic bags constitute around 7% of the items found. WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020, p. 13.

¹¹³⁰ WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020, p. 13.

¹¹³¹ DAUVERGNE Peter, « Why is the global governance of plastic failing the oceans? », *Global Environmental Change*, 51, 2018, p. 22-31, p. 29.

wrappings, would provide a more acute picture of the state of national and international efforts to mitigate plastic pollution.

In addition, the transfer of the methodology to new fields of research is promising. The exploration of comprehensiveness and forcefulness patterns across countries and themes could enable to raise the alert on chronic dysfunction of environmental law. The preliminary investigation of transferability opportunities to the analysis of the two other principal sources of land-based pollution – *i.e.*, pesticides and sewage – has nonetheless brought to the fore challenges – especially as to the identification of key questions – which require to be raised by future research. Other themes, such as the ban of fishing of some species, could be explored. The multiplication of analysed areas of environment protection should, with time, enhance the contribution of this method to the analysis of legal frameworks' contribution to the protection of the ocean.

More broadly, the question of the extent to which law protects the environment must be urgently investigated. As presented by Bell and McGillivray, “one of the key characteristics of environmental law is that it is (or rather should be) law in action rather than law for lawyers”¹¹³², given the common interest it seeks to protect. If this work has highlighted the need to investigate the potential of protection embodied by the provisions contained in adopted legal frameworks, the journey to determine the extent to which law protects the oceans should be continued. If the task may be considered Herculean, the present contribution could be considered as a step to disperse the mirages of adopted but unprotective regulations, to show the way towards an effective protection of the environment, lying just there, at the horizon.

¹¹³² BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford; New York, Oxford University Press, 2006, 910 p., p. 100.

Bibliography

Legal texts

International law

International conventions

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, signed in London on December 29th, 1972 and entered into force on August 30th, 1975.

Convention for the Prevention of Pollution from Ships (MARPOL), signed on 2 November 1973 in London, and entered in force on 2 October 1983.

Convention for the Protection of the Mediterranean Sea Against Pollution, adopted on 16 February 1976 in Barcelona and entered into force on 15 April 1978.

Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region signed in Abidjan on March 23, 1981 and entered into force on August 5, 1984 and the Protocole additionnel à la Convention d'Abidjan relatif à la coopération en matière de protection du milieu marin et côtier de la région de l'Afrique occidentale, centrale et australe contre la pollution due aux sources et activités terrestres, adopté le 22 juin 2012 à Grand-Bassam (Côte d'Ivoire).

United Nations Convention on the Law of the Sea, adopted December 10th 1982 in Montego Bay (Jamaica) and entered in force on November 16th 1994.

Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, signed in Cartagena on March 24, 1983 and entered into force on October 11, 1986 and the Protocol concerning Pollution from Land-Based sources and activities to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, signed in Oranjestad on October 6, 1999 and entered into force on August 13, 2010.

Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, signed on 22 March 1989 in Basel, Switzerland, and entered in force on 5 May 1992.

Convention for the Protection of the Marine Environment of the North-East Atlantic signed in Paris on September 22, 1992 and entered into force on March 25, 1998.

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, signed in Rotterdam on the 10th of September, 1999 and entered in force on the 24th of February 2004.

The Stockholm Convention on Persistent Organic Pollutants, signed in Stockholm on the 22nd of May 2001, and entered in force on the 17th of May 2004.

CONVENTION ON BIOLOGICAL DIVERSITY, Thirteenth meeting of the Conference of the Parties, 4-17 December 2016, Decision XIII/28, Indicators for the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets paragraph 13.

International Organisations: Regulations

Règlement C/REG.3/05/2008 portant harmonisation des règles régissant l'homologation des pesticides dans l'espace CEDEAO, publié au Journal Officiel de la CEDEAO vol. 53 de Mai 2008.

Règlement N°04/2009/CM/UEMOA relatif à l'harmonisation des règles régissant l'homologation, la commercialisation et le contrôle des pesticides au sein de l'UEMOA, Conseil des Ministres de l'UEMOA: Abidjan, le 27 mars 2009.

International Organisations: Resolutions

United Nations Conference on Environment and Development, Agenda 21: programme of action for sustainable development, Rio Declaration on Environment and Development, 3-14 June 1992, Rio de Janeiro, Brazil, 294p.

Résolution N° 7/27/CM/92 de la 27^{ème} session ordinaire du Conseil des Ministres du CILSS relative au contrôle phytosanitaire et à l'homologation des pesticides, révisé en 1999.

United Nations Environment Programme, Fourth Programme for the Development and Periodic Review of Environmental Law (Montevideo Programme IV), UNEP/Env.Law/2010/1, UNEP, Nairobi, 2010.

Manila Declaration on Furthering the Implementation of the global Programme of Action for the Protection of the Marine Environment from Land-based activities, UNEP/GPA/IGR.3/CRP.1/Rev.1, Intergovernmental Review Meeting on the

Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, Third session, Manila, 25-27 January 2012.

The Future we Want, Resolution adopted by the General Assembly of the United Nations, July 27th 2012, A/RES/66/288, United Nations.

General Assembly of the United Nations, Resolution n° 70/169, The human rights to safe drinking water and sanitation, adopted by the General Assembly on 17 December 2015.

United Nations Environment Assembly of the United Nations Environment Programme, “End plastic pollution: Towards an international legally binding instrument”, UNEP/EA.5/L.23/Rev.1, adopted on 2nd March 2022.

European Union law

Treaties

European Union, *Consolidated version of the Treaty on the Functioning of the European Union*, 26 October 2012, Official Journal of the European Union n°32, pp. 1-390.

Regulations

Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, OJ L 396, 30.12.2006, p.1.

Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC, OJ L 309, 24.11.2009, p.1.

Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC, OJ L 342, 22.12.2009.

Regulation 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under

the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013, OJ L 435, 6.12.2012, p. 1-186.

Directives

Directive 94/62/EC of the European Parliament and of the Council of 20 December 1994 on packaging and packaging waste, Official Journal L 365, 31.12.1994 p.10 – 23.

Directive 2006/22/EC of the European Parliament and of the Council of 15 March 2006 on minimum conditions for the implementation of Council Regulations (EEC) No 3820/85 and (EEC) No 3821/85 concerning social legislation relating to road transport activities, Official Journal of the European Union L 102, 11.4.2006, p. 35–44.

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), Official Journal of the European Union L164/19 of 25.06.2008, p. 19-40.

Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides, Official Journal of the European Union L309/71, of 24.11.2009, p. 71-86.

Directive 2015/720 of the European Parliament and of the Council of 29 April 2015 amending Directive 94/62/EC as regards reducing the consumption of lightweight plastic carrier bags (Text with EEA relevance), Official Journal L 115, 06.05.2015 p. 11-15.

Directive 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (Text with EEA relevance), Official Journal L 155, 12.06.2019 p. 1-19.

Decisions

Decision n° 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013), Official Journal of the European Union L412/1, 30.12.2006, p. 24.

Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 ‘Living well, within the limits of our planet’, published in the Official Journal of the European Union L354/171 on December 28th 2013.

Communications

EUROPEAN COMMISSION, Proposal for a Directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags COM (2013) 761 final.

EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Innovation in the Blue Economy: realizing the potential of our seas and oceans for jobs and growth, COM (2014) 254 final / 2, Brussels, 13.5.2014.

EUROPEAN COMMISSION, « Report from the Commission to the European Parliament and the Council on the impact of the use of oxo-degradable plastic, including oxo-degradable plastic carrier bags, on the environment », COM (2018) 35, Brussels, European Commission, 2018.

EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a new approach for a sustainable blue economy in the EU transforming the EU's Blue Economy for a Sustainable Future, COM (2021) 240, Brussels, 17.5.2021;

Other

EUROPEAN COMMISSION, « Better Regulation Toolbox », Brussels, European Commission, 2021.

EUROPEAN COMMISSION, « Commission guidelines on single-use plastic products in accordance with Directive (EU) 2019/904 of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment », Brussels, Belgium, European Commission, 2021.

EUROPEAN ENVIRONMENT AGENCY, « Biodegradable and compostable plastics - challenges and opportunities », Brussels, European Environment Agency, 2020.

National law

Brazil

Constituição Federal. *Constituição da República Federativa do Brasil de 1988*, Brasília, DF, 05 Outubro 1988.

Lei nº 6.938, de 31 de agosto de 1981. *Dispõe sobre a Política Nacional do Meio Ambiente, seus fins e mecanismos de formulação e aplicação, e dá outras providências*, Brasília, DF, 31 ago 1981.

Lei nº7.802, de 11 de julho de 1989. *Dispõe sobre a pesquisa, a experimentação, a produção, a embalagem e rotulagem, o transporte, o armazenamento, a comercialização, a propaganda comercial, a utilização, a importação, a exportação, o destino final dos resíduos e embalagens, o registro, a classificação, o controle, a inspeção e a fiscalização de agrotóxicos, seus componentes e afins, e dá outras providências*, Brasília, DF, 11 julho 1989.

State of Sao Paulo

Lei No 15.374 de 18 de Maio de 2011, Dispõe sobre a proibição da distribuição gratuita ou venda de sacolas plásticas a consumidores em todos os estabelecimentos comerciais do Município de São Paulo, e dá outras providências, Publicado no DOM - São Paulo em 19 mai 2011 and Decreto N° 55827 de 06/01/2015, ublicado no DOM - São Paulo em 7 jan 2015.

State of Pernambouco

Lei no 17.475/2008 Dispõe sobre as sacolas e sacos plásticos utilizados pelos estabelecimentos comerciais e órgãos municipais no âmbito do município do Recife, Publicado no DOM em 07 jun 2008.

Lei no 16559 de 15/01/2019 Institui o Código Estadual de Defesa do Consumidor de Pernambuco, publicado no DOE - PE em 16 jan 2019.

Lei no 16758 de 18/12/2019, Altera a Lei no 16.559, de 15 de janeiro de 2019, que institui o Código Estadual de Defesa do Consumidor de Pernambuco, de autoria do Deputado Rodrigo Novaes, a fim de aperfeiçoar dispositivos desta Lei, publicado no DOE - PE em 19 dez 2019.

Cape Verde

Constituição da República de Cabo Verde, Boletim Oficial n°17, I Série, 3 de Maio de 2010.

Lei n°86/IV/93 define as bases da política do ambiente, Boletim oficial número 27, 26 de julho de 1993.

Lei n°99/VIII/2015 de 27 de Agosto, Boletim oficial número 51, 27 de agosto de 2015, pp. 1600-1603.

France

Constitution du 4 octobre 1958. J.O. 5 oct. 58 : 9151-9173.

Loi n°2014-110 du 6 février 2014 visant à mieux encadrer l'utilisation des produits phytosanitaires sur le territoire national, publiée au JORF n°33 du 8 février 2014.

Loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte, Publiée au JORF n°189 du 18 août 2015.

Loi n°2016-1087 du 8 août 2016 pour la reconquête de la biodiversité, de la nature et des paysages, publiée au JORF n°0184 du 9 août 2016.

Loi n° 2018-938 du 30 octobre 2018 pour l'équilibre des relations commerciales dans le secteur agricole et alimentaire et une alimentation saine, durable et accessible à tous, JORF n°0253 du 1 novembre 2018.

Loi n°2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire (1), JORF n°0035 du 11 février 2020.

Décret n°2016-379 du 30 mars 2016 relatif aux modalités de mise en œuvre de la limitation des sacs en matières plastiques à usage unique, JORF n°0076 du 31 mars 2016.

Décret n°2019-1500 du 27 décembre 2019 relatif aux mesures de protection des personnes lors de l'utilisation de produits phytopharmaceutiques à proximité des habitations, publié au JORF n°0302 du 29 décembre 2019.

Décret n° 2020-1724 du 28 décembre 2020 relatif à l'interdiction d'élimination des invendus non alimentaires et à diverses dispositions de lutte contre le gaspillage, JORF n°0315 du 30 décembre 2020.

Décret n° 2020-1828 du 31 décembre 2020 relatif à l'interdiction de certains produits en plastique à usage unique, JORF n°0001 du 1 janvier 2021.

Décret n°2020-869 du 15 juillet 2020 relatif aux attributions du ministre de la transition écologique, JORF n°0174 du 17 juillet 2020.

Décret n°2020-2214 Relatif aux attributions du Ministre de l'Environnement et du Développement Durable, JORF n°0306 du 19 décembre 2020.

Décret n° 2021-763 du 14 juin 2021 définissant la catégorie des sacs en plastique très légers, JORF n°0138 du 16 juin 2021.

Arrêté du 27 décembre 2019 relatif aux mesures de protection des personnes lors de l'utilisation de produits phytopharmaceutiques et modifiant l'arrêté du 4 mai 2017 relatif à la mise sur le marché et à l'utilisation des produits phytopharmaceutiques et de leurs adjuvants visés à l'article L. 253-1 du code rural et de la pêche maritime, publié au JORF n°0302 du 29 décembre 2019.

Circulaire du 29 février 2008 relative à l'application des lois, JORF n°0057 du 7 mars 2008, point 2.

Ireland

Waste Management Act 1996, number 10 of 1996, enacted on 20 May 1996.

Statutory Instrument No. 36/2001, Waste Management (amendment) Act, 17th of July 2001.

Statutory Instrument No. 605/2001 — Waste Management (Environmental Levy) (Plastic Bag) Regulations, 2001, Given under the Official Seal of the Minister for the Environment and Local Government this 19th day of December 2001.

Statutory Instrument No. 155 of 2012, signed on 17th of May 2012 and published in “Iris Oifigiúil” of 25th May, 2012.

Statutory Instrument. No. 167/2007 — Waste Management (Environmental Levy) (Plastic Bag) (Amendment) (No. 2) Regulations 2007, published in “Iris Oifigiúil” of 27th April, 2007.

Senegal

Loi n°2001-03 du 22 janvier 2001 portant Constitution, Journal Officiel de la République du Sénégal, numéro spécial 5963 du 22 janvier 2001, p. 27.

Loi n° 2002-28 du 9 décembre 2002 autorisant le Président de la République à ratifier la version révisée de l’Accord portant Réglementation commune aux États membres du CILSS, publié au Journal Officiel de la République du Sénégal n° 6084 du 25 janvier 2003

Loi constitutionnelle n°2016-10 du 5 avril 2016 portant révision de la Constitution, Journal Officiel de la République du Sénégal du 13/6/2016.

Loi n° 2015-09 du 04 mai 2015 relative à l’interdiction de la production, de l’importation, de la détention, de la distribution, de l’utilisation de sachets plastiques de faible micronnage et à la gestion rationnelle des déchets plastiques ; publiée au Journal Officiel de la République du Sénégal n°6859 du samedi 04 juillet 2015.

Loi n°2020-04 du 08 janvier 2020 relative à la prévention et à la réduction de l’incidence sur l’environnement des produits plastiques ; publiée au Journal Officiel de la République du Sénégal du lundi 20 janvier 2020.

United Kingdom

Statutory Instrument n°1657 of 2012, The Plant Protection Products (Sustainable Use) Regulations 2012, made on June 20th 2012 and entered into force on 18th of July 2012.

The European Union (Withdrawal) Act 2018, June 26th, 2018.

England

Statutory Instrument No. 776 of 2015, The Single Use Carrier Bags Charges (England) Order 2015, 19th of March 2015.

Statutory Instrument No. 324 of 2020, The Single Use Carrier Bags Charges (England) (Amendment) 2020, adopted on March 20th, 2020.

Statutory Instrument No. 598 of 2021, The Single Use Carrier Bags Charges (England) (Amendment) Order 2021, made 20th May 2021 and coming into force 21st May 2021.

Scotland

Statutory Instrument No. 161 of 2014, The Single Use Carrier Bags Charge (Scotland) Regulations, 3rd June 2014.

The Single Use Carrier Bags Charge (Fixed Penalty Notices and Amendment) (Scotland) Regulations 2015 no 159, 31st of March 2015.

The Single Use Carrier Bags Charge (Scotland) Amendment Regulations 2020 no. 118, made on 01/04/2020, in force until the 3 October 2020.

The Single Use Carrier Bags Charge (Coronavirus) (Scotland) Amendment Regulations 2021 no. 53, January 28th, 2021.

United States of America

Florida

2008 Florida Statutes, Title XXIX Public Health, Chapter 403 Environmental Control, Section 7033 Departmental analysis of particular recyclable materials. Accessed <https://www.flsenate.gov/Laws/Statutes/2008/403.7033>, on 19/10/2021.

Florida Energy, Climate Change, and Economic Security Act of 2008, approved by the Governor on 25/06/2008.

Florida Third District Court of Appeal, *Florida Retail Federation, Inc., et al., vs. The City of Coral Gables, Florida*, August 14 2019, accessed https://www.3dca.flcourts.org/pre_opinion_content_download/596159, on 19/10/2021.

Florida Senate Bill 40, A bill to be entitled an Act relating to the prohibition of plastic carryout bags and straws; creating s. 509.235, F.S.; defining terms; prohibiting a store or food service business from providing to a customer a carryout bag made of plastic film; prohibiting a food service business from selling or providing to a customer a single-use plastic straw; providing an exception; providing penalties; providing an effective date.

Bill history accessed <https://www.flsenate.gov/Session/Bill/2020/40/?Tab=BillHistory>, on 19/10/2021.

Florida Senate Bill 182, A Bill to be entitled an Act relating to the preemption of recyclable and polystyrene materials; amending s. 403.7033, F.S.; deleting preemptions of local law relating to the regulation of auxiliary containers, wrappings, or disposable plastic bags; amending s. 500.90, F.S.; repealing the preemption of local laws regarding the use or sale of polystyrene products to the Department of Agriculture and Consumer Services; providing an effective date. Bill history accessed <https://www.flsenate.gov/Session/Bill/2020/182/?Tab=BillText>, on 19/10/2020.

Texas

Texas Health & Safety Code, § 361.0961(a)(1).

Supreme Court of Texas, *City of Laredo, Texas, v. Laredo Merchants Association*, no 16-0748, January 11th, 2018. Accessed <https://www.txcourts.gov/media/1441865/160748.pdf>, on 19/10/2021.

Texas House Bill 1877, A bill to be entitled an Act relating to the imposition of a fee for certain plastic bags provided to customers by retailers to fund a grant program to support local recycling efforts. Bill history accessed <https://capitol.texas.gov/BillLookup/History.aspx?LegSess=82R&Bill=HB1877>, on 19/10/2021.

Texas House Bill 2416, a Bill to be entitled an Act relating to the provision of bags to customers of a business at the point of sale. Bill history accessed <https://capitol.texas.gov/BillLookup/BillStages.aspx?LegSess=83R&Bill=HB2416>, on 19/10/2021.

Other

Charte canadienne des droits et libertés, partie I de la *Loi constitutionnelle de 1982*, constituant l'annexe B de la *Loi de 1982 sur le Canada (R-U)*, 1982, c11.

Books

General publications

ANTOINE Aurélien, *Droit constitutionnel britannique*, 2ème édition., Issy-les-Moulineaux, LGDJ Lextenso éditions, 2018, 206 p.

BALDWIN Robert, CAVE Martin et LODGE Martin, *Understanding Regulation: Theory, Strategy and Practice*, Second Edition., Oxford, Oxford University Press, 2012, 548 p.

BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford; New York, Oxford University Press, 2006, 910 p.

CLERGERIE Jean-Louis, GRUBER Annie et RAMBAUD Patrick, *Droit institutionnel et matériel de l'Union européenne*, 13ème édition., Paris, Dalloz, 2020, 1164p.

DAVID René, JAUFFRET-SPINOSI Camille et GORÉ Marie, *Les grands systèmes de droit contemporains*, 12ème., Paris, Dalloz, 2016, 539 p.

DEUMIER Pascale, *Introduction générale au droit*, 4th éd., Issy-les-Moulineaux, LGDJ, Lextenso éditions, 2017, 390 p.

GUTTERIDGE Harold C., *Comparative Law, An Introduction to the comparative method of legal study and research*, 2nd Edition., Cambridge, United Kingdom, Cambridge University Press, 1949, 214 p.

KRAMER Ludwig, *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p.

PRIEUR Michel, *Droit de l'environnement*, 8ème édition., Paris, Editions Dalloz, 2019, 1394 p.

SIEMS Mathias, *Comparative Law*, 2ème., Cambridge, Cambridge University Press, 2018, 506 p.

THIEFFRY Patrick, *Droit de l'environnement de l'Union européenne*, 2ème édition., Bruxelles, Bruylant, 2011, 528 p.

Technical publications

BALEYTE Jean, KURGANSKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème édition., Paris, LGDJ, 2000, 645 p.

- CARSON Rachel, *Silent Spring*, Boston, Houghton Mifflin, 1962, 352 p.
- COLLECTIF, *Harrap's Chambers Compact dictionary of contemporary English*, London, Harrap's, 2011, 928 p.
- COLLIN Peter H., *Dictionary of law*, 3rd ed., Reprinted., London, Peter Collin Publishing, 2002, 398 p.
- CORNU Gérard, *Vocabulaire juridique*, 13ème édition, Paris, Presses Universitaires de France, 2020, 1092 p.
- DHUIQ Bernard et FRISSON Danielle, *Dictionnaire de l'anglais juridique*, Paris, Pocket, 2004, 672 p.
- GARNER Bryan A., *Black's Law Dictionary*, 10th edition, St. Paul, MN, Thomson West, 2014, 2052 p.
- GREAT BRITAIN BETTER REGULATION TASKFORCE, *Imaginative Thinking for Better Regulation*, Better Regulation Task Force, 2003, 53 p.
- HAINAUT Jean-Luc, *Bases de données - Concepts, utilisation et développement*, 4e édition., Malakoff, Dunod, 2018, 736 p.
- HOUGH Peter, *The Global Politics of Pesticides: Forging consensus from conflicting interests*, London, Routledge, 2014, 244 p.
- LAW Jonathan, *A Dictionary of Law*, 8th edition, Oxford, United Kingdom, OUP Oxford, 2015, 704 p.
- LYNTON Jonathan, *Ballentine's Legal Dictionary/Thesaurus*, 1st edition, Albany : Rochester, N.Y., Cengage Learning, 1994, 736 p.
- MOORE Charles et PHILLIPS Cassandra, *Plastic Ocean: How a Sea Captain's Chance Discovery Launched a Determined Quest to Save the Oceans*, New York City, Avery, 2011, 358 p.
- PANSIER Frédéric-Jérôme et GOÛT Edouard Umberto, *Petit lexique juridique ; mots et expressions*, 2^e éd., Bruxelles, Larcier, 2016, 332 p.
- PENNER James E., *Mozley and Whiteley's Law Dictionary*, 12th edition, London; Charlottesville, Va, Oxford University Press, 2005, 392 p.

RICHARDS Paul et CURZON Leslie B., *Longman Dictionary of Law*, 8th edition, Harlow, Longman, 2011, 528 p.

SULLIVAN Larry E. et SIMONETTI ROSEN Marie (dir.), *Encyclopaedia of Law Enforcement*, vol. 1, Thousand Oaks, United States, Sage Publications, 2004, 1729 p.

Specific publications

ANDERSEN Stine, *The Enforcement of EU law: The Role of the European Commission*, Oxford, United Kingdom, Oxford University Press, 2012, 272 p.

AYKUT Stefan et DAHAN Amy, *Gouverner le climat ?*, Les Presses de Sciences Po, 2015, 752 p.

BEMELMANS-VIDEC Marie-Louise, RIST Ray C. et VEDUNG Evert (dir.), *Carrots, Sticks & Sermons: Policy Instruments & Their Evaluation*, New York, Routledge, 2017, 280 p.

BOX George E. P. et DRAPER Norman R., *Empirical Model-Building and Response Surfaces*, 1st edition., New York, Wiley, 1987, 688 p.

BONNIN Marie, LY Ibrahima, QUEFFELEC Betty *et al.* (dir.), *Droit de l'environnement marin et côtier au Sénégal*, Dakar, Sénégal, IRD, PRCM, 2016, 532 p.

CRUZ Peter De, *Comparative Law in a Changing World*, 3rd edition., London, Routledge-Cavendish, 2007, 544 p.

MARTIN Paul et KENNEDY Amanda, *Implementing Environmental Law*, Edward Elgar Publishing Limited, 2015, 372p.

MCGRATH Chris, *Does environmental law work? how to evaluate the effectiveness of an environmental legal system*, Saarbrücken, Lambert Academic Publishing, 2010, 251 p.

MERRY Sally Engle, DAVIS Kevin E. et KINGSBURY Benedict (dir.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, 353 p.

MERRYMAN John Henry, *The Loneliness of the Comparative Lawyer and Other Essays in Foreign and Comparative Law*, The Hague; Boston, Kluwer Law International, 1999, 541 p.

RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p.

SCHÄFFER Heinz, RÁCZ Attila, RHODE Barbara *et al.* (dir.), *Quantitative analyses of law: a comparative empirical study: sources of law in Eastern and Western Europe*, Budapest, Akadémiai Kiadó, 1990, 404 p.

SIEBER Sam D., *Fatal Remedies: the Ironies of Social Intervention*, New York, Plenum Press, 1981, 234 p.

SUPIOT Alain, *La gouvernance par les nombres : cours au Collège de France, 2012-2014*, Paris, Fayard, 2015, 520 p.

WESTERLUND Staffan, *Fundamentals of Environmental Law Methodology*, Uppsala, Uppsala University, Department of Law, 2007, 664p.

Book chapters

BELL Stuart, United Kingdom, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 351-373.

BENJAMIN Antonio Herman and BRYNER Nicholas, Brazil, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 82-107.

BERMANN George A. et NICOLAIDIS Kalypso, « Appendix Basic Principles for the Allocation of Competence in the United States and the European Union », in NICOLAIDIS Kalypso et HOWSE Robert (éd.), *The Federal Vision: Legitimacy and Levels of Governance in the United States and the European Union*, Oxford, Oxford Scholarship Online, 2001, 556p., pp. 483-504.

BRADLEY Christopher G., « International Organizations and the Production of Indicators », in DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, 374p., pp. 27-74.

BELL J., “Legal Research and the Distinctiveness of Comparative Law”, in HOECKE Mark Van (dir.), *Methodologies of Legal Research: Which Kind of Method for What Kind of Discipline?*, London, Hart Publishing, 2011, 294 p., pp. 155-176.

- DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, (dir.), « The Local-Global Life of Indicators: Law, Power and Resistance », *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, 374p., pp. 1-23.
- EPSTEIN Lee and MARTIN Andrew D., “Quantitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., pp. 901-925.
- GALLIGAN Denis J., “Legal Theory and Empirical Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., pp. 976-1001.
- GRUBER Tom, « Ontology », in LING Liu et ÖZSU M. Tamer (éd.), *Encyclopedia of Database Systems*, Springer-Verlag, 2008, 3749p., p. 1959.
- JANSEN Nils, Comparative law and comparative knowledge, in REIMANN Mathias et REINHARD Zimmermann (dir.), *The Oxford Handbook of Comparative Law*, 1st edition., Oxford, Oxford University Press, 2006, 1430 p., pp. 305-338.
- LANGE Bettina., Command and Control Standards and Cross-jurisdictional Harmonization, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 852-875.
- MICHAELS R., The Functional Method of Comparative Law, in REIMANN Mathias et REINHARD Zimmermann (dir.), *The Oxford Handbook of Comparative Law*, The Oxford Handbook of Comparative Law, 1st edition., Oxford, Oxford University Press, 2006, 1430 p., pp. 339-382.
- MINTZ Joel A., “Assessing National Environmental Enforcement: Some Lessons from the United States’ Experience”, in KRAMER Ludwig (dir), *Enforcement of Environmental Law*, Cheltenham, UK, Edward Elgar Publishing Ltd, 2016, 864 p.
- NELKEN David, « Contesting Global Indicators », in DAVIS Kevin E., KINGSBURY Benedict, MERRY Sally Engle *et al.* (dir.), *The Quiet Power of Indicators: Measuring*

- Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, 358 p., p. 317-338.
- NEWMAN Stephanie, WATKINS Emma, FARMER Andrew *et al.*, « The Economics of Marine Litter », in BERGMANN Melanie, GUTOW Lars, KLAGES Michael, *Marine Anthropogenic Litter*, Springer International Publishing, 2015, 447p., pp. 367-394.
- NEYRET Laurent, France, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 171-189.
- NIELSEN Laura B., “The Need for Multi-Method Approaches in Empirical Legal Research” in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., pp. 951-975;
- PÂQUES Michel, « Instruments souples, instruments non contraignants, instruments de marché : une alternative pertinente ? », *Acteurs et outils du droit de l'environnement*, Ed. JADOT Benoit, Anthemis, 2010, 387 p., pp. 19-67.
- RESTREPO AMARILES David, « Transnational Legal Indicators: The Missing Link in a New Era of Law and Development », in FORTES Pedro, BORATTI Larissa, PALACIOS Andres, et al. (éd.), *Law and Policy in Latin America: Transforming Courts, Institutions, and Rights*, London, Palgrave Macmillan, 2016, 354 p., p. 95-111.
- SALZMAN James, United States of America, in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 375-395.
- URUEÑA René, « Indicators and the Law. A Case study of the Rule of Law Index », in DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle (éd.), *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*, New York, Cambridge University Press, 2015, 358 p., p. 75-102.
- VIÑUALES, Jorge E., “Comparative Environmental law: Structuring a Field” in LEES Emma et VIÑUALES Jorge E. (dir.), *The Oxford Handbook of Comparative Environmental Law*, Oxford, New York, Oxford University Press, 2019, 1328 p., pp. 3-34.
- WEBLEY Lisa, “Qualitative Approaches to Empirical Legal Research”, in CANE Peter et KRITZER Herbert (dir.), *The Oxford Handbook of Empirical Legal Research*, The

Oxford Handbook of Empirical Legal Research, Oxford, Oxford University Press, 2010, 1112 p., pp. 926-950

Articles

ABBOTT Joshua K. et SUMAILA U. Rashid, « Reducing Marine Plastic Pollution: Policy Insights from Economics », *Review of Environmental Economics and Policy*, 13, Oxford Academic, 2019, no 2, p. 327-336.

ADAM Issahaku, WALKER Tony R., BEZERRA Joana Carlos *et al.*, « Policies to reduce single-use plastic marine pollution in West Africa », *Marine Policy*, 116, 2020, p. 103928.

AL-ABDULRAZZAK Dalal, GALLAND Grantly R., MCCLENACHAN Loren *et al.*, « Opportunities for improving global marine conservation through multilateral treaties », *Marine Policy*, 86, 2017, p. 247-252.

ALPIZAR F., CARLSSON F., LANZA G. *et al.*, « A framework for selecting and designing policies to reduce marine plastic pollution in developing countries », *Environmental Science & Policy*, 109, 2020, p. 25-35.

AMARA Rachid, « Impact de l'anthropisation sur la biodiversité et le fonctionnement des écosystèmes marins. Exemple de la Manche-mer du nord », *VertigO - la revue électronique en sciences de l'environnement*, 2010, Hors-série 8.

ANTELAVA Ana, CONSTANTINOU Achilleas, BUMAJDAD Ali *et al.*, « Identification of Commercial Oxo-Biodegradable Plastics: Study of UV Induced Degradation in an Effort to Combat Plastic Waste Accumulation », *Journal of Polymers and the Environment*, 2020.

ARDIA David S., « Does the Emperor Have No Clothes? Enforcement of International Laws Protecting the Marine Environment », *Michigan Journal of International Law*, 1998, p. 497-567.

AURISANO Nicolò, WEBER Roland et FANTKE Peter, « Enabling a circular economy for chemicals in plastics », *Current Opinion in Green and Sustainable Chemistry*, 31, 2021.

BAGHERI Amir Reza, LAFORSCH Christian, GREINER Andreas *et al.*, « Fate of So-Called Biodegradable Polymers in Seawater and Freshwater », *Global Challenges*, 1, 2017, n° 4, p. 1700048.

- BARNES Jeb et BURKE Thomas F., « The Diffusion of Rights: From Law on the Books to Organizational Rights Practices », *Law & Society Review*, 40, 2006, n° 3, p. 493-524.
- BARONDES Royce de R., « The Limits of Quantitative Legal Analyses: Chaos in Legal Scholarship and FDIC v. W.R. Grace & Co. », *Rutgers University Law Review*, 1995, no 161, p. 161-226.
- BELL Liza et TODORAN Gina Scutelnicu, « Plastic bag legislation in the United States: influential factors on its creation », *Journal of Environmental Studies and Sciences*, 2022.
- BÉTAILLE Julien, « Répression et effectivité de la norme environnementale », *Revue juridique de l'environnement*, Volume 39, 2014, n° HS01, p. 47-59.
- BEZERRA Joana Carlos, WALKER Tony R., CLAYTON Andrea *et al.*, « Single-use plastic bag policies in the Southern African development community », *Environmental Challenges*, 3, Elsevier, 2021, p. 100029.
- BIGNAMI Francesca, « Formal Versus Functional Method in Comparative Constitutional Law », *Osgoode Hall Law Journal*, 53, 2016, n° 2, p. 442-471.
- BILLANT Odeline et BONNIN Marie, « Vers l'interdiction des sacs plastique en Afrique atlantique : une analyse numérique en droit de l'environnement », *Mondes en développement*, n° 193, De Boeck Supérieur, 2021, n° 1, p. 7-25.
- BISHOP George, STYLES David et LENS Piet N. L., « Recycling of European plastic is a pathway for plastic debris in the ocean », *Environment International*, 142, 2020, p. 105893.
- BÖCHER Michael, « A theoretical framework for explaining the choice of instruments in environmental policy », *Forest Policy and Economics*, 16, Elsevier, 2012, n° C, p. 14-22.
- BÖHRINGER Christoph et JOCHEM Patrick E. P., « Measuring the immeasurable — A survey of sustainability indices », *Ecological Economics*, 63, 2007, p. 1.
- BORRELLE Stephanie B., ROCHMAN Chelsea M., LIBOIRON Max *et al.*, « Why we need an international agreement on marine plastic pollution », *Proceedings of the National Academy of Sciences*, 114, Proceedings of the National Academy of Sciences, 2017, n° 38, p. 9994-9997.

- BROWN Christopher J., JUPITER Stacy D., ALBERT Simon *et al.*, « A guide to modelling priorities for managing land-based impacts on coastal ecosystems », *Journal of Applied Ecology*, 56, 2018, n° 5.
- BROWN Christopher J., JUPITER Stacy D., LIN Hsien-Yung *et al.*, « Habitat change mediates the response of coral reef fish populations to terrestrial run-off », *Marine Ecology Progress Series*, 576, 2017.
- BULMER Simon et BURCH Martin, « British devolution and European policy-making : a step-change towards multi-level governance ? », *Politique européenne*, 6, 2002, n° 2, p. 114-135, p.
- CADES J. Russell, « Jurimetrics and General Semantics Articles and Reports », *M.U.L.L. Modern Uses of Logic in Law*, 5, 1964, n° 1, p. 8-17.
- CARBERY Maddison, O'CONNOR Wayne et PALANISAMI Thavamani, « Trophic transfer of microplastics and mixed contaminants in the marine food web and implications for human health », *Environment International*, 115, 2018.
- CARNEY William J., « The Political Economy of Competition for Corporate Charters », *The Journal of Legal Studies*, 26, 1997, n° 1, p. 303-329.
- CHIBA Sanae, SAITO Hideaki, FLETCHER Ruth *et al.*, « Human footprint in the abyss: 30 year records of deep-sea plastic debris », *Marine Policy*, 96, 2018, p. 204-212.
- CLAPP Jennifer *et* SWANSTON Linda, « Doing away with plastic shopping bags », *Environmental Politics*, 18, 2009, p. 315-332.
- COLEMAN Ronald J. *et* VAZ Ana, « Law and Multidimensional Measurement », *Southern Illinois University Law Journal*, 44, 2020 2019, n° 2, p. 253-272.
- CONVERY Frank, MCDONNELL Simon *et* FERREIRA Susana, « The most popular tax in Europe? Lessons from the Irish plastic bags levy », *Environmental and Resource Economics*, 38, 2007, n° 1, p. 1-11.
- COSTA DE OLIVEIRA Carina, « B) En droit brésilien : « des sources aux principes » », *Revue juridique de l'Environnement*, 40, 2015, n° 2, pp. 218-222.
- DA COSTA João Pinto, MOUNEYRAC Catherine, COSTA Mónica *et al.*, « The Role of Legislation, Regulatory Initiatives and Guidelines on the Control of Plastic Pollution », *Frontiers in Environmental Science*, 8, 2020, article 104.

- DARPO Jan et NILSSON Annika, « On the Comparison of Environmental Law Emerging Theories in Environmental Law », *Journal of Court Innovation*, 3, 2010, n° 1, p. 315-336.
- DAUVERGNE Peter, « Why is the global governance of plastic failing the oceans? », *Global Environmental Change*, 51, 2018, p. 22-31.
- DAVIES Gareth, « The Relationship between Empirical Legal Studies and Doctrinal Legal Research », *Erasmus Law Review*, 13, 2020, n° 2, p. 3-12.
- DAVIS Kevin E., KINGSBURY Benedict et MERRY Sally Engle, « Indicators as a Technology of Global Governance », *Law & Society Review*, 46, 2012, n° 1, p. 71-104, p. 87.
- DAVIS Kevin, « Legal Indicators: The Power of Quantitative Measures of Law », *Annual Review of Law and Social Science*, 10, 2014, p. 37-52.
- DE CONINCK Julie, « The Functional Method of Comparative Law: “Quo Vadis”? », *The Rabel Journal of Comparative and International Private Law*, Bd. 74 H. 2, 2010, p. 318-350.
- DE REDON Louis, « Climat judiciaire et protection de l’environnement : pas de risque de surchauffe », *Lexis Nexis SA - Droit Pénal*, 2, 2019, p. 17-25.
- DJANKOV Simeon, LA PORTA Rafael, LOPEZ-DE-SILANES Florencio *et al.*, « The law and economics of self-dealing », *Journal of Financial Economics*, 88, 2008, n° 3, p. 430-465.
- DONALD David C., « Law in Regression - Impacts of Quantitative Research on Law and Regulation », *Columbia Business Law Review*, 2015, 2015, n° 2, p. 520-612.
- DUR Robert et VOLLAARD Ben, « Saliency of law enforcement: A field experiment », *Journal of Environmental Economics and Management*, 93, 2019, p. 208-220.
- EMISON Gerald, « The Potential for Unconventional Progress: Complex Adaptive Systems and Environmental Quality Policy », *Duke Environmental Law & Policy Forum*, 7, 1996, n° 1, p. 167-192.
- FERRARO Gianluca et FAILLER Pierre, « Governing plastic pollution in the oceans: Institutional challenges and areas for action », *Environmental Science & Policy*, 112, 2020, p. 453-460.

- FINDLEY Roger W., JURGENSMEYER Julian C. et LAMBRECHTS Claude, « Etats-Unis : La législation sur les pesticides aux Etats-Unis », *Revue juridique de l'Environnement*, 12, 1987, no 2, p. 179-200.
- FINKELSTEIN Claire Oakes, « When the Rule Swallows the Exception », *Quinnipiac Law Review*, 19, 2000, p. 505-537.
- FONBAUSTIER Laurent, « L'(in)efficacité de la norme environnementale », *Deliberee*, N° 8, 2019, n° 3, p. 19-25.
- GAZELL James A., « A Stalled Upheaval: A Quantitative Analysis of Legal Research Modes », *New England Law Review*, 8, 1973 1972, n° 1, p. 1-36.
- GLENN H. Patrick, « Are Legal Traditions Incommensurable? », *The American Journal of Comparative Law*, 49, American Society of Comparative Law, 2001, n° 1, p. 133-145.
- GOLDBERG Olga, « Biodegradable Plastics: A Stopgap Solution for the Intractable Marine Debris Problem Note », *Texas Environmental Law Journal*, 42, 2012 2011, n° 3, p. 307-346.
- GRASMICK, H.G., & BURSIK, R.J. Jr., « Conscience, significant others, and rational choice: Extending the deterrence model », *Law and Society Review*, 24, 1990, p. 837–861.
- GREEN Maria, « What We Talk about When We Talk about Indicators: Current Approaches to Human Rights Measurement », *Human Rights Quarterly*, 23, 2001, n° 4, p. 1062-1097.
- GRIMONPREZ Benoît et BOUCHEMA Inès, « Pesticides – Exportation des produits phytosanitaires : un monde, une seule santé environnementale », *Droit rural*, LexisNexis SA, 2020, n° 482, comm 76.
- GUNNINGHAM Neil et SINCLAIR Darren, « Policy Instrument Choice and Diffuse Source Pollution », *Journal of Environmental Law*, 17, 2005, n° 1, p. 51-82.
- GUNNINGHAM Neil, « Enforcing Environmental Regulation », *Journal of Environmental Law*, 23, 2011, n° 2, p. 169-201.
- HALPERN Benjamin S., FRAZIER Melanie, AFFLERBACH Jamie *et al.*, « Recent pace of change in human impact on the world's ocean », *Scientific Reports*, 9, 2019.

- HART Rachel, « Shifting the Burden of Plastic Bags: A Proposal for a Federal Extended Producer Responsibility Law Comments », *LSU Journal of Energy Law and Resources*, 9, 2021, n° 2, p. 531-562.
- HERBERZ Timo, BARLOW Claire Y. et FINKBEINER Matthias, « Sustainability Assessment of a Single-Use Plastics Ban », *Sustainability*, 12, Multidisciplinary Digital Publishing Institute, 2020, n° 9, p. 3746.
- HERZ Michael, « Les grands débats autour du droit de l'environnement aux Etats-Unis », *Pouvoirs*, 2008, n° 127, p. 87-107.
- HOMONOFF Tatiana, KAO Lee-Sien, SELMAN Javiera *et al.*, « Skipping the Bag: The Intended and Unintended Consequences of Disposable Bag Regulation », *Journal of Policy Analysis and Management*, 41, John Wiley & Sons, Ltd., 2022, n° 1, p. 226-251.
- HOWLETT Michael, « Policy Instruments, Policy Styles, and Policy Implementation », *Policy Studies Journal*, 19, 1991, n° 2, p. 1-21.
- HULL N. E. H., « The Perils of Empirical Legal Research Review Essay », *Law & Society Review*, 23, 1989, n° 5, p. 915-920.
- JACKSON Jonathan, BRADFORD Ben, HOUGH Mike *et al.*, « Why Do People Comply with the Law? Legitimacy and the Influence of Legal Institutions », *British Journal of Criminology*, 52, 2012, p. 1051-1071.
- JAMBECK Jenna R., GEYER Roland, WILCOX Chris *et al.*, « Plastic waste inputs from land into the ocean », *Science*, 347, 2015.
- KASIDONI Maria, MOUSTAKAS Konstantinos et MALAMIS Dimitris, « The existing situation and challenges regarding the use of plastic carrier bags in Europe », *Waste Management & Research*, 33, 2015, n° 5, p. 419-428.
- KAUFMANN Daniel, KRAAY Aart et MASTRUZZI Massimo, «The Worldwide Governance Indicators: Methodology and Analytical Issues», *Hague Journal on the Rule of Law*, 3, 2011, n° 2, p. 220-246.
- KEANE A., JONES J. P. G., EDWARDS-JONES G. *et al.*, « The sleeping policeman: understanding issues of enforcement and compliance in conservation », *Animal Conservation*, 11, 2008, n° 2, p. 75-82.
- KHAN Liaquat Ali, « Temporality of Law », *McGeorge Law Review*, 40, 2009, n° 1, p. 55-106.

- KIRK Elizabeth A. et POPATTANACHAI Naporn, « Marine plastics: Fragmentation, effectiveness and legitimacy in international lawmaking », *Review of European Comparative & International Environmental Law*, 27, 2018, n° 3, p. 222-233.
- KIRSTEIN Inga V., KIRMIZI Sidika, WICHELS Antje *et al.*, « Dangerous hitchhikers? », *Marine Environmental Research*, 120, 2016.
- KNOBLAUCH Doris, MEDERAKE Linda et STEIN Ulf, « Developing Countries in the Lead: What Drives the Diffusion of Plastic Bag Policies? », *Sustainability*, 10, 2018, n° 6, p. 1994, p.
- KREVER Tor, « Quantifying Law: Legal Indicator Projects and the Reproduction of Neoliberal Common Sense », *Third World Quarterly*, 34, 2013, no 1, p. 131-150.
- LA FUENTE Carla I. A., TRIBST Alline A. L. et AUGUSTO Pedro E. D., « Knowledge and perception of different plastic bags and packages: A case study in Brazil », *Journal of Environmental Management*, 301, 2022, p. 113881.
- LA PORTA Rafael, LOPEZ-DE-SILANES Florencio, SHLEIFER Andrei *et al.*, « Law and Finance », *Journal of Political Economy*, 106, 1998, n° 6, p. 1113-1155.
- LAMB Joleah B., WILLIS Bette L., FIORENZA Evan A. *et al.*, « Plastic waste associated with disease on coral reefs », *Science*, 359, 2018; p. 360.
- LANGBROEK Philip, VAN DEN BOS Kees, THOMAS Marc Simon *et al.*, « Methodology of Legal Research: Challenges and Opportunities Editorial », *Utrecht Law Review*, 13, 2017, n° 3, p. 1-8.
- LECLERC Olivier, « Statistiques et normes : jalons pour une rencontre interdisciplinaire », *Cahiers Droit, Sciences & Technologies*, 2014, n° 4, p. 37-44.
- LEE Rhiannon, DEN UYL Roos et RUNHAAR Hens, « Assessment of policy instruments for pesticide use reduction in Europe; Learning from a systematic literature review », *Crop Protection*, 126, 2019, p. 104929.
- LEMOINE-SCHONNE Marion, « Le droit transnational de l'environnement et du climat : analyse des enjeux d'effectivité entre les sphères publiques et privées », *Énergie - Environnement - Infrastructures*, LexisNexis SA, 2018, dossier 35.
- LEROY Yann, « La notion d'effectivité du droit, The Concept of a Law's Effectiveness », *Droit et société*, 2011, n° 79, p. 715-732.

- LOEVINGER Lee, « Jurimetrics--The Next Step Forward », *Minnesota Law Review*, 33, 1949 1948, n° 5, p. 455-493.
- LOGES Bastian et JAKOBI Anja P., « Not more than the sum of its parts: de-centered norm dynamics and the governance of plastics », *Environmental Politics*, 29, Routledge, 2020, n° 6, p. 1004-1023, p. 1011.
- LOZOWICK Arnold H., STEINER Peter O. et MILLER Roger, « Law and Quantitative Multivariate Analysis: An Encounter », *Michigan Law Review*, 66, 1968 1967, n° 8, p. 1641-1678.
- LUÍS Idalina Perestrelo et SPÍNOLA Hélder, « The influence of a voluntary fee in the consumption of plastic bags on supermarkets from Madeira Island (Portugal) », *Journal of Environmental Planning and Management*, 53, 2010, n° 7, p. 883-889.
- LYYTIMÄKI Jari, SALO Hanna, LEPENIES Robert *et al.*, « Risks of producing and using indicators of sustainable development goals », *Sustainable Development*, 28, 2020, n° 6, p. 1528-1538.
- MACRORY Richard, « Environmental law in the United Kingdom post Brexit », *ERA Forum*, 19, 2019, n° 4, p. 643-657.
- MARTINHO Graça, BALAIA Natacha et PIRES Ana, « The Portuguese plastic carrier bag tax: The effects on consumers' behaviour », *Waste Management*, 61, 2017, p. 3-12.
- MCELFISH James M. Jr. et VARNELL Lyle M., « Designing Environmental Indicator Systems for Public Decisions », *Columbia Journal of Environmental Law*, 31, 2006, n° 1, p. 45-86.
- MERRY Sally Engle, « Measuring the World: Indicators, Human Rights, and Global Governance: with CA comment by John M. Conley », *Current Anthropology*, 52, The University of Chicago Press, 2011, n° S3, p. S83-S95.
- MERRYMAN John Henry, «Law and Development Memoirs II: SLADE», *The American Journal of Comparative Law*, 48, 2000, n° 4, p. 713-727.
- MITCHELL Gregory, « Empirical Legal Scholarship as Scientific Dialogue Essay », *North Carolina Law Review*, 83, 2005 2004, no 1, p. 167-204.
- MUPOSHI Asphat, MPINGANJIRA Mercy et WAIT Marius, « Considerations, benefits and unintended consequences of banning plastic shopping bags for environmental

- sustainability: A systematic literature review », *Waste Management & Research*, SAGE Publications Ltd STM, 2021, p. 1-14.
- MURTHY Sharmila L., « Translating Legal Norms into Quantitative Indicators: Lessons from the Global Water, Sanitation, and Hygiene Sector », *William & Mary Environmental Law and Policy Review*, 42, 2018 2017, n° 2, p. 385-446.
- NAPPER Imogen E. et THOMPSON Richard C., « Environmental Deterioration of Biodegradable, Oxo-biodegradable, Compostable, and Conventional Plastic Carrier Bags in the Sea, Soil, and Open-Air Over a 3-Year Period », *Environmental Science & Technology*, 53, American Chemical Society, 2019, n° 9, p. 4775-4783.
- NARANCIC Tanja et O'CONNOR Kevin E., « Plastic waste as a global challenge: are biodegradable plastics the answer to the plastic waste problem? », *Microbiology*, 165, Microbiology Society, 2019, n° 2, p. 129-137.
- NAZARETH Monick, MARQUES Mônica R. C., LEITE Marcia C. A. *et al.*, « Commercial plastics claiming biodegradable status: Is this also accurate for marine environments? », *Journal of Hazardous Materials*, 366, 2019, p. 714-722.
- OGIEN Albert, « Peut-on se dépendre du pouvoir du chiffre? », *Droit et société*, n° 105, Lextenso, 2020, n° 2, p. 479-489.
- OWEN Dave et NOBLET Caroline, « Interdisciplinary Research and Environmental Law », *Ecology Law Quarterly*, 41, 2014, n° 4, p. 887-938.
- OWEN Dave, « Mapping, Modeling, and the Fragmentation of Environmental Law », *Utah Law Review*, 2013, p. 219.
- OWSIŃSKI Jan W., « Is There Any 'Law of Requisite Variety' in Construction of Indices for Complex Systems? », *Social Indicators Research*, 136, 2018, n° 3, p. 1125-1137.
- PELLICER Miquel, WEGNER Eva et CAVATORTA Francesco, « Is There Strength in Numbers », *Middle East Law and Governance*, 7, 2015, n° 1, p. 153-168.
- RAYNE Sierra, « The need for reducing plastic shopping bag use and disposal in Africa », *African Journal of Environmental Science and Technology*, 3, 2008.
- REID Colin T., « Brexit: challenges for environmental law », *Scots Law Times*, 27, 2016, p. 143-147.

- REILING Dory, HAMMERGREN Linn et DI GIOVANNI Adrian, « Law & Justice Institutions - Justice Sector Assessment Handbook: Carrying out a Justice Sector Diagnostic », *American Society of International Law and the International Judicial Academy*, 2, 2007, n° 2, 100p.
- RESTREPO AMARILES David, « Legal indicators, global law and legal pluralism: an introduction », *The Journal of Legal Pluralism and Unofficial Law*, 47, 2015, n° 1, p. 9-21.
- RIJCKE Sarah de, WOUTERS Paul F., RUSHFORTH Alex D. *et al.*, « Evaluation practices and effects of indicator use—a literature review », *Research Evaluation*, 25, Oxford University Press, 2016, n° 2, p. 161-169.
- RILES Annelise, “Wigmore’s Treasure Box: Comparative Law in the Era of Information”, *Harvard International Law Journal*, 40, 1999, p. 221-283.
- ROBINSON Nicholas A., « Comparative Environmental Law: Evaluating How Legal Systems Address Sustainable Development », *Environmental Policy and Law*, 27, 1997, n° 4, p. 338-347.
- RUHL J.B., « Complexity Theory as a Paradigm for the Dynamical Law-and-Society System: a Wake-Up Call for Legal Reductionism and the Modern Administrative State », *Duke Law Journal*, 45, 1996, n° 5, pp. 849-928.
- SALAIIS Robert, « La donnée n’est pas un donné - Pour une analyse critique de l’évaluation chiffrée de la performance », *Cahiers Droit, Sciences & Technologies*, PUP, 2014, n° 4, p. 15-36.
- SANTILLO David, MILLER Kathryn et JOHNSTON Paul, « Microplastics as contaminants in commercially important seafood species », *Integrated Environmental Assessment Management*, 13, 2017.
- SANZ-LÁZARO Carlos, CASADO-COY Nuria et BELTRÁN-SANAHUJA Ana, « Biodegradable plastics can alter carbon and nitrogen cycles to a greater extent than conventional plastics in marine sediment », *Science of The Total Environment*, 756, 2021, p. 143978.
- SARKAR Prabirjit et SINGH Ajit, « Law, finance and development: further analyses of longitudinal data », *Cambridge Journal of Economics*, 34, 2009, n° 2, p. 325-346.

- SCHLACHER Thomas A., MONDON Julie A. et CONNOLLY Rod M., « Estuarine fish health assessment », *Marine Pollution Bulletin*, 54, 2007.
- SCHNURR Riley E. J., ALBOIU Vanessa, CHAUDHARY Meenakshi *et al.*, « Reducing marine pollution from single-use plastics (SUPs): A review », *Marine Pollution Bulletin*, 137, 2018, p. 157-171.
- SHIPTON Leah et DAUVERGNE Peter, « Health concerns of plastics: energizing the global diffusion of anti-plastic norms », *Journal of Environmental Planning and Management*, September 2021, p. 1-21.
- SIEMS Mathias M., « Numerical Comparative Law: Do We Need Statistical Evidence in Law in Order to Reduce Complexity », *Cardozo Journal of International and Comparative Law*, 13, 2005, p. 521-540.
- SIEMS Mathias, « Measuring the Immeasurable: How to Turn Law into Numbers », in Faure Michael et Smits Jan (éd.), *Does Law Matter? On Law and Economic Growth*, Cambridge, United Kingdom, Intersentia, 2011, p. 115-136.
- SILVER Carole et ROCCONI Louis, « Learning from and about the Numbers Journal of Legal Metrics », *Journal of Law*, 5, 2015, n° 1, p. 53-84.
- SIMON Nils, RAUBENHEIMER Karen, URHO Niko *et al.*, « A binding global agreement to address the life cycle of plastics », *Science*, 373, American Association for the Advancement of Science, 2021, n° 6550, p. 43-47.
- SINCLAIR Darren, « Self-Regulation Versus Command and Control? Beyond False Dichotomies », *Law & Policy*, 19, 1997, n° 4, p. 529-559.
- SMITH Allan E. et SECOY Diane M., « Forerunners of Pesticides in Classical Greece and Rome », *Journal of Agricultural and Food Chemistry*, 23, 1975, n° 6, p. 1050-1055.
- STANTON Thomas, KAY Paul, JOHNSON Matthew *et al.*, « It's the product not the polymer: Rethinking plastic pollution », *WIREs Water*, 8, 2020, n° 1, p. e1490.
- TAYLOR Rebecca L. C., « Bag leakage: The effect of disposable carryout bag regulations on unregulated bags », *Journal of Environmental Economics and Management*, 93, 2019, p. 254-271.

- UNGER Bianca, REBOLLEDO Elisa L. Bravo, DEAVILLE Rob *et al.*, « Large amounts of marine debris found in sperm whales stranded along the North Sea coast in early 2016 », *Marine Pollution Bulletin*, 112, 2016.
- VERSTEEG Mila et GINSBURG Tom, « Measuring the Rule of Law: A Comparison of Indicators », *Law & Social Inquiry*, 42, 2017, n° 1, p. 100-137.
- VIMAL K. E. K., MATHIYAZHAGAN K., AGARWAL Vernika *et al.*, « Analysis of barriers that impede the elimination of single-use plastic in developing economy context », *Journal of Cleaner Production*, 272, 2020, p. 122629.
- VINCE J. et HARDESTY B.D., « Governance solutions to the tragedy of the commons that marine plastics have become », *Frontiers in Marine Science*, 5, 2018, p. 214.
- WAGNER Travis P., « Reducing single-use plastic shopping bags in the USA », *Waste Management (New York, N.Y.)*, 70, 2017, p. 3-12.
- WINTER Søren et MAY Peter, « Motivation for Compliance with Environmental Regulations », *Journal of Policy Analysis and Management*, 20, 2001, p. 675-698.
- WORM Boris, BARBIER Edward B., BEAUMONT Nicola *et al.*, « Impacts of Biodiversity Loss on Ocean Ecosystem Services », *Science*, 314, 2006.
- WULF Alexander J., « The Contribution of Empirical Research to Law », *Journal of Jurisprudence*, 29, 2016, p. 29-49.
- XANTHOS Dirk et WALKER Tony R., « International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review », *Marine Pollution Bulletin*, 118, 2017, n° 1, p. 17-26.
- YATES Madeleine R. et BARLOW Claire Y., « Life cycle assessments of biodegradable, commercial biopolymers—A critical review », *Resources, Conservation and Recycling*, 78, 2013, p. 54-66.
- ZHU Jingkun et WANG Can, « Biodegradable plastics: Green hope or greenwashing? », *Marine Pollution Bulletin*, 161, 2020, p. 111774.

Reports

International organisations

FAO, « The State of World Fisheries and Aquaculture: sustainability in action », Food and Agriculture Organisation, 2020.

GESAMP, « Sources, Fate and Effects of Microplastics in the Marine Environment: a Global Assessment », London, GESAMP (IMO/ FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/ UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, 2015.

OECD et JRC EUROPEAN COMMISSION, « Handbook on Constructing Composite Indicators. Methodology and User guide », Paris, France, Organisation for Economic Co-operation and Development, 2008.

OECD, « Regulatory Policies in OECD Countries: from interventionism to regulatory governance », Paris, France, OECD Publishing, 2002.

UNITED NATIONS ENVIRONMENT, « Environmental Rule of Law », Nairobi, United Nations Environment, 2019.

UNITED NATIONS ENVIRONMENT, « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations », Nairobi, United Nations Environment, 2018.

UNITED NATIONS ENVIRONMENT, « Single-use plastics: A Roadmap for Sustainability », Nairobi, United Nations Environment, 2018.

UNITED NATIONS ENVIRONMENT, RAUBENHEIMER Karen, ORAL Nilüfer et MCILGORM Alistair, « Combating marine plastic litter and microplastics: an assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches », Nairobi, United Nations Environment Programme, 2017.

UNITED NATIONS DEVELOPMENT PROGRAMME, « Biodegradable Plastics & Marine Litter. Misconceptions, Concerns and Impacts on Marine Environments. », Nairobi, United Nations Environment Programme, 2015.

UNITED NATIONS DEVELOPMENT PROGRAMME, ROSE Gregory L., « Gaps in the Implementation of Environmental Law at the National, Regional and Global Level », Kuala Lumpur, Malaysia, UNEP, 2011.

UNITED NATIONS DEVELOPMENT PROGRAMME, “Why, what and how to measure? A user’s guide to measuring rule of law, justice and security programmes”, New York, United Nations Development Programme, 2014.

UNITED NATIONS GENERAL ASSEMBLY, INNIS Lorna et SIMCOCK Alan, « The First Global Integrated Marine Assessment », United Nations General Assembly, 2016.

UNITED NATIONS HUMAN RIGHTS, « Human Rights Indicators: A guide to Measurement and Implementation », New York, United Nations, 2012, 188p.

UNITED NATIONS, « The United Nations Rule of Law Indicators: Implementation Guide and Project Tools », New York, United Nations, 2011.

WORLD BANK GROUP, « Doing Business 2020 », Washington DC, World Bank, 2020.

WORLD BANK, « CPIA Criteria 2017 », Washington DC, World Bank Group, 2018.

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, « Report of the World Commission on Environment and Development: Our Common Future », Oxford University Press: Oxford, UK, 1987.

National public organisations

CHANTEGUET Jean-Paul, BATTISTEL Marie-Noël et BUIS Sabine, « Rapport d’information déposé en application de l’article 145 du Règlement par la Mission d’information commune sur l’application de la loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte », Assemblée Nationale, 2016.

CONSEIL D’ETAT, « Mesurer l’inflation législative », Paris, France, Conseil d’Etat, 2018.

CONSEIL D’ETAT, « Étude annuelle 2020 : Conduire et partager l’évaluation des politiques publiques », Conseil d’État, 2020.

COUR DE CASSATION, « Rapport Annuel 2020 », Paris, Cour de Cassation, 2021.

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, « Retail Bags Report », Tallahassee, Florida Department of Environmental Protection, 2010.

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, « Update of the 2010 retail bags report », Tallahassee, Florida Department of Environmental Protection, 2021.

JACKSON Laura, KURTZ Janis et FISHER William, « Evaluation Guidelines for Ecological Indicators », Washington DC, Environmental Protection Agency, 2000.

LEENHARDT Sophie, MAMY Laure, PESCE Stéphane *et al.*, « Impacts des produits phytopharmaceutiques sur la biodiversité et les services écosystémiques. Résumé de l'expertise scientifique collective », ESCo, INRAE, Ifremer, 2022.

SECRÉTARIAT GÉNÉRAL DU GOUVERNEMENT, « Indicateurs de suivi de l'activité normative », Paris, 2021.

SIMSON CAIRD Jack et ARMSTRONG Hazel, « The Supreme Court on Devolution », London, House of Commons Library, 2016.

Other

ABEL Jean-David, CHEVASSUS-AU-LOUIS Bernard, HOSY Christian *et al.*, « Livre Blanc Pour que vive la nature », Collectif de 14 ONG, 2020, objectif 1.1.4.

AZOULAY David, VILLA Priscillia, ARELLANO Yvette *et al.*, « Plastic Threatens Human Health at a Global Scale - New Report », Center for International Environmental Law (CIEL), 2019.

BOUWMA I. M., GERRITSEN A. I., KAMPHORST D. A. *et al.*, « Policy instruments and modes of governance in environmental policies of the European Union : past, present and future », Wageningen, Statutory Research Tasks Unit for Nature & the Environment (WOT Natuur & Milieu), 2015.

COOTER Robert D. et GINSBURG Tom, « Leximetrics: Why the Same Laws are Longer in Some Countries than Others », Rochester, NY, Social Science Research Network, 2003.

DALBERG CONSULTING FIRM, « Plastics: the costs to society, the environment and the economy », WWF, 2021.

ELCOATE Vicki, FILGUEIRA Begonia et SCOTFORD Eloise, « The State of UK Environmental Law in 2011-2012. Is there a case for legislative reform? », London, UK Environmental Law Association, King's College London, Cardiff University, 2012.

ENVIRONMENTAL INVESTIGATION AGENCY, CENTER FOR INTERNATIONAL ENVIRONMENTAL LAW et GLOBAL ALLIANCE FOR INCINERATOR ALTERNATIVE, « Convention on Plastic Pollution: toward a new global agreement to address plastic pollution », Washington DC, Environmental Investigation Agency, 2020.

FREEDOM HOUSE, « Freedom in the World 2021 Methodology », Washington DC, Freedom House, 2021.

HAMMOND Allen, « Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development », World Resources Institute, 1995.

HAVERCROFT Ian, « CCS Legal and Regulatory Indicator (CCS-LRI) », Melbourne, Australia, Global CCS Institute, 2018.

HAWKEN Angela et MUNCK Gerardo L., « Does the Evaluator Make a Difference? Measurement Validity in Corruption Research », Rochester, NY, Social Science Research Network, 2011.

IMPEL-NEPA, « Better Regulation Checklist to assess practicability and enforceability of legislation », Brussels, Belgium, European Union Network for the Implementation and Enforcement of Environmental Law, 2010.

KARASIK Rachel, VEGH Tibor, DIANA Zoie *et al.*, « 20 Years of Government Responses to the Global Plastic Pollution Problem », Durham, Duke Nicholas Institute, 2020, 309p.

KISTLER Amanda et MUFFETT Carol, « Plastic & Climate: the hidden costs of a plastic planet », Center for International Environmental Law (CIEL), 2019.

MCKINSEY COMPANY et OCEAN CONSERVANCY, « Stemming the Tide: Land-based strategies for a plastic- free ocean », McKinsey Company, 2015.

MO IBRAHIM FOUNDATION, « 2020 Ibrahim Index of African Governance - Index Report », London, United Kingdom, Mo Ibrahim Foundation, 2021.

NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE, « Reckoning with the U.S. Role in Global Ocean Plastic Waste », The National Academies Press, 2021.

NORDIC COUNCIL OF MINISTERS, « Possible elements of a new global agreement to prevent plastic pollution », Copenhagen, Nordic Council of Ministers, 2020.

OCEAN CONSERVANCY et INTERNATIONAL COASTAL CLEANUP, « We Clean On: 2021 Report », Ocean Conservancy, 2021.

PEW CHARITABLE TRUSTS et SYSTEMIQ, « Breaking the Plastic Wave: a Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution », Pew Charitable Trust and Systemiq, 2020.

PRIEUR Michel, BASTIN Christophe et MEKOUAR Mohamed Ali, « Mesurer l'effectivité du droit de l'environnement. Des indicateurs juridiques au service du développement durable », Brussels, Belgium, Chaire de Normandie pour la Paix, 2021.

TRANSPARENCY INTERNATIONAL, “Corruption Perception Index 2020: Full Source Description”, Berlin, Transparency International, 2020.

VICARIO Lorenzo et OHLINGER Tina, « The United States Environmental Policy », Brussels, Belgium, POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICIES, 2015.

WENDLING Zachary. A., EMERSON John W., DE SHERBININ Alex *et al.*, « Environment Performance Index 2020 », New Haven, CT, Yale Center for Environmental Law and Policy, 2020.

WWF, THE ELLEN MACARTHUR FOUNDATION et BCG, « The Business Case for a UN Treaty on Plastic Pollution », Ghent, WWF, 2020.

WORKER Jesse et DE SILVA Lalanath, « The Environmental Democracy Index: Technical note », Washington DC, World Resources Institute, 2015.

WORLD JUSTICE PROJECT, “Rule of Law Index 2021”, Washington DC, World Justice Project, 2021.

Theses and master theses

AMARA Anis, *Évaluation de la toxicité de pesticides sur quatre niveaux trophiques marins : microalgues, échinoderme, bivalves et poisson*, Université de Bretagne Occidentale, 2012, 214 p.

BÉTAILLE Julien, *Les conditions juridiques de l'effectivité de la norme*, Limoges, 2012, 767 p.

FRANSSON Lovisa Norine, *Wasting our future by wasting the sea -How to combat marine pollution from land-based sources on international and regional level*, Master thesis, Uppsala University, 2020, 83p.

NAIDOO Ruchir, *Should Seas Have Standing? A Critical Study Of Plastic Marine Debris And Pollution Laws In International And South African Law*, Master thesis, University of Kwa-Zulu Natal, 2015, 106 p.

SCHWOB David, *La mise sur le marché des pesticides agricoles : étude comparée des législations brésilienne, française et sénégalaise*, Mémoire de Master 2, Université Paris Saclay, 2020, 73 p.

Websites

ANSES, <https://www.anses.fr>, accessed 25/04/2022.

ANVISA, <https://www.gov.br/anvisa/pt-br>, accessed 25/04/2022.

BNP PARIBAS, “Senegal minimum wage”,

<https://www.tradesolutions.bnpparibas.com/fr/implanter/senegal/les-conditions-de-travail>, accessed 17/03/2022.

BRITANNICA, <https://www.britannica.com>, accessed 01/07/2020.

CAMBRIDGE DICTIONARY, <https://dictionary.cambridge.org>, accessed 22/07/2020.

CEDRE, “Amoco Cadiz”, <http://wwz.cedre.fr/Ressources/Accidentologie/Accidents/Amoco-Cadiz>, accessed 27/06/2022.

CENTRE DE L’INFORMATION SUR L’EAU, « Histoire des eaux usées : comment leur évacuation a-t-elle été gérée à travers les âges ? », <https://www.cieau.com/le-metier-de-leau/ressource-en-eau-eau-potable-eaux-usees/histoire-des-eaux-usees/>, accessed 05/05/2022.

CENTRE NATIONAL DE RESSOURCES TEXTUELLES ET LEXICALES, « causal », <https://www.cnrtl.fr/definition/causal>, accessed 30/06/2022.

CHAIRE NORMANDIE POUR LA PAIX, « Indicateurs juridiques du droit des générations futures », <https://chairepaix.hypotheses.org/indicateurs-juridiques>, consulté le 02/10/2020.

CNRTL, <https://www.cnrtl.fr>, accessed 02/10/2022.

COLLINS DICTIONARY, <https://www.collinsdictionary.com>, accessed 28/02/2022.

COUNTRY ECONOMY, “United Kingdom, France and Ireland minimum wages”,
<https://fr.countryeconomy.com/marche-du-travail/salaire-minimum-national>, accessed
17/03/2022.

DEPARTMENT OF THE ENVIRONMENT, CLIMATE AND COMMUNICATIONS,
IRISH GOVERNMENT, “Plastic Bags” [https://www.gov.ie/en/publication/28528-
plastic-bags/](https://www.gov.ie/en/publication/28528-plastic-bags/), accessed 26/01/2022.

ECOLEX, <https://www.ecolex.org>, accessed 03/03/2022.

ENVIRONMENT PROTECTION AGENCY, <https://www.epa.ie>, accessed 30/06/2022.

ETALAB, <https://www.etalab.gouv.fr>, accessed 27/06/2022.

EUR-LEX, <https://eur-lex.europa.eu/homepage.html?locale=fr>, accessed on 21/02/2022.

EUROPEAN COMMISSION, « Brazil », [https://ec.europa.eu/trade/policy/countries-and-
regions/countries/brazil/](https://ec.europa.eu/trade/policy/countries-and-regions/countries/brazil/), accessed 10/09/2021.

EUROPEAN COMMISSION, « International issues »,
https://ec.europa.eu/environment/international_issues/index_en.htm, accessed
02/09/2021.

EUROPEAN ENVIRONMENT AGENCY, “Policy instruments”,
<https://www.eea.europa.eu/themes/policy/intro>, accessed 15/02/2022.

EUROPEAN UNION TERMINOLOGY, “enforcement”,
<https://iate.europa.eu/entry/result/136783/en-en-fr-la-mul>, accessed 30/06/2022.

FAOLEX, <https://www.fao.org/faolex/fr/>, accessed on 21/02/2022.

FRENCH MINISTRY of JUSTICE, “Datajust”, [https://www.justice.fr/donnees-
personnelles/datajust](https://www.justice.fr/donnees-personnelles/datajust), accessed 27/06/2022.

GLOBAL PARTNERSHIP ON MARINE LITTER, <https://gpmarinelitter.org>, accessed
30/06/2022.

GLOBAL PARTNERSHIP ON NUTRIENT MANAGEMENT
<http://www.nutrientchallenge.org/>, accessed 30/06/2022.

GOUVERNEMENT DU QUÉBEC, « Thésaurus de l'activité gouvernementale », <http://www.thesaurus.gouv.qc.ca/tag/accueil.do>, accessed on 18/01/2022.

GOVERNMENT OF IRELAND, “Environmental Funds Accounts”, <https://www.gov.ie/en/publication/f6b84-environment-fund-accounts/>, accessed 26/01/2022.

GOVERNMENT OF IRELAND, “Environmental protection”, <https://www.gov.ie/en/policy-information/26f183-environmental-policy/>, accessed 02/09/2021.

HEALTH AND SAFETY EXECUTIVE, “Pesticide Products with Great Britain and Northern Ireland Authorisation for use in the Garden”, <https://secure.pesticides.gov.uk/garden/prodsearch.asp>, accessed 02/05/2022.

HEALTH AND SAFETY EXECUTIVE, “Regulating pesticides in the UK after Brexit”, <https://www.hse.gov.uk/pesticides/brexit.htm>, accessed 26/04/2022.

HEALTH AND SAFETY EXECUTIVE, <https://www.hse.gov.uk/index.htm>, accessed 26/04/2022.

IMPEL, <https://www.impel.eu>, accessed 30/06/2022.

INFO ESCOLA, “Tipos de leis”, <https://www.infoescola.com/direito/tipos-de-leis/>, accessed 10/09/2021.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATISTICA, <https://www.ibge.gov.br>, accessed 06/04/2022.

INTERGOVERNMENTAL SCIENCE-POLICY PLATFORM ON BIODIVERSITY AND ECOSYSTEM SERVICES (IPBES), “Policy instruments”, <https://ipbes.net/policy-instruments>, accessed 15/02/2022.

INTERNATIONAL UNION OF THE CONSERVATION OF NATURE, “Governing areas beyond national jurisdiction”, *Issues Brief*, March 2022, <https://www.iucn.org/resources/issues-briefs>, accessed 14/06/2022.

IRD, « Datasuds », <https://dataverse.ird.fr>, accessed on 23/01/2022.

IRELAND DEPARTMENT FOR AGRICULTURE, FOOD AND THE MARINE, “Pesticide Registration and Control”, <https://www.pcs.agriculture.gov.ie>, accessed 25/04/2022.

IUCN, « Motion adopted at the 2020 IUCN World Conservation Congress, « Mesurer l’effectivité du droit de l’environnement grâce à des indicateurs juridiques », <https://www.iucncongress2020.org/fr/motion/060>, accessed 15/06/2022.

LAROUSSE, <https://www.larousse.fr>, accessed 17/06/2020.

LEGAL DICTIONARY, <https://legal-dictionary.thefreedictionary.com>, accessed 04/01/2022.

LEGAL INFORMATION INSTITUTE, <https://www.law.cornell.edu/wex/>, accessed 15/02/2022.

LEGIFRANCE, « Bilan semestriel au 30 juin 2021 », <https://www.legifrance.gouv.fr/contenu/menu/autour-de-la-loi/legislatif-et-reglementaire/application-des-lois/bilans-semestriels/bilan-semestriel-au-30-juin-2021>, accessed 28/02/2022.

LEGIFRANCE, <https://www.legifrance.gouv.fr>, accessed on 21/01/2022.

LEXICO, <https://www.lexico.com>, accessed on 14/02/2022.

MERRIAM-WEBSTER DICTIONARY, <https://www.merriam-webster.com>, accessed 28/02/2022.

MINISTÉRIO DA AGRICULTURA E AMBIENTE, « Missão e atribuições », <http://www.maa.gov.cv/index.php/maa/missao-visao-e-estrategias>, consulted on 15/06/2021.

NATIONAL CONFERENCE OF STATE LEGISLATURE, “Plastic bag legislation”, <https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx>, accessed 06/04/2022.

NEW YORK’S TIME, “Nairobi Journal; Flower of Africa: A Curse That's Blowing in the Wind”, April 7, 2005, Section A, Page 4, accessed <https://www.nytimes.com/2005/04/07/world/africa/flower-of-africa-a-curse-thats-blowing-in-the-wind.html>, on 13/09/2021.

NORHERN IRELAND GOVERNMENT SERVICES, “Overview of government in Northern Ireland”, <https://www.nidirect.gov.uk/articles/overview-government-northern-ireland#toc-1>, accessed 04/03/2022.

OCEAN DECADE, <https://www.oceandecade.org>, accessed 01/08/2022.

OCEAN HEALTH INDEX, « Data », <https://ohi-science.org/data>, accessed 26/07/2022.

OECD DATA, “Gross domestic product (GDP)”, <https://data.oecd.org/gdp/gross-domestic-product-gdp.htm>, accessed 18/03/2022.

OECD GLOSSARY OF STATISTICAL TERMS, <https://www.oecd.org>, accessed on 10/12/2021.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, <https://www.oecd.org>, accessed 30/06/2022.

PLASTIC BAG LAWS, “Plastic bag law fact sheets”, <https://plasticbaglaws.org>, accessed 19/10/2021.

PLASTIC POLLUTION TREATY, “Business Statement for a Legally Binding UN Treaty on Plastic Pollution”, <https://www.plasticpollutiontreaty.org>, accessed 13/05/2022.

SCOTTISH ENVIRONMENT PROTECTION AGENCY, <https://www.sepa.org.uk>, accessed 04/03/2022.

SERVICE PUBLIC, <https://www.service-public.fr/particuliers/vosdroits/F2300>, accessed 17/03/2022.

TAKE-PROFIT, “Cape Verde minimum wage”, , <https://take-profit.org/en/statistics/minimum-wages/cape-verde/>, accessed 17/03/2022.

THE UNITED NATIONS TERMINOLOGY DATABASE, <https://unterm.un.org/unterm/portal/welcome> accessed on 18/01/2022.

THE WHITE HOUSE, “The Executive Branch”, <https://www.whitehouse.gov/about-the-white-house/our-government/the-executive-branch/>, accessed 13/09/2021.

THE WORLD BANK, “Doing Business Methodology”, <https://www.doingbusiness.org/en/methodology>, accessed 26/10/2021.

THE WORLD BANK, “Doing Business”, <https://www.doingbusiness.org/en/reforms>, accessed 15/11/2021.

THE WORLD BANK, « Country Policy and Institutional Assessment », <https://datacatalog.worldbank.org/search/dataset/0038988>, accessed 28/10/2021.

THE WORLD BANK, « Worldwide Governance Indicators”, <https://info.worldbank.org/governance/wgi/>, accessed 19/02/2020.

TRANSPARENCY INTERNATIONAL, “Corruption Perception Index 2019”,
<https://www.transparency.org/cpi2019>, accessed 19/02/2020.

TRANSPARENCY INTERNATIONAL, “Corruption Perception Index 2021”,
<https://www.transparency.org/en/cpi/2021>, accessed 17/06/2022

UK ENVIRONMENTAL LAW ASSOCIATION, “Roles and responsibilities (UK)”,
<http://www.environmentlaw.org.uk/rte.asp?id=299>, accessed 04/03/2022.

UK PARLIAMENT, “How are laws made” <https://www.parliament.uk/about/how/laws/>,
accessed 07/09/2021.

UNITED NATIONS DEVELOPMENT PROGRAMME, “Human Development Index”,
<https://hdr.undp.org/en/content/human-development-index-hdi>, accessed 18/03/2022.

UNITED NATIONS DEVELOPMENT PROGRAMME, “Seoul Policy Centre for
Knowledge Exchange through SDG Partnerships, Goal 14: Life Below Water”,
https://www1.undp.org/content/seoul_policy_center/en/home/sustainable-development-goals.html, accessed 14/06/2022.

UNITED NATIONS ENVIRONMENT PROGRAMME, “From birth to ban: A history of the
plastic shopping bag”, <https://www.unep.org/news-and-stories/story/birth-ban-history-plastic-shopping-bag>, accessed on 13/09/2021.

UNITED NATIONS ENVIRONMENT, “Addressing land-based pollution”,
<https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution>, accessed 10/06/2020.

UNITED NATIONS TERMINOLOGY DATABASE, “Effectiveness”,
<https://unterm.un.org/unterm/search?urlQuery=effectiveness>, accessed 18/01/2022.

UNITED NATIONS, “Goal 6: Ensure access to water and sanitation for all”,
<https://www.un.org/sustainabledevelopment/water-and-sanitation/>, accessed
13/07/2021.

UNITED STATES SENATE, “Vetoes”,
https://www.senate.gov/reference/reference_index_subjects/Vetoes_vrd.htm, accessed
13/09/2021.

VASSALLO & SALAZAR, P.C. LAW FIRM, « Federal Preemption of State Environmental Law », <https://www.vslawyers.com/federal-preemption-of-state-environmental-law/>, accessed 02/03/2022.

WORLD RESOURCES INSTITUTE, “Environmental Democracy Index”, <https://www.environmentaldemocracyindex.org/index.html>, frequently asked questions. Accessed 28/02/2022.

WORLD RESOURCES INSTITUTE, “Interactive Map of Eutrophication and Hypoxia”, <https://www.wri.org/data/interactive-map-eutrophication-hypoxia>, accessed 04/05/2021.

YALE CENTER FOR ENVIRONMENTAL LAW & POLICY, “Environment Performance Index”, <https://epi.yale.edu>, accessed 18/03/2022.

Annexes

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Annex I List of legal texts analysed – relative to plastic bags

Cape Verde

Lei n°99/VIII/2015 de 27 de Agosto, BO n°51 du 27/08/2015 pp. 1600-1603.

Florida

N.A.

France

Loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte, JORF n°189 du 18/08/2015.

Loi n°2016-1087 du 8 août 2016 pour la reconquête de la biodiversité, de la nature et des paysages, publiée au JORF n°0184 du 9 août 2016.

Loi n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire (1), JORF n°0035 du 11 février 2020.

Décret n°2016-379 du 30 mars 2016 relatif aux modalités de mise en œuvre de la limitation des sacs en matières plastiques à usage unique, JORF n°0076 du 31 mars 2016.

Décret n° 2020-1724 du 28 décembre 2020 relatif à l'interdiction d'élimination des invendus non alimentaires et à diverses dispositions de lutte contre le gaspillage, [JORF n°0315 du 30 décembre 2020](#).

Décret n° 2020-1828 du 31 décembre 2020 relatif à l'interdiction de certains produits en plastique à usage unique, JORF n°0001 du 1 janvier 2021.

Décret n° 2021-763 du 14 juin 2021 définissant la catégorie des sacs en plastique très légers, JORF n°0138 du 16 juin 2021.

England

Statutory Instrument No. 776 of 2015, The Single Use Carrier Bags Charges (England) Order 2015, 19th of March 2015.

Statutory Instrument No. 324 of 2020, The Single Use Carrier Bags Charges (England) (Amendment) 2020, adopted on March 20th, 2020.

Statutory Instrument no. 598 of 2021, The Single Use Carrier Bags Charges (England) (Amendment) Order 2021, adopted on May 20th 2021.

Ireland

Statutory Instrument n°36 of 2001, Waste Management (amendment) Act, 17th of July 2001

Statutory Instrument No. 605/2001 — Waste Management (Environmental Levy) (Plastic Bag) Regulations, 2001, Given under the Official Seal of the Minister for the Environment and Local Government this 19th day of December 2001.

Statutory Instrument No. 167/2007 — Waste Management (Environmental Levy) (Plastic Bag) (Amendment) (No. 2) Regulations 2007, published in “Iris Oifigiúil” of 27th April, 2007.

Scotland

Statutory Instrument No. 161 of 2014, The Single Use Carrier Bags Charge (Scotland) Regulations, 3rd June 2014.

The Single Use Carrier Bags Charge (Fixed Penalty Notices and Amendment) (Scotland) Regulations 2015 no 159 adopted on March 31st, 2015.

The Single Use Carrier Bags Charge (Scotland) Amendment Regulations 2020 no. 118, adopted on April 1st, 2020.

The Single Use Carrier Bags Charge (Coronavirus) (Scotland) Amendment Regulations 2021 no. 53, adopted on January 28th, 2021.

Senegal

Loi n° 2015-09 du 04 mai 2015 relative à l’interdiction de la production, de l’importation, de la détention, de la distribution, de l’utilisation de sachets plastiques de faible micronnage et à la gestion rationnelle des déchets plastiques ; publiée au Journal Officiel de la République du Sénégal n°6859 du samedi 04 juillet 2015.

Loi n°2020-04 du 08 janvier 2020 relative à la prévention et à la réduction de l’incidence sur l’environnement des produits plastiques ; publiée au Journal Officiel de la République du Sénégal du lundi 20 janvier 2020.

State of Pernambuco

Lei n° 16559 de 15/01/2019, Institui o Código Estadual de Defesa do Consumidor de Pernambuco, publicado no DOE - PE em 16 jan 2019.

Lei N° 16758 de 18/12/2019, Altera a Lei no 16.559, de 15 de janeiro de 2019, que institui o Código Estadual de Defesa do Consumidor de Pernambuco, de autoria do Deputado

Rodrigo Novaes, a fim de aperfeiçoar dispositivos desta Lei, publicado no DOE - PE em 19 dez 2019.

State of Sao Paulo

N.A.

Texas

N.A.

Annex II Country factsheets

Table: summary of main indices, per country

	BR	CV	FR	IE	SN	UK	US
Population (million people)	211	0,54	66,97	4,87	15,85	66,46	326,69
Population growth	0,80%	1,20%	0,20%	1,20%	2,80%	0,60%	0,50%
Land surface (th km ²)	8515,8	4	549,1	70,3	196,7	243,6	9831,5
ZEE surface (th km ²)	3677,7	734	10070,4	427	158,4	5884,8	12167,3
GDP (billion \$)	1885,48	1,97	2787,86	382,67	23,24	2860,67	20580,22
GDP annual growth	1,30%	4,50%	1,80%	1,30%	6,40%	1,30%	3,20%
GDP per capita (current US\$):	6796,8	3064,3	38625,1	83812,8	1487,8	40284,6	63543,6
Agricultural land (% land area)	28,30%	19,60%	52,30%	65,60%	46,10%	71,70%	44,40%
HDI	0,761	0,651	0,891	0,942	0,514	0,92	0,92
Gini index	53,9	42,4	31,6	32,8	40,3	34,8	41,4
RLI	0,52	NA	0,73	NA	0,55	0,79	0,72
EPI	51,2	32,8	80	72,8	30,7	81,3	69,3

In green the top two figures for each measure. In red the bottom two figures for each measure.

Nota Bene: the year of reference of each value is precised in each country factsheet.

Sources:

Population	World bank country profiles, https://data.worldbank.org/country
Population growth	World bank country profiles, https://data.worldbank.org/country
Land surface	World bank country profiles, https://data.worldbank.org/country
ZEE surface	Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at https://www.marineregions.org/ . https://doi.org/10.14284/386
GDP	World bank country profiles, https://data.worldbank.org/country
GDP annual growth	World bank country profiles, https://data.worldbank.org/country
GDP per capita	World bank country profiles, https://data.worldbank.org/country
Agricultural land	World bank country profiles, https://data.worldbank.org/country
Human Development Index (HDI)	Human Development center, http://hdr.undp.org/en/data
Gini index	World bank country profiles, https://data.worldbank.org/country
Rule of Law Index (RLI)	World Justice Project, https://www.worldjusticeproject.org/rule-of-law-index/global
Environment Performance Index (EPI)	https://epi.yale.edu/epi-results/2020/component/epi

Federative Republic of Brazil (Brazil)



State characteristics

- Capital city: Brasilia
- System of government: federal
- Population (million people): 211 (2018), 6th country most populated
- Population growth: 0.8%
- Land surface (*thousand km²*): 8515.8, 5th largest country
- ZEE surface (*thousand km²*): 3677,7

Legal profile and development of environmental law

Brazil is a federal country comprised of the federal government, 26 states and a federal district. In this work, the focus is set on the states of Pernambuco and Sao Paulo (circled in red on the map). These two states have been chosen to benefit from existing partnerships in universities of Recife and Sao Paulo.

The Brazilian legal system derives mainly from the civil law system. The supreme law is the Federal Constitution since the 5th of October 1988. Legislative, executive and judiciary powers are held federal, and state levels. At the federal level, the legislative power is held by the National Congress, comprised of the Chamber of Deputies and the Federal Senate. The National Congress elaborates and adopts *emendas à constituição* (amendments to the constitution), *leis complementares*, *leis ordinárias*, *leis delegadas*, *medidas provisórias*, *decretos legislativos*, and *resoluções*¹¹³³.

Leis complementares are subject to a special legislative process (absolute majority required), on subjects that the constituents considered of fundamental importance. They cannot be amended by other types of laws. *Leis ordinárias* are adopted at simple majority, on matters that do not require *leis complementares*, *decretos legislativos* nor *resoluções*. *Leis delegadas* are a delegation of the legislative power to the President of the Republic (see article 68 of the Constitution). Article 62 of the Constitution organise *medidas provisórias*, adopted by the President in case of urgency, and submitted to the Congress. The Congress then has 60 days to adopt a *lei* on these matters, or the *medida provisória* is no longer in force. *Resoluções* are administrative acts issued by a higher authority, on specific matters under its competence¹¹³⁴.

The two main sources of environmental law in Brazil are the National Environmental Policy¹¹³⁵ and the Constitution adopted in 1988¹¹³⁶, which provides for environment protection through nine articles.

¹¹³³ Art. 59, BRASIL. Constituição Federal. *Constituição da República Federativa do Brasil de 1988*, Brasília, DF, 05 Outubro 1988.

¹¹³⁴ <https://www.infoescola.com/direito/tipos-de-leis/>, accessed 10/09/2021

¹¹³⁵ BRASIL. Lei nº 6.938, de 31 de agosto de 1981, precited

¹¹³⁶ COSTA DE OLIVEIRA Carina, « B) En droit brésilien : « des sources aux principes » », *Revue juridique de l'Environnement*, 40, Persée - Portail des revues scientifiques en SHS, 2015, n° 2, p. 218-222, p. 218.

Main socioeconomic components:

- GDP (*billion \$*): 1,878 (2019), 9th largest economy
- GDP annual growth: 1.4% (2019)
- GDP per capita (current US\$): 6796,8 (2020)
- Agricultural land (*% of land area*): 28,3 (2018)
- Human Development Index (HDI): 0.761 (79/189)
- Gini index: 53.9 (2018)
- Rule of Law index: 0.52 (67/128)
- Environment Performance Index: 51,2 (55/180)

Brazil is one of the ten world leading economies, with nonetheless one of the smallest GDP growth rate of the case study countries. The GDP per capita is near to 10 times smaller than the US's and twice bigger than Cape Verde's. Brazil's agricultural land represents only 28% of the total land area, one of the weakest rates of the case study countries. Its HDI places Brazil as a country of high human development. Income inequalities remain high with a Gini index of 53,9, the largest of the studied countries. As for the Rule of Law, Brazil is approximately at the same level as Senegal.

Regional integration and trade

Brazil is part of the MERCOSUR trading block (along with Argentina, Uruguay and Paraguay) since 1991. It goes beyond a free-trade agreement, organising for example the free circulation of member countries' citizens. The European Union and MERCOSUR are currently negotiating a free trade agreement. Brazil accounted for "30,8% of EU's total trade with the Latin America region in 2016"¹¹³⁷.

¹¹³⁷ <https://ec.europa.eu/trade/policy/countries-and-regions/countries/brazil/>, accessed 10/09/2021.

Cabo Verde (Cabo Verde)



Source: <https://gisgeography.com/cape-verde-map/>, accessed 10/09/2021

State characteristics

- Capital city: Praia
- System of government: unitary
- Population (million people): 0.54 (2018), 169th country most populated
- Population growth: 1.2%
- Land surface (thousand km²): 4, 174th largest country
- ZEE surface (thousand km²): 734

Cape Verde is the least populated and the smallest country of this study. Its population growth rate is nonetheless one of the largest.

Legal profile and development of environmental law

Cape Verde is a unitary country. Its supreme law is the Constituição da República de Cabo Verde, promulgated in 1992¹¹³⁸. The legislative power is held by the *Assembleia Nacional de Cabo Verde*, a unique chamber composed of 72 deputies. The executive power is held by the President.

The article 72 of the Constitution recognises the fundamental right to a clean environment. The bases of environmental policy in Cabo Verde are set by the *Lei n.º 86/IV/93 define as bases da política do ambiente*¹¹³⁹. In 1997, the Ministry of Agriculture is renamed Ministério da Agricultura, Alimentação e Ambiente.

Main socioeconomic components:

- GDP (billion \$): 1.97¹ (2018), 186th largest economy
- GDP average annual growth: 4.5%¹
- GDP per capita (current US\$): 3064,3 (2020)
- Agricultural land (% of land area): 19,6% (2018)¹
- Human Development Index (HDI): 0.651 (126/189)
- Gini index: 42.4 (2015)
- Rule of Law index: NA
- Environment Performance Index: 32.8 (144/180)

If Cabo Verde is the smallest economy in absolute and per capita GDP, its GDP annual growth is one of the higher. Regarding agricultural land, it is the study country where the least rate of land area is agricultural. The Human Development Index of Cape Verde rates this country in the “medium human development” tier. As for the Gini index, Cape Verde is rated as a country where income inequalities are rather high.

Regional integration and trade

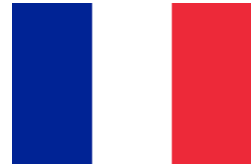
Cape Verde joined the Organisation of African Unity in 1975, the year it acquired its independence from Portugal. This organisation is now known as the African Union.

Cape Verde is party to the Economic Community of West African States (ECOWAS) since 1976, one year after the creation of the organisation, in 1975. It aims to enhance economic integration and trade among west African countries. Cape Verde is the only country of ECOWAS to be geographically isolated from other member countries.

¹¹³⁸ Constituição da República, aprovada pela lei constitucional n.º 1/IV/92, de 25 de setembro.

¹¹³⁹ Boletim oficial número 27, 26 de julho de 1993.

French Republic (France)



Source: <https://www.cartes-2-france.com/carte-villes.php>, accessed 10/09/2021

State characteristics

- Capital city: Paris
- System of government: unitary
- Population (million people): 66.97 (2018), 20th country most populated
- Population growth: 0,2%
- Land surface (*thousand km²*): 549.1, 41th largest country
- ZEE surface (*thousand km²*): 10070,4

Legal profile and development of environmental law

France is a unitary country which supreme law is the Constitution de 1958¹¹⁴⁰. The legislative power is held by the *Parlement*, composed of the *Assemblée nationale* and the *Sénat*. The executive power is held by the President and the Prime minister. The *Parlement* can discuss and adopt texts named *lois*, then promulgated by the President. The executive power adopts *décrets* to implement legislative texts or *ordonnances*, which are delegated legislative powers.

The Environment is allocated a Ministry for the first time in 1971. Since, the *Charte de l'environnement* is adopted in 2004 and integrated in the corpus of texts composing the supreme law in 2005. It recognises the fundamental right to a clean environment. The *Code de l'environnement* is the legal basis of environmental policy in France¹¹⁴¹.

Main socioeconomic components:

- GDP (billion \$): 2787.86 (2018), 6th largest economy
- GDP annual growth: 1.8%
- GDP per capita (current US\$): 38 625,1 (2020)
- Agricultural land (% of land area): 52,3% (2018)
- Human Development Index (HDI): 0.891 (26/189)
- Gini index: 31.6 (2017)
- Rule of Law index: 0.73 (20/128)
- Environment Performance Index: 80 (5/180)

France's different socioeconomic indices are mostly around the median of the case study countries. The UK and US are larger economies, Senegal and Cape Verde are faster growing economies and Ireland and the US are richer in GDP/capita. Its HDI rates it as a "very high human developed country". Its Gini Index is one the lowest of the seven countries, meaning that it is the country where income inequalities are the smallest. France's score at the Rule of Law index is the second highest, just behind the UK.

Regional integration and trade

France is one of the founding members of the European Economic Community in 1957, which became the European Union in 1993.

¹¹⁴⁰ Constitution du 4 octobre 1958. J.O. 5 oct. 58 : 9151-9173.

¹¹⁴¹ NB : *certaines Outre Mers ont leur propre Code de l'environnement.*

Ireland



State characteristics

- Capital city: Dublin
- System of government: unitary
- Population (million people): 4.87 (2018), 121st country most populated
- Population growth: 1.2%
- Land surface (*thousand km²*): 70.3, 120th largest country
- ZEE surface (*thousand km²*): 427

Legal profile and development of environmental law

Ireland is a unitary country, its supreme law is Bunreacht na hÉireann, the Constitution of Ireland adopted in 1937. The legislative power is vested in the Oireachtas, the bicameral

Parliament composed of Dáil Éireann, Seanad Éireann and the President of Ireland. The President of Ireland is elected while the head of government is nominated by the lower house.

The Parliament discusses bills, becoming an Act when voted in equal terms and signed into law by the President. The Statute Book is the compilation of acts. Statutory instruments are defined by the Statutory Instruments Act 1947 as "an order, regulation, rule, scheme or bye-law made in exercise of a power conferred by statute".

The Environment Protection Agency, holding the executive powers in the field of the environment, is created in 1992 through the Environmental Protection Agency Act 1992 (as amended). The Protection of the Environment Act 2003 (as amended) and Environmental (Miscellaneous Provisions) Acts 2011 and 2015 are two other key pieces of legislation for Ireland.

Main socioeconomic components:

- GDP (*billion \$*): 382.67 (2018), 33rd largest economy
- GDP annual growth: 1,3% (2018)
- GDP per capita (current US\$): 83 812,8
- Agricultural land (*% of land area*): 65,6% (2018)
- Human Development Index (HDI): 0,942 (3/189)
- Gini index: 32,8 (2016)
- Rule of Law index: NA
- Environment Performance Index: 72.8 (16/180)

Although Ireland's population is the second smallest of the case study countries, the GDP per capita is by far the largest. Ireland is the second most cultivated country of our selection, with 65% of agricultural land out of the land area. Ireland is the third country of the world with the highest HDI. Income inequalities are relatively low, as showed by the Gini index.

Regional integration and trade

Ireland joined the European Economic Communities in 1973 at the same time as the United Kingdom and Denmark. Contrary to the UK, Ireland also joined the euro zone in 1999.

Republic of Senegal (Senegal)



Source : <https://gisgeography.com/senegal-map/>, accessed 10/09/2021

State characteristics

- Capital city: Dakar
- System of government: unitary
- Population (million people): 15.85 (2018), 72th country most populated
- Population growth: 2.8%
- Land surface (*thousand km²*): 196.7, 88th largest country
- ZEE surface (*thousand km²*): 158,4

Legal profile and development of environmental law

Senegal is a country of the civil law tradition, influenced by French law. Its supreme law is the Constitution adopted on January 22, 2001. On environmental matters, the founding legal basis

is the *Loi n°2001-01 du 12 avril 2001 portant code de l'environnement*. A law amending the Constitution in 2016¹¹⁴², recognises the right to a healthy environment (art.3).

The legislative power is vested in the Parliament, composed of a unicameral chamber, which discusses and adopts legal texts named *lois*, signed by the President. The executive power is vested in the President, and is responsible for the adoption of *textes de nature réglementaire*, named *décrets* and *arrêtés*.

Main socioeconomic components:

- GDP (*billion \$*): 23.24 (2018), 113th largest economy
- GDP annual growth: 6.4%
- GDP per capita (current US\$): 1 487,8
- Agricultural land (*% of land area*): 46,1% (2018)
- Human Development Index (HDI): 0.514 (166/189)
- Gini index: 40.3 (2011)
- Rule of Law index: 0.55 (52/128)
- Environment Performance Index: 30.7 (155/180)

Senegal has the highest population growth rate and the highest GDP annual growth rate of the case study countries. If its GDP is the second lowest, its GDP per capita is the lowest, being far more populated than Cape Verde. Around 46% of the total land area is cultivated, ranking it around the median of the case study countries. The Gini index of Senegal is close to the United States', meaning that the spread between the highest and the lowest incomes is relatively proportional. The HDI is just below the "middle human development" tier, and the Rule of Law index is the lowest of the five studied countries for which it has been calculated.

Regional integration and trade

Senegal joined the Organisation of African Unity at its creation, in 1963. This organisation is now known as the African Union. It is also party to the Economic Community of West African States (ECOWAS or CEDEAO). and to the West African Economic and Monetary Union (WAEMU or UEMOA).

¹¹⁴² Loi constitutionnelle n°2016-10 du 5 avril 2016 portant révision de la Constitution, JORS du 13/6/2016.

United Kingdom of Great Britain and Northern Ireland (United Kingdom, UK)



State characteristics

- Capital city: London
- System of government: unitary, devolved competences to the countries
- Population (million people): 66.46 (2018), 21st country most populated
- Population growth: 0,6%
- Land surface (*thousand km²*): 243.6, 80th largest country
- ZEE surface (*thousand km²*): 5884,8

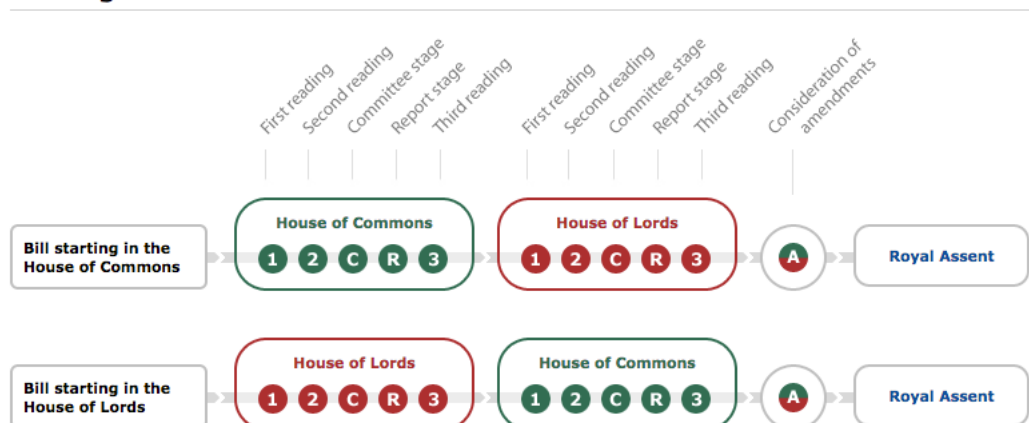
Legal profile and development of environmental law

The United Kingdom belongs to the common law legal tradition. Statutory law is often opposed to case law and equity. Statutory law is composed of statutes and statutory instruments.

Statutes are Acts of Parliament. They are adopted by both the House of Commons and the House of Lords (see Passage of a Bill illustration) and receive the Royal Assent. Statutory instruments (or regulations) are an expression of the executive power exercised by the Queen (Order in Council) or a Minister of the Crown (senior ministers are also called Secretary of State). The power to adopt statutory instruments is conferred by an Act of Parliament.

A bill is a draft Act of Parliament. The fully detailed procedure is described on the website of the UK Parliament¹¹⁴³.

Passage of a Bill



Source: <https://guides.ll.georgetown.edu/c.php?g=365741&p=4199179>, accessed 07/09/2021

The Environment Act 1995 provides for the creation of the Environment Agency and the Scottish Environment Protection Agency, as executive agencies for environmental matters.

Bell and McGillivray break down the sources of domestic environmental legislation in the United Kingdom into three main categories: primary legislation (statutes), secondary legislation (statutory instruments) often more technical and detailed, and tertiary legislation, composed of guidance and other rules acting as an aid to the interpretation of statutory provisions)¹¹⁴⁴.

¹¹⁴³ <https://www.parliament.uk/about/how/laws/passage-bill/commons/coms-commons-first-reading/>, accessed 07/09/2021.

¹¹⁴⁴ BELL Stuart et MCGILLIVRAY Donald, *Environmental law*, 6th Edition., Oxford; New York, Oxford University Press, 2006, 910 p., pp. 92-93.

Two events make the analysis of UK environmental law special: devolution in the 1999 and Brexit in December 2020. Devolution is an asymmetric process of transfer of competences to national elected parliaments and executive institutions¹¹⁴⁵. ‘Asymmetric’, because the transfer of competence from the Westminster parliament to national parliaments is decreasingly advanced in Scotland, Northern Ireland, and Wales¹¹⁴⁶. A ‘process’ as devolution was initiated in 1998 in the three countries¹¹⁴⁷, and evolved since with the adoption of further devolution acts¹¹⁴⁸. ‘A transfer of competence’ as legislative and executive powers on a set of matters are no longer exerted by Westminster and Whitehall¹¹⁴⁹ but by nationally elected parliaments and governments. Therefore, a distinction is made between ‘reserved matters’ and ‘devolved matters’, in a distinction resembling the share of competencies in a federal state. The first are reserved to the UK institutions (Westminster and Whitehall), and cover matters such as, for Scotland, macroeconomic and fiscal issues, foreign policy and international relations, defence and national security, employment or immigration¹¹⁵⁰. All matters that are not reserved are considered as devolved.

As devolution in Scotland is more advanced than in other countries, it has been chosen as a case-study, to be compared with the regulations adopted in England. Both are circled in red on the map.

¹¹⁴⁵ ANTOINE Aurélien, *Droit constitutionnel britannique*, 2ème édition., Issy-les-Moulineaux, LGDJ Lextenso éditions, 2018, 206 p, p. 176.

¹¹⁴⁶ Scotland is the country with the most devolved matters and Wales the least. ANTOINE Aurélien, *Droit constitutionnel britannique*, *op.cit.*, p. 176.

¹¹⁴⁷ Devolution started in Scotland with the adoption of the Scotland Act 1998; in Northern Ireland with the adoption of the Northern Ireland Act (1998); in Wales with the adoption of the Government of Wales Act 1998. Additional documents, such as the Sewel Convention and Memorandum of Understanding address inter-governmental relations under devolution.

Devolution was suspended in Northern Ireland in October 2002 and restored in May 2007. <https://www.nidirect.gov.uk/articles/overview-government-northern-ireland#toc-1>, accessed 04/03/2022.

¹¹⁴⁸ E.g. in Scotland the Scotland Act 2012 deepening the transfer of financial powers from Westminster and the Scotland Act 2016 devolving further powers to Scotland.

¹¹⁴⁹ Designating by metonymy respectively the United Kingdom Parliament and Government.

¹¹⁵⁰ Schedule 5, Scotland Act 1998.

Main socioeconomic components:

- GDP (*billion \$*): 2860,67 (2018), 5th largest economy
- GDP annual growth: 1,3% (2018)
- GDP per capita (current US\$): 40 284,6 (2020)
- Agricultural land (*% of land area*): 71,7% (2018)
- Human Development Index (HDI): 0,920 (15/189)
- Gini index: 34,8 (2016)
- Rule of Law index: 0,79 (13/128) (2020)
- Environment Performance Index: 81.3 (4/180)

These indices show that the United Kingdom is an economic leader, it is the 5th largest economy (in Gross Domestic Product). In 2018 its GDP annual growth rate is relatively low, meaning that the UK economy is growing, but slowly. Out of the case study countries, the UK is the country with the largest share of agricultural land, out of total land area.

The Human Development Index of the UK places it in the category of “very high human developed countries”, and the 15th most human developed country. The Gini index measures income inequalities (0 perfect equality, 1 absolute inequality). The score of the UK places it in the middle of the ranking of European countries. As for the Rule of Law index, the UK is the country of this case study with the strongest rule of law, and the 13th out of the 128 countries assessed by the World Justice Project.

Regional integration and trade

The UK joined the European Economic Community in 1973, and quit the European Union in 2020¹¹⁵¹. In the meanwhile, it had chosen to opt out from the euro zone.

¹¹⁵¹ Consequences of BREXIT for environmental law are dealt with in the Title 2 of the part 2, on environmental competences in the case study countries.

United States of America (USA)



State characteristics

- Capital city: Washington DC
- System of government: federal
- Population (million people): 326.69 (2018), 3rd country most populated
- Population growth: 0,5%
- Land surface (*thousand km²*): 9831.5, 3rd/ 4th largest country
- ZEE surface (*thousand km²*): 12167,3

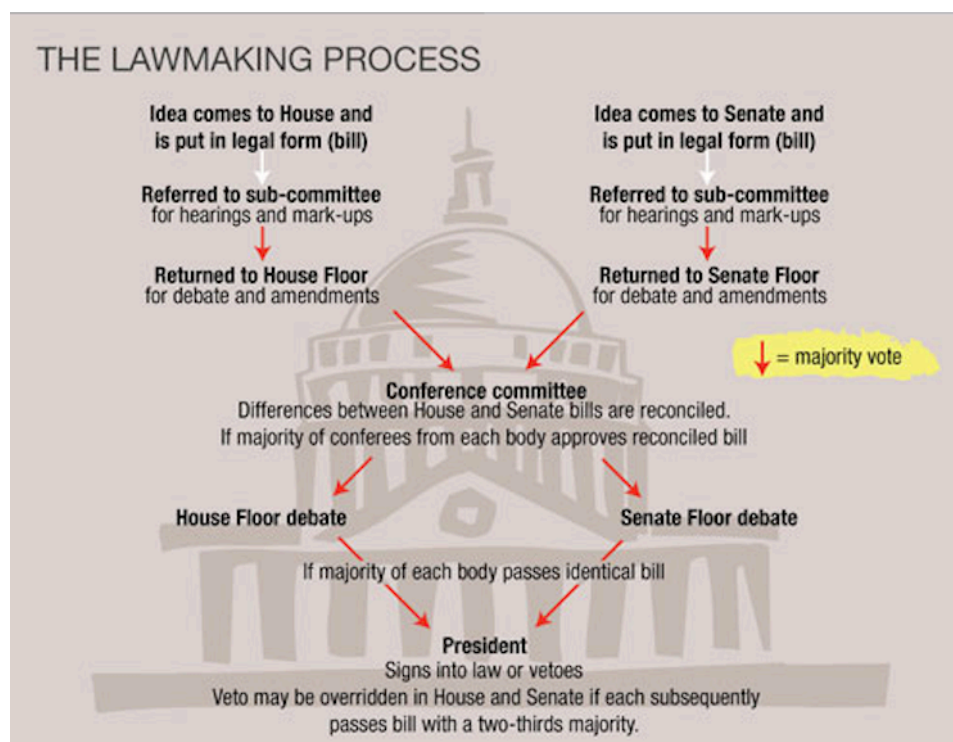
Legal profile and development of environmental law

The United States of America is a federal country. The two case-study states are Texas and Florida, circled in red on the map. The project initially planned to study the regulation of pesticides along with plastic. Texas and Florida were therefore chosen as two agricultural states.

The United States is a country belonging to the common law tradition, and its Supreme law is the Constitution of the United States written in 1787, ratified in 1788 and in force since 1789. 27 amendments have been adopted to the original text.

The legislative power is vested in Congress, composed of the House of Representatives and Senate. The President detains the executive power. Fifteen independent federal agencies are in charge of the day to day enforcement and administration of federal laws¹¹⁵². The Environment Protection Agency (EPA) is the agency of main interest here.

A draft law is called a bill. The bill is discussed and adopted in the House of Representatives and the Senate. The President can then either sign the bill into law, veto it and return the bill to Congress, let it become law without signing it in the ten days period or pocket-veto it¹¹⁵³.



Source: <https://guides.nyu.edu/govdocs/lawmaking>, accessed 13/09/2021

¹¹⁵² <https://www.whitehouse.gov/about-the-white-house/our-government/the-executive-branch/>, accessed 13/09/2021

¹¹⁵³ See https://www.senate.gov/reference/reference_index_subjects/Vetoes_vrd.htm, accessed 13/09/2021

The broad national framework for environment protection is set by the National Environmental Policy Act from which stems the creation of the Environmental Protection Agency.

Main socioeconomic components:

- GDP (*billion \$*): 20580.22 (2018), 1st largest economy
- GDP annual growth: 2,1 % (2019)%
- GDP per capita (current US\$): 63 543,6 (2020)
- Agricultural land (*% of land area*): 44,4% (2018)
- Human Development Index (HDI): 0,920 (15/189)
- Gini index: 41,4 (2016)
- Rule of Law index: 0,72 (21/128)
- Environment Performance Index: 69.3 (24/180)

The USA is the largest economy of this case study (and also the world's largest), in GDP and GDP per capita. It is approximately in the median of agricultural land coverage out of the countries of this case study. Its HDI rates it as a very high human developed countries, one of the more developed of the case study, but also a country where inequalities remain high, as shown by the Gini index. The Rule of Law index is relatively high, the USA is the 21st country out of the 128 rated by the World Justice Project.

Regional integration and trade

The USA is one of the leading economies of the world. Since January 1994, the North America Free Trade Agreement (NAFTA) organises free trade of goods between Canada, Mexico and the USA. Political barriers remain. Since January 2020, the United States–Mexico–Canada Agreement (USMCA) replaces NAFTA, reviewing sectoral deals (dairy, auto manufacturing) and including provisions on labour laws or environment protection. USMCA doesn't deepen political integration between the three countries.

Annex III Effectivité vs. Efficacité : vers une troisième voie ?

Effectivité et efficacité de la règle : des concepts centraux aux contours flous

Alors que les notions d'effectivité et d'efficacité du droit sont centrales à l'étude des normes juridiques, leur définition et la distinction entre ces deux concepts est souvent ardue et source de débats. Cette thèse s'inscrit dans un projet de recherche dont la vision est expérimentale plutôt que fondamentale. Dès lors, il s'agit davantage de concevoir et développer des méthodes d'analyse de l'effectivité du droit, plutôt que de contribuer au débat sur les fondements de ce concept. Il convient donc d'expliquer ce qu'il est entendu ici par ce terme, et comment cette définition s'articule avec la doctrine pour éviter une mauvaise compréhension des ambitions de ce travail. Partant de la définition des concepts d'effectivité, d'efficacité et d'efficience, nous verrons comment ces concepts s'entremêlent et se complètent. Faire le lien avec des termes similaires et complémentaires en anglais achèvera de mieux définir le champ de cette étude¹¹⁵⁴.

L'effectivité, ou la production d'un effet sur le réel

En s'appuyant sur l'origine de ce concept et sur son interprétation donnée en droit par la doctrine, nous éclaircirons les contours de la notion d'effectivité.

Le mot 'effectivité' fait son apparition dans la langue française au XX^{ème} siècle, « formé à partir de l'épithète 'effectif' »¹¹⁵⁵. Les racines latines du mot 'effectif' – *effectus* et *effectus* – renvoient à la notion d'effet¹¹⁵⁶. Est 'effectif' à la fois ce « qui produit l'effet recherché », ce « qui a été réalisé, accompli, fait » et ce « qui correspond à la réalité, au réel »¹¹⁵⁷. Ces trois acceptions de la racine d'effectivité sont à l'origine des différentes interprétations de ce concept juridique, et de sa confusion récurrente avec le terme 'efficacité'¹¹⁵⁸.

¹¹⁵⁴ Ici, l'effectivité est entendue dans un contexte de droit national. Le sens du mot effectivité est différent en droit international. Voir par exemple COUVEINHES MATSUMOTO Florian, *L'effectivité en droit international public*, thèse, Paris 2, 2011, 798p.

Voir aussi le principe d'effectivité en droit européen.

¹¹⁵⁵ CORNU Gérard, *Vocabulaire juridique*, 13^{ème} édition, Paris, Presses Universitaires de France, 2020, 1092 p., entrée 'effectivité'.

¹¹⁵⁶ Sur les racines du mot effectif, voir BÉTAILLE Julien, *Les conditions juridiques de l'effectivité de la norme*, Limoges, 2012, 767 p., pp.1-7

¹¹⁵⁷ CORNU Gérard, *ibid.*, entrée 'effectif'.

¹¹⁵⁸ Voir ci-après la définition d'efficacité'.

Ainsi, les définitions rapportées pour la notion d'effectivité d'une règle de droit dans les dictionnaires juridiques sont variables. Le *Vocabulaire juridique*¹¹⁵⁹ la définit comme le « caractère d'une règle de droit qui produit l'effet voulu, qui est appliquée réellement », entremêlant l'idée de production de l'effet recherché et de correspondance à la réalité. Cette définition en fait un synonyme d'application, avec un sens plus étroit, une loi pouvant être effective sans être appliquée¹¹⁶⁰. Le *Lexique des termes juridiques* définit l'effectivité comme le « caractère réel et concret d'un droit, au-delà de sa reconnaissance abstraite dans des textes de loi »¹¹⁶¹. Cette définition est plus restrictive que celle donnée par le *Vocabulaire juridique* en ce qu'elle se centre sur l'effectivité d'un droit plutôt que d'une règle de droit. Elle interroge néanmoins la réalité d'un droit dans le 'monde réel', alors qu'il est confronté à des contraintes¹¹⁶² dans son exercice. Par ailleurs, l'effectivité peut aussi être entendue comme « le degré de réalisation du contenu des normes par leurs destinataires »¹¹⁶³, se rapprochant du concept anglophone de *compliance*.

Julien Bétaille, qui a consacré sa thèse à l'étude de critères d'effectivité du droit de l'environnement¹¹⁶⁴, propose une troisième voix en redécoupant le concept d'effectivité. L'effectivité-état indiquerait un « état résultat du passé » alors que l'effectivité-action, « une action en cours ». Le premier renvoie à « ce qui existe dans le réel » alors que le deuxième à « ce qui produit un effet sur le réel ». Il en déduit une définition de l'effectivité, appréhendée comme le « degré d'influence qu'exerce la norme juridique sur les faits au regard de sa propre finalité »¹¹⁶⁵. Si une norme juridique vise à interdire la production de sacs en plastique, l'effectivité est appréhendée comme le degré d'influence de cette norme sur le fait que les sacs plastiques ne sont plus produits. Des facteurs autres que juridiques¹¹⁶⁶ peuvent aller dans le sens ou à l'encontre de la réalisation de cette norme juridique.

¹¹⁵⁹ CORNU Gérard, *Vocabulaire juridique*, 13^{ème} édition, Paris, Presses Universitaires de France, 2020, 1092 p.

¹¹⁶⁰ L'exemple donné dans le *Vocabulaire juridique* est celui d'une loi pénale jamais appliquée parce que personne ne commet l'infraction, mais pas moins effective si sa menace a un effet de dissuasion.

¹¹⁶¹ L'exemple donné dans le *Lexique des termes juridiques* est celui d'un droit d'accès à la justice qui « n'est effectif que si le justiciable démuné bénéficie d'une aide juridictionnelle ».

¹¹⁶² Ces contraintes peuvent être d'ordre légal, économique, technique, financier, culturel, etc.

¹¹⁶³ LEMOINE-SCHONNE Marion, « Le droit transnational de l'environnement et du climat : analyse des enjeux d'effectivité entre les sphères publiques et privées », *Énergie - Environnement - Infrastructures*, LexisNexis SA, 2018, dossier 35.

¹¹⁶⁴ BÉTAILLE Julien, *Les conditions juridiques de l'effectivité de la norme*, Limoges, 2012, 767 p.

¹¹⁶⁵ BÉTAILLE Julien, « Répression et effectivité de la norme environnementale », *Revue juridique de l'environnement*, Volume 39, 2014, n° HS01, p. 47-59, p. 47.

¹¹⁶⁶ Économiques, sociaux, environnementaux, politiques, culturels, etc.

Dans le même ordre d'idée, pour Michel Prieur, l'effectivité naît de la rencontre entre le droit et le fait, entre le droit écrit et le droit vivant¹¹⁶⁷ ou en action. L'effectivité serait maximale lorsque cette rencontre débouche sur l'unité entre le droit et le fait. Pour reprendre l'exemple précédent, non seulement la norme juridique interdit la production des sacs en plastiques, mais les sacs plastique ne sont plus, de fait, produits. Dès lors, le droit qui serait cantonné à être écrit sans être applicable (*i.e.*, potentiellement appliqué), sanctionné et respecté, ne pourrait pas être effectif¹¹⁶⁸.

Dans les travaux de Bétaille comme de Prieur, on retrouve une notion de 'degré d'effectivité' à laquelle concourent un ensemble de facteurs que Bétaille identifie dans sa thèse. Il y décrit par exemple l'existence de sanctions dans les textes et dans les faits comme un facteur concourant à l'effectivité de la règle¹¹⁶⁹. Si l'objet de la norme est de protéger l'environnement, cette sanction, de par sa sévérité et ses chances d'intervenir, doit avoir un caractère préventif et dissuasif. En matière de sanction, il propose quelques prérequis pour que l'existence de sanctions participe à l'effectivité de la règle : l'intelligibilité des normes primaires et secondaires, la qualité du dispositif de détection – qui impose des moyens juridiques, humains et techniques –, que la sanction prononcée en cas d'infraction, et la proportionnalité des sanctions face à l'infraction¹¹⁷⁰.

L'efficacité, ou l'atteinte d'un objectif

La définition de la notion d'efficacité renvoie à quelque chose « qui produit l'effet attendu » ou « qui remplit son but »¹¹⁷¹. Dès lors, une norme juridique est efficace lorsque son adoption a

¹¹⁶⁷ PRIEUR Michel et MEKOUAR Mohamed Ali, « Measuring the Effectivity of Environmental Law Through Legal Indicators in the Context of Francophone Africa », in *Blazing the trail: Professor Charles Okidi's enduring legacy in the development of environmental law*, School of Law, University of Nairobi, 2019, p. 2.

¹¹⁶⁸ *Ibid.*

¹¹⁶⁹ La cohérence de l'ordre juridique – entre la réception des normes externes et l'articulation des normes internes – et la sanction par la puissance publique complète ce qu'il dénomme « les conditions classiques de l'effectivité ». Les « conditions ampliatives de l'effectivité » ont trait à la conception de la norme et à sa réception.

¹¹⁷⁰ BÉTAILLE Julien, « Répression et effectivité de la norme environnementale », *Revue juridique de l'environnement*, Volume 39, 2014, n° HS01, p. 47-59, pp. 52-58.

¹¹⁷¹ Larousse, <https://www.larousse.fr/dictionnaires/francais/efficace/27925>, 17/06/2020

permis d'atteindre son objectif¹¹⁷². Si Martin et Kennedy¹¹⁷³ considèrent que “*understanding effectiveness in practice requires consideration of the quality, integrity, capacities and performance of political, legal, administrative and judicial bodies; and often of non state agents*”, on pourrait ajouter qu'il est primordial de prendre également en considération, en droit de l'environnement, les conditions écologiques dans lesquelles la règle de droit prend corps. Le caractère causal¹¹⁷⁴ est un élément important de la mesure de l'efficacité d'une règle. Il s'agit d'isoler l'impact de l'effectivité de la règle dans l'atteinte de l'objectif, de tous les éléments extra-juridiques¹¹⁷⁵ qui peuvent avoir un effet, positif ou négatif, sur l'objet de la règle et donc un impact sur l'atteinte ou non de son objectif. Il s'agit avant tout d'une évaluation 'toutes choses égales par ailleurs'. Son étude nécessite dès lors une approche interdisciplinaire entre des juristes d'une part, et des écologistes, économistes, sociologues, *etc.* d'autre part en fonction des normes étudiées.

La notion, proche, d'“*efficience*” se rattache à la notion économique de rendement¹¹⁷⁶. Serait efficiente une règle dont le compromis entre efficacité et coût serait le meilleur. La mesure de l'efficience implique donc d'évaluer les coûts et les bénéfices d'une règle en termes monétaires, pour en déterminer les coûts et les bénéfices en terme marginal, d'où on déduit un optimum.

Un pas de côté : l'étude du potentiel de protection

Cette thèse s'inscrit dans le cadre du projet OceanLAM, visant à mesurer la protection des océans par le droit de l'environnement marin. Ce projet est né du constat que les indicateurs sur l'état de l'environnement ne permettent pas d'isoler l'effet produit par les règles juridiques qui visent à sa protection des aléas non-juridiques. Il est donc, dans l'état actuel des connaissances, impossible de connaître l'état de protection ou d'identifier les lacunes de protection de l'environnement marin par le droit.

¹¹⁷² LEMOINE-SCHONNE Marion, « Le droit transnational de l'environnement et du climat : analyse des enjeux d'effectivité entre les sphères publiques et privées », *Énergie - Environnement - Infrastructures*, LexisNexis SA, 2018, dossier 35.

¹¹⁷³ MARTIN Paul et KENNEDY Amanda, *Implementing Environmental Law*, Edward Elgar Publishing Limited, 2015, 372p., p.7.

¹¹⁷⁴ « Qui consiste dans un rapport de cause à effet », CNRTL, <https://www.cnrtl.fr/definition/causal>

¹¹⁷⁵ « diagnosis of effectiveness requires consideration of a complex mix of legal and non-legal matters, human and organisational behaviours, the multi-faceted contexts within which instruments operate and pragmatic considerations such as economic resources and human capacity », MARTIN Paul et KENNEDY Amanda, *Implementing Environmental Law*, Edward Elgar Publishing Limited, 2015, 372p., p. 9, p.5

¹¹⁷⁶ CNRTL, 02/10/2020, <https://www.cnrtl.fr/definition/efficience>

L'étude de l'effectivité comme de l'efficacité d'une règle nécessitent d'évaluer son application. Bien que ce fut initialement l'objet de ce travail, la restriction des déplacements induites par l'épidémie de Covid-19 a complexifié cette tâche dans une perspective de droit comparé.

Dès lors, ce projet de recherche effectue un pas de côté au regard de l'étude de l'effectivité et de l'efficacité. L'attention est ici portée à l'étude des processus et des prérequis juridiques qui concourent ou s'opposent à ce que la norme ait un effet sur son objet ; autrement dit l'identification des prérequis pour que la norme, si elle était appliquée, protège l'environnement. Deux conditions sont ici identifiées, permettant l'analyse du potentiel de protection de la règle : qu'elle soit englobante dans son champ d'application (*cf. comprehensive*) et contraignante dans son application (*cf. forceful*). Ainsi, l'analyse du potentiel de protection met l'accent sur l'importance de la conception de la norme, en plus de son application. De plus, ces analyses permettent de poser les bases d'une étude de l'effectivité et de l'efficacité de la norme, en identifiant ses failles de conception, telles que l'absence de sanction ou la définition imprécise de son champ d'application. Par ailleurs, il faut garder à l'esprit qu'une norme peut être pleinement effective mais inefficace, si les solutions proposées pour résoudre un problème sont inadaptées ou non pertinentes. Ainsi, l'instauration d'une aire marine protégée peut être pleinement effective mais inefficace, si elle ne prend pas en compte la migration des espèces à protéger.

Le travail de recherche développé dans cette thèse consiste donc à concevoir une méthode permettant de caractériser qualitativement et quantitativement, notamment à l'aide d'indicateurs, la contribution potentielle d'une règle à la protection de l'environnement, en ayant identifié les éléments du système juridique qui y concourent dans la théorie¹¹⁷⁷, pour sonder leur prépondérance dans la pratique, sur certains cas d'étude.

La définition et la traduction en français des concepts anglophones principalement utilisés dans cette thèse est proposée dans le glossaire.

¹¹⁷⁷ Voir Partie I, Titre 3.

Annex IV Additional material to the state of the art of law measurement initiatives

The two following tables provide a non-comprehensive insight into tools and networks for law implementation, enforcement and compliance (table 1) and into measurement initiatives pertaining to the environment or development (table 2).

This research has been conducted as a preliminary work for the elaboration of the OceanLAM project, in 2018, and updated in the course of this PhD thesis.

Table 1: Tools and networks for law implementation, enforcement and compliance.

Name of the initiative	Objectives	Type of initiative	Year started	Area	Type of institution	Institution
International Network for Environmental Enforcement and Compliance (INECE)	Network developing practical and innovative activities that strengthen environmental compliance and enforcement at all levels of governance – local, national, regional, and international.	Network	1989	150 countries	Non-profit organisation	INECE
European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL)	Share good practices and favour cooperation to facilitate law implementation and enforcement.	Network	1992	European Union	Non-profit organisation	IMPEL

Environmental Performance Review	Qualitative assessment of the progress a country has made in reconciling its environmental and economic targets and in meeting its international environmental commitments.	Information on implementation	1992	44 countries (2019)	International organisation	OECD
<i>Rapport d'information sur la mise en application de la loi</i>	Provide qualitative information of the implementation of the law, and recommendations for further implementation.	Information on implementation	2004	France	National Parliament	National Assembly and Senate
<i>Echéancier de mise en application de la loi</i>	Provide information on and access to application texts that are required for the implementation of the law.	Information on implementation	2011	France	National Parliament	National Assembly and Senate
Environmental Rights Database	Identify, promote and exchange views on best practices relating to the use of human rights obligations and commitments to inform, support and strengthen environmental policy making, especially in the area of environmental protection.	Toolbox	2015	World	International organisation	UN Human Rights Council
Environmental Implementation Review (EIR)	Report to improve implementation of EU environmental law and policy. It aims to address the causes of implementation gaps and try to find solutions before problems become urgent.	Information on implementation	2016	European Union	Supranational organisation	European Commission

Table 2: Indicator-based initiatives in the field of environment or development

Name of the initiative	Objectives	Type of initiative	Year started	Area	Type of institution	Institution
City Development Index (CDI)	Rank cities of the world according to their level of development: infrastructure, waste, health, education, product.	Development	1996	125 countries	International organisation	UN Centre for Human Settlements
Environmental Adjusted Domestic Product (EDP)	Index of economic growth with the environmental consequences of that growth factored into a country's conventional GDP.	Development Environment	2005	World	International organisation	OECD
Environmental Vulnerability Index (EVI)	Estimate the vulnerability of a country to future shocks.	Environment	2001	235 countries	International organisation	South Pacific Applied Geoscience Commission (SOPAC), UNEP
Genuine Savings Index (GS)	Defines the level of re-investment from resource rents that are reinvested to assure that the (societal) capital stock will never decline.	Development	1997	104 countries	International organisation	World Bank
Human Development Index (HDI)	Summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living.	Development	1990	177 countries	International organisation	UN Development Programme

Human Well-Being Index (WI)	Arithmetic mean of a Human Well-being Index (HWI) and an Ecosystem Well-Being Index (EWI).	Development and Environment	2001	180 countries	Non-profit organisation	IUCN
Index of Sustainable Economic Welfare/Genuine Progress Index (ISEW/GPI),	Measure the sustainability of current national income by distinguishing between economic transactions that are welfare-enhancing from those that are well-being and sustainability reducing.	Development and Environment	1989	6 countries	Academia	Cobb, J.B., & Daly, H. E.
Living Planet Index (LPI)	Measure of the state of the world's biological diversity based on population trends of vertebrate species from terrestrial, freshwater and marine habitats.	Environment	1998	World	Non-profit organisation	WWF
OHI-Ocean Health Index	Assess the health and benefits of the global ocean.	Environment	2014	World	Academia	65 scientists
Red List Index	Show trends in overall extinction risk for species and provide an indicator that is used by governments to track their progress in achieving targets that reduce biodiversity loss.	Environment	2005	World	Non-profit organisation	IUCN
UN Sustainable Development Goals Indicators	Blueprint to achieve a better and more sustainable future for all.	Development and Environment	2015	World	International organisation	UN
World Risks Index	Assess the exposure to natural hazards faced by countries (risk and vulnerability at global national scales).	Development and Environment	2013	171 countries	Academia	Uni. Stuttgart

CAIT-Climate analysis indicators tool (Climate Watch)	Document and assess historical and projected GHG emission data in regard to SDGs and countries' NDCs.	Development and Environment	2010	World	Think tank	World Resources Institute
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Annex V Dictionaries of data

Dictionary of data for the COUNTRY table

Code of attribute	Description	Type	Values (if list)	Source
count_id_text	Number of related legal texts	Numerical		Calculated
Created by	Name of user who has created the record	Alphanumerical		Automatic
Created on	Date of creation of the record	Date		Automatic
ID_country	ID of country	Alphanumerical		Alpha-2 ISO 3166
id_state	ID of related state	Alphanumerical		Automatically generated
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated
language_country	Official languages of the country (two principal)	List	English; French; Portuguese; Spanish	NA
Modified by	Name of user who has last modified the record	Alphanumerical		Automatic
Modified on	Date of last modification of the record	Date		Automatic
name_country	Name of the country	Alphanumerical		NA
organisation of power	Type of political organisation	List	unitary state; federal state	NA
supraorg_yeno	Integration in a supranational organisation	List	yes; no	NA
system_country	Belonging to legal traditions	List	common law; civil law; customary law	NA

Dictionary of data for the STATE table

Code of attribute	Description	Type	Values (if list)	Source
code_state	Two letter code of the State	Alphanumerical		Country usages
count_id_instrument	Number of related administrations	Numerical		Calculated
count_id_text	Number of related legal texts	Numerical		Calculated
CreatedBy	Name of user who has created the record	Alphanumerical		Automatic
CreationTimestamp	Date of creation of the record	Date		Automatic
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
ID_state	ID of state	Alphanumerical		Automatically generated
id_text	ID of related text	Alphanumerical		Automatically generated
ModificationTimestamp	Date of last modification of the record	Date		Automatic
ModifiedBy	Name of user who has last modified the record	Alphanumerical		Automatic
name_state	Name of the state	Alphanumerical		
population	Population of the state	Numerical		Official country sources

Dictionary of data for the SUPRAORG table

Code of attribute	Description	Type	Values (if list)	Source
code_supraorg	Code of the supranational organisation	Alphanumerical		Common usage
count_id_administration	Number of related administrations	Numerical		Calculated
count_id_country	Number of related countries	Numerical		Calculated
count_id_text	Number of related texts	Numerical		Calculated
CreatedBy	Name of user who has created the record	Alphanumerical		Automatic
CreationTimestamp	Date of creation of the record	Date		Automatic
ID_supraorg	ID of the supranational organisation	Alphanumerical		Automatically generated
ModificationTimestamp	Date of last modification of the record	Date		Automatic
ModifiedBy	Name of user who has last modified the record	Alphanumerical		Automatic

Dictionary of data for the TEXT table

Code of attribute	Description	Type	Values (if list)	Source
attachment_description	Short description of the document attached in the container field	Alphanumerical		Interpretation
attachment_filename	Code used to refer to the text (“ <i>id_country</i> ”_year of adoption_” <i>type_text</i> ”_number of the text.pdf)	Alphanumerical		Creation
binding_yeno	Binding character of the text	List	yes; no	Interpretation
citation_text	Combination of <i>title_text</i> and <i>publication_text</i>	Alphanumerical		Calculation
code_text	Code used to refer to the text (“ <i>id_country</i> ”_year of adoption_” <i>type_text</i> ”_number of the text)	Alphanumerical		Creation
count_id_administration	Count of the number of administrations related to the text	Numerical		Calculation
count_id_article	Count of the number of articles related to the text	Numerical		Calculation
count_id_control	Count of the number of controls related to the text	Numerical		Calculation
count_id_instrument	Count of the number of instruments related to the text	Numerical		Calculation
count_id_object	Count of the number of objects related to the text	Numerical		Calculation
count_id_sanction	Count of the number of sanctions related to the text	Numerical		Calculation
Create by	Name of user who has created the record	Alphanumerical		Automatic
Created on	Date of creation of the record	Date		Automatic
datevote_text	Date of adoption of the text	Date		Legal text
delay_from	Date of the start of enforcement delay	Date		Legal text
delay_months	Number of months provided for the delay, starting from <i>delay_from</i>	Numerical		Legal text
delay_yeno	Provision for an enforcement delay	List	yes; no	Legal text
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
id_state	ID of related state	Alphanumerical		Automatically generated
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated

ID_text	ID of text	Alphanumerical		Automatically generated
id_text_referenced	ID of text related through <i>type_relationship</i>	Alphanumerical		Automatically generated
legal_source	Level at which the text has been adopted	List	supranational; national; federated; municipal	Legal text
Modified by	Name of user who has last modified the record	Alphanumerical		Automatic
Modified on	Date of last modification of the record	Date		Automatic
need_implementation	Whether the text provides for the adoption of implementing texts	List	yes; no	Legal text
object_type_text	Type of object regulated by the text	List	plastic bags; pesticide, wastewater, other	Legal text
publication_text	Reference of the publication of the text in an official journal	Alphanumerical		Legal text
received_implementation	Whether implementing texts have been adopted	List	yes; no	Legal text
status_text	Status of the text	List	in force; no longer in force ; not yet in force	Interpretation
title_text	Title of the text	Alphanumerical		Legal text
type_relationship	Type of relationship with another text or article	List	implements; is implemented by; amends; is amended by; repeals; is repealed by	Interpretation
type_text	Type of text	List	Law; act; statutory instrument (STA); decree (DEC); directive (DIR); regulation (REG); bill (BIL); arrêté (ARE); ordonnance (ORD)	Legal text
URL_text	URL link to access the text	Alphanumerical		Internet

Dictionary of data for the ARTICLE table

Code of attribute	Description	Type	Values (if list)	Source
code_article	Code of the article (" <i>Code_text</i> "-" <i>number_article</i> ")	Alphanumerical		Creation
count_id_control	Number of related controls	Numerical		Calculated
count_id_instrument	Number of related instruments	Numerical		Calculated
count_id_object	Number of related objects	Numerical		Calculated
count_id_sanction	Number of related sanctions	Numerical		Calculated
Create by	Name of user who has created the record	Alphanumerical		Automatic
Created on	Date of creation of the record	Date		Automatic
ID_article	ID of article	Alphanumerical		Automatically generated
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
id_state	ID of related state	Alphanumerical		Automatically generated
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated
id_text	ID of related text	Alphanumerical		Automatically generated
Modified by	Name of user who has last modified the record	Alphanumerical		Automatic
Modified on	Date of last modification of the record	Date		Automatic
need_implementation	Whether the article provides for the adoption of implementing texts	List	yes; no	Legal text
number_article	Number of the article in the legal text	Numerical		Legal text
received_implementation	Whether implementing texts have been adopted	List	yes; no	Legal text

Dictionary of data for the ARTICLE table (continued)

Code of attribute	Description	Type	Values (if list)	Source
role_article	Role the article plays in the regulation	List	admin. Enforcement; Amends; Breach; complements article; composition; creates admin.; defines object; definition; enforcement power; EU implementation; EU objective; implements; introduction; miscellaneous; mission; organises control; Power to impose instrument; Procedure; Promulgates; recipient; Revokes; Right to appeal; sanctions; scope of application; sets delay; sets instrument	Interpretation
status_article	Status of the article	List	in force; no longer in force; not yet in force	Interpretation
text_article	Text of the article in English or translated in English	Alphanumerical		Legal text
text_article_original_version	Text of the article in its original version	Alphanumerical		Legal text

Dictionary of data for the ARTICLE table (continued)

Code of attribute	Description	Type	Values (if list)	Source
type_miscellaneous	If <i>role_article</i> is miscellaneous, precision	List	Awareness; Participation; Role of local authorities; Alternative means; Reduction rates; Traceability; Labelling; Funding; Decentralisation; Application control; Entry into force; Report; Amount of tax or charge; Record; Review; Conditions of use	
type_relationship	Type of relationship with another text or article	List	implements; is implemented by; amends; is amended by; repeals ; is repealed by	Interpretation

Dictionary of data for INSTRUMENT table

Code of attribute	Description	Type	Values (if list)	Source
code_article_creation	Code of the article creating the instrument	Alphanumerical		Interpretation
code_instrument	Code of the instrument (" <i>code_article_creation</i> "-" <i>type_instrument</i> ")	Alphanumerical		Creation
count_id_admin	Number of related administrations	Numerical		Calculated
count_id_control	Number of related controls	Numerical		Calculated
count_id_object	Number of related objects	Numerical		Calculated
count_id_sanction	Number of related sanctions	Numerical		Calculated
count_object_excludes	Number of objects excluded from instrument	Numerical		Calculated
count_object_includes	Number of objects included in instrument	Numerical		Calculated
count_type_sanction	Number of types of sanctions related to instrument	Numerical		Calculated
Created on	Date of creation of the record	Date		Automatic
Créé par	Name of user who has created the record	Alphanumerical		Automatic
delay_from	Date of the start of enforcement delay specific to instrument	Date		Legal text
delay_months	Number of months provided for the delay, starting from <i>delay_from</i>	Numerical		Legal text
delay_yeno	Provision for an enforcement delay specific to the instrument	List	yes; no	Legal text
description_instrument	Short description of the instrument	Alphanumerical		Interpretation
id_admin_control	ID of the administration in charge of contrils	Alphanumerical		Automatically generated
id_article_control	ID of the article providing for controls	Alphanumerical		Automatically generated
id_article_creation	ID of the article creating the instrument	Alphanumerical		Automatically generated
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166

ID_instrument	ID of the instrument	Alphanumerical		Automatically generated
id_object	ID of related subject	Alphanumerical		Automatically generated
id_state	ID of related state	Alphanumerical		Automatically generated
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated
level	Level at which the instruments applies	List	Fabrication; importation; exportation; commercialisation; detention; distribution; utilisation; non-defined; NA	Legal text
Modifié par	Name of user who has last modified the record	Alphanumerical		Automatic
Modified on	Date of last modification of the record	Date		Automatic
pl_level_unlisted	<i>level</i> in an unlisted format	Alphanumerical		Calculated
status_instrument	Status of the instrument	List	in force; no longer in force; not yet in force	Interpretation
type_instrument	Type of instrument	List	interdiction; taxation; ob. to charge; standard; permit; pref. Service; funding; awareness	Interpretation
type_standard	If <i>type_instrument</i> is standard, type of standard	List	product; process; emission	Interpretation

Dictionary of data for OBJECT table

Code of attribute	Description	Type	Values (if list)	Source
?definition_object	Short description of the object	Alphanumeric		Interpretation
comment	Any comment on the object	Alphanumeric		Interpretation
Created on	Date of creation of the record	Date		Automatic
Créé par	Name of user who has created the record	Alphanumeric		Automatic
detail_object	Subtype of plastic bag object	List	Checkout bag (caisse); Retail outlets bag (point de vente) ; Non-identified ; Hygiene/sanitation ; Thickness ; Destination ; Destination what for ; Destination where ; Re-use ; Material ; Single use; Size; General definition; + / - authorization; NA	Interpretation
id_article_creation	ID of the related article creating this object	Alphanumeric		Automatically generated
id_article_modification	ID of the related article modifying this object	Alphanumeric		Automatically generated
id_country	ID of related country	Alphanumeric		Alpha-2 ISO 3166
ID_object	ID of object	Alphanumeric		Automatically generated
id_state	ID of related state	Alphanumeric		Automatically generated

Dictionary of data for the OBJECT table (continued)

Code of attribute	Description	Type	Values (if list)	Source
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated
id_text	ID of related text	Alphanumerical		Automatically generated
Modifié par	Name of user who has last modified the record	Alphanumerical		Automatic
Modified on	Date of last modification of the record	Date		Automatic
name_object	codification of the object using <i>id_article_creation</i>	Alphanumerical		Created
pl_material	Type of material from which plastix bag is made	Alphanumerical		Legal text
pl_max_depth	Maximum depth of the plastic bag	Numerical		Legal text
pl_max_length	Maximum length of the plastic bag	Numerical		Legal text
pl_max_width	Maximum width of the plastic bag	Numerical		Legal text
pl_size_yeno	Whether the plastic bag is defined by its size	List	yes; no	Legal text
pl_thickness	Maximum thickness of plastic bag	Numerical		Legal text
pl_thickness_yeno	Whether the plastic bag is defined by its thickness	List	yes; no	Legal text
subtype_object	Plastic bag subtype	Alphanumerical		Interpretation
type_object	Type of object	List	plastic bags; pesticide, wastewater, other	Legal text

Dictionary of data for ADMINISTRATION table

Code of attribute	Description	Type	Values (if list)	Source
Created on	Date of creation of the record	Date		Automatic
Créé par	Name of user who has created the record	Alphanumerical		Automatic
ID_administration	ID of the administration	Alphanumerical		Automatically generated
id_article_control	ID of the article providing for controls by this administration	Alphanumerical		Automatically generated
id_article_creation	ID of the article creating the creation of the administration	Alphanumerical		Automatically generated
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
id_instrument	ID of related instrument	Alphanumerical		Automatically generated
id_state	ID of related state	Alphanumerical		Automatically generated
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated
Modifié par	Name of user who has last modified the record	Alphanumerical		Automatic
Modified on	Date of last modification of the record	Date		Automatic
name_administration	Name of the administration	Alphanumerical		Legal text
type_administration	Type of administration	List	Ministry; agency; police, local authority, city councils, DK	Legal text

Dictionary of data for CONTROL table

Code of attribute	Description	Type	Values (if list)	Source
comment	Any comment useful to better understand the provided control	Alphanumerical		Interpretation
CreatedBy	Name of user who has created the record	Alphanumerical		Automatic
CreationTimestamp	Date of creation of the record	Date		Automatic
id_administration	ID of related administration	Alphanumerical		Automatically generated
id_article_creation	ID of the article providing for controls	Alphanumerical		Automatically generated
ID_control	ID of the control	Alphanumerical		Automatically generated
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
id_instrument	ID of related instrument	Alphanumerical		Automatically generated
id_sanction	ID of related sanction	Alphanumerical		Automatically generated
id_state	ID of related state	Alphanumerical		Automatically generated
id_supraorg	ID of related supranational organisation	Alphanumerical		Automatically generated
id_text	ID of related text	Alphanumerical		Automatically generated
item_control	Element which application is controlled	List	text; instrument	Interpretation
ModificationTimestamp	Date of last modification of the record	Date		Automatic
ModifiedBy	Name of user who has last modified the record	Alphanumerical		Automatic
type_agents	Type of agents in charge of the control	Alphanumerical		Legal text

Dictionary of data for SANCTION table

Code of attribute	Description	Type	Values (if list)	Source
comment	Any comment used to specify the sanction	Alphanumerical		Interpretation
created on	Date of creation of the record	Date		Automatic
Créé par	Name of user who has created the record	Alphanumerical		Automatic
fine_comment	Any comment to specify the amount of the fine, if relevant	Alphanumerical		Interpretation
fine_max	Maximum amount of fine	Numerical		Legal instrument
fine_min	Minimum amount of fine	Numerical		Legal instrument
id_administration	ID of related administration	Alphanumerical		Automatically generated
id_article	ID of related article	Alphanumerical		Automatically generated
id_control	ID of related control	Alphanumerical		Automatically generated
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
id_instrument	ID of related instrument	Alphanumerical		Automatically generated
ID_sanction	ID of sanction	Alphanumerical		Automatically generated
id_state	ID of related state	Alphanumerical		Automatically generated
id_text	ID of related text	Alphanumerical		Automatically generated
jail_comment	Any comment to specify the jail sanction, if relevant	Alphanumerical		Interpretation
jail_max	Maximum duration of imprisonment	Numerical		Legal text
jail_min	Minimum duration of imprisonment	Numerical		Legal text

level	Level at which the instruments applies	List	Fabrication; importation; exportation; commercialisation; detention; distribution; utilisation; non-defined; NA	Legal text
Modifié par modified on	Name of user who has last modified the record Date of last modification of the record	Alphanumerical Date		Automatic Automatic
type_person	Type of person at whom the sanction applies	List	natural; legal; legal & natural; non-defined; NA.	Legal text
type_sanction	Type of sanction	List	Jail; fine; seizure; confiscation; display; closure; transaction; see Code ; destruction; discretionary requirement	Legal text
type_sanction_and_or	Used when two sanctions can be used in complement / replacement	List	and; or; and/or; and if	Legal text

Dictionary of data for INCLUDES / EXCLUDES table

This table is used to create the many-to-many relationship between instruments and objects, characterised by the fact that an object is either “included” or “excluded” in an instrument.

Code of attribute	Description	Type	Values (if list)	Source
count_id_instrument	Number of related instruments	Numerical		Calculated
CreatedBy	Name of user who has created the record	Alphanumeric		Automatic
CreationTimestamp	Date of creation of the record	Date		Automatic
ID_inc_exc	ID of the record	Alphanumeric		Automatically generated
id_instrument	ID of related instrument	Alphanumeric		Automatically generated
id_object	ID of related object	Alphanumeric		Automatically generated
inc_exc_subtype_object	Subtype of the object (calculated from OBJECT table)	Alphanumeric		Calculated
inc_exc_type_instrument	Type of the instrument (calculated from INSTRUMENT table)	Alphanumeric		Calculated
ModificationTimestamp	Date of last modification of the record	Date		Automatic
ModifiedBy	Name of user who has last modified the record	Alphanumeric		Automatic
type_relationship	Type of the relationship	List	Include; exclude	Interpretation

Dictionary of data for REFERENCE table

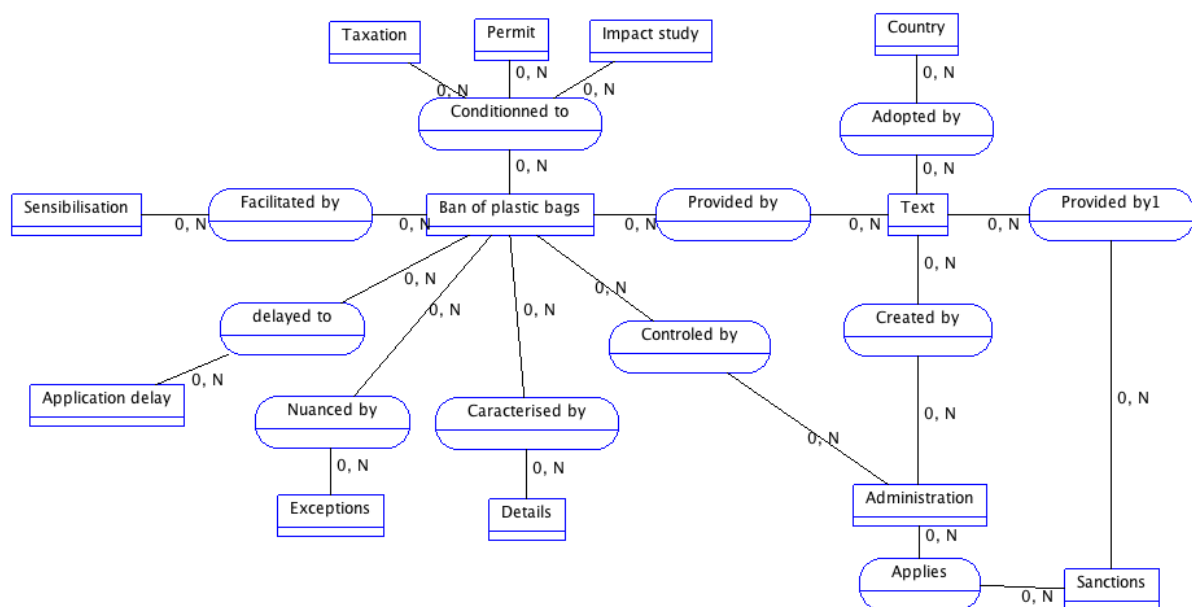
This table is used to provide for many-to-many relationships between the ARTICLE and TEXT tables.

Code of attribute	Description	Type	Values (if list)	Source
Créé par	Name of user who has created the record	Alphanumerical		Automatic
Horodatage de création	Date of creation of the record	Date		Automatic
Horodatage de modification	Date of last modification of the record	Date		Automatic
id_article	ID of the article providing for amendment / repeal / implementation	Alphanumerical		Automatically generated
id_article_referenced	ID of the article to which the reference is made	Alphanumerical		Automatically generated
id_country	ID of related country	Alphanumerical		Alpha-2 ISO 3166
ID_reference	ID of reference	Alphanumerical		Automatically generated
id_text	ID of the text providing for amendment / repeal / implementation	Alphanumerical		Automatically generated
id_text_referenced	ID of the text to which the reference is made	Alphanumerical		Automatically generated
Modifié par	Name of user who has last modified the record	Alphanumerical		Automatic
type_reference	Type of the reference	List	Implements; amends; revokes; is implemented; is amended; is revoked	Legal text

Annex VI Successive database conceptual models

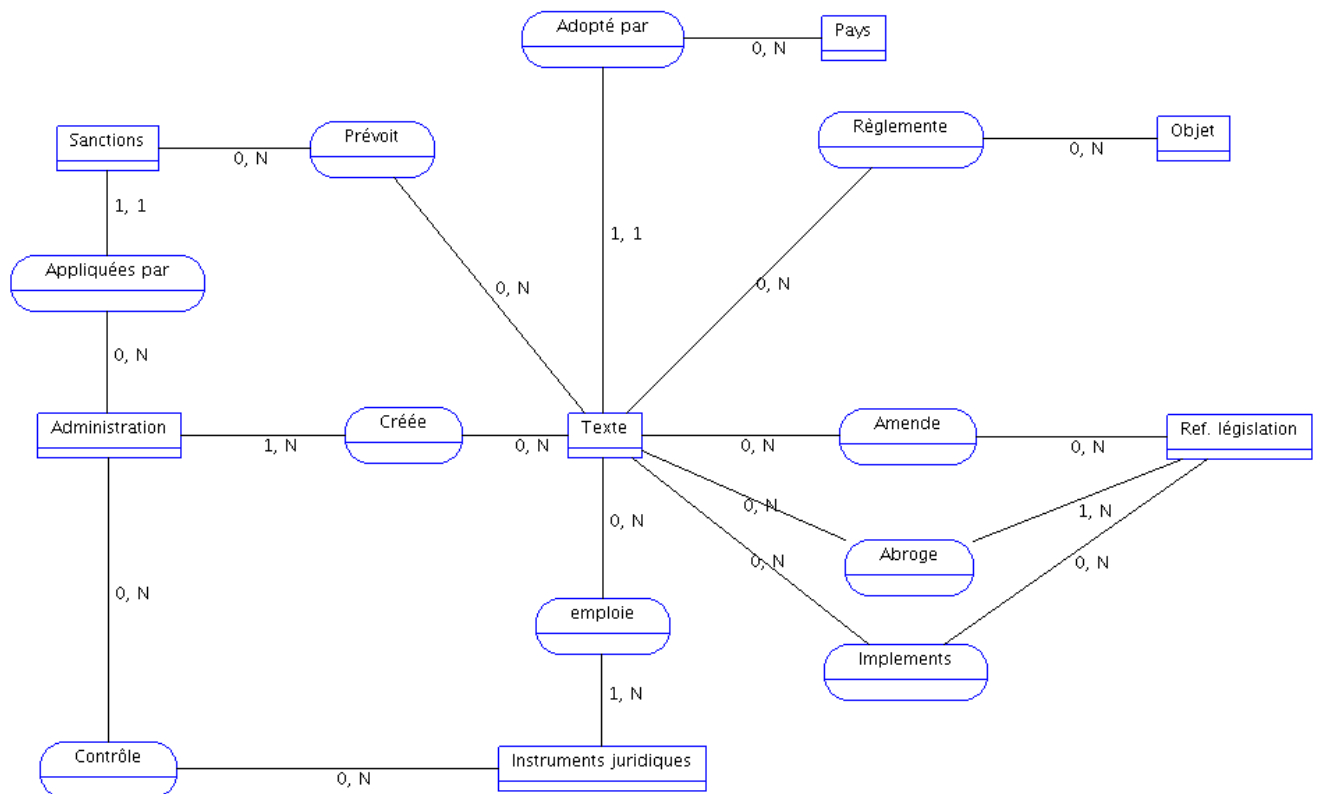
This annex presents the main successive versions of the database conceptual models. These successive versions show that the conceptualisation of a database is an iterative process, and show the evolution of the reflexion. A short explanation of the reasons behind these evolutions is provided.

The first version of the conceptual model presented below is centred on the ban of plastic bags. This model has been abandoned to regroup the characteristics of the object in a single entity, and to group policy instruments in a single entity. These evolutions enable the database to be more flexibly adapted to other thematic case studies.



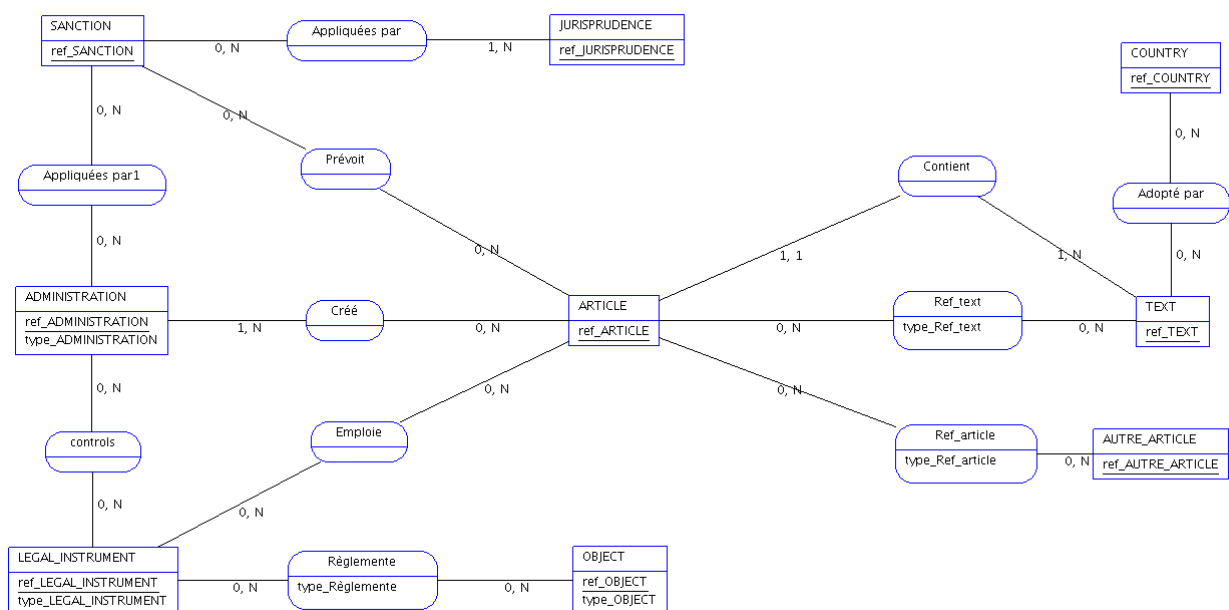
Conceptual model n°1

The second conceptual model below presents these evolutions. All the policy instruments (taxation, ban, sensibilisation, etc.) have been grouped in the *instruments juridiques* entity. In the same way, the exceptions and object details entity have been grouped in the *objet* entity. In addition, the second conceptual model adds a *ref. legislation* entity which enables to relate a text with another, precising which text implements, amends or repeals the other. The conceptual model n°2 is also the first to pay attention to the type of relationships between the different entities. The obligatory or optional character of the relationship is coded respectively by 1 or 0. The singular or plural characteristic of the object is coded by 1 or N. For example, (1, N) is a plural obligatory relationship whereas (0, 1) is a singular optional relationship.



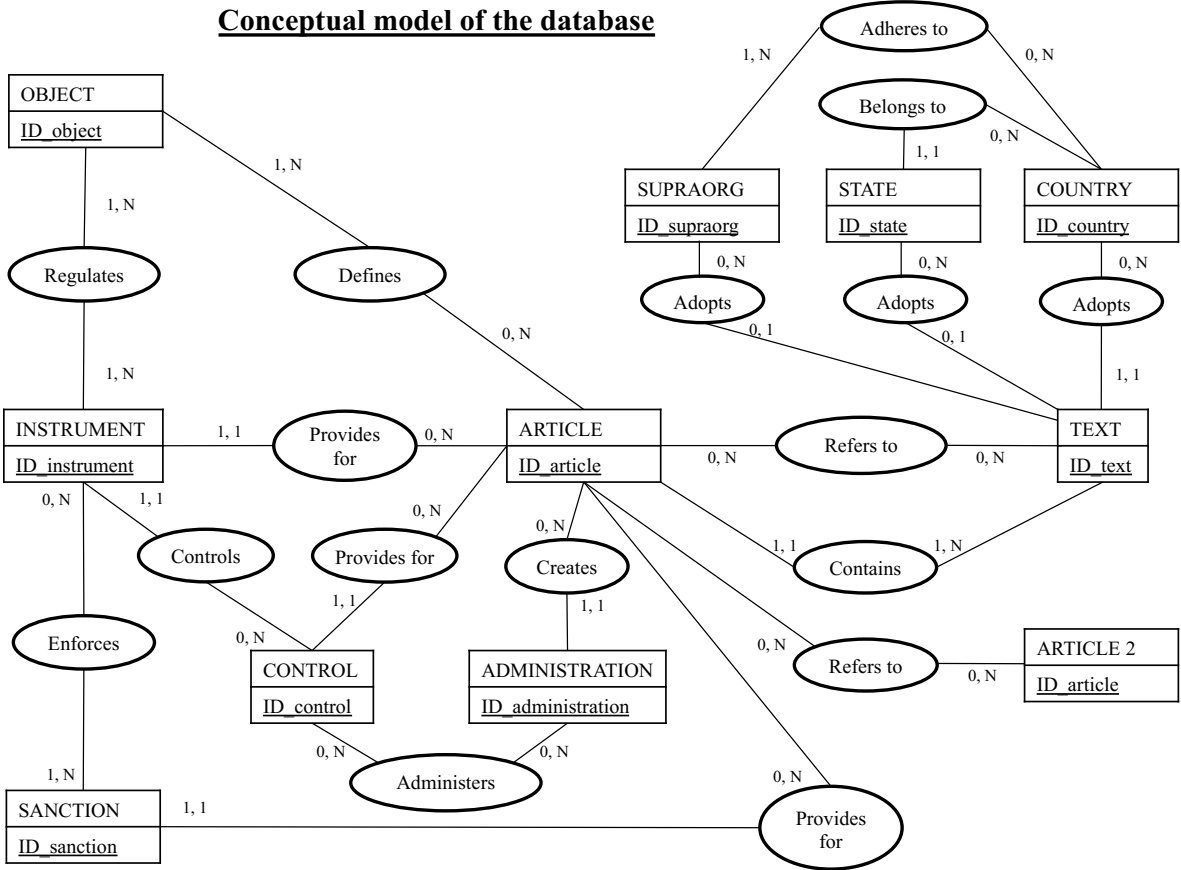
Conceptual model n°2

The third conceptual model introduces the article as the centre of the model. The rationale for this evolution is that the article of the text has to be cited in legal analyses in addition to the reference to the text. Earlier conceptual models would not have made this information easily accessible. In addition, references to relationships between texts and articles are added, as an article can repeal a text, or a text implement a specific article.



Conceptual model n°3

Last, the fourth conceptual model conceptualizes the fact that supranational organisations (supraorg on the graph) can, along with states, and countries, adopt legal texts. It also organises the relationships between countries, states and supranational organisations. Last, a “control” entity is added to reference controls provided by the articles, in relation with the relevant administration.



Conceptual model n°4

Annex VII A back-office immersion in the relational database

The database is constructed on the software Filemaker Pro 17 Advanced.

The following should serve as a starting guide for people wishing to take over the management of the database with an admin role.

Collaborative work on the database

The database is currently, hosted on a computer, in a single file. This means that the database can be sent to other users by email for example, but that modifications made by different users will not be automatically synchronized. It is possible to host the database online allowing multi-user access (administration, edition and read) without requiring the download of the software. It is also possible to host the database on IT servers with simultaneous multi-user access and edition. These setups were not required for the single use that was made of the database for this PhD thesis, but could be required with the establishment of team work. An intermediate solution was used to allow a M2 student to work on the database on his computer, while I continued working on mine: he only modified pesticide-related records, which were then imported into my file. Doing so, it is important to keep the same identification numbers for each record, to preserve relationships with existing records in the database.

It is essential to create a new account for every new user of the database who will add or modify data, to enable a follow up of the metadata. It is possible to do so and to manage privilege sets by in File > Manage > Security > Accounts.

Relationships between tables

The guiding principle in the construction of a relational database is that data must be stored only once. To do so, the different fields (which will contain the data) are organized in tables regrouping fields of the same type. For example, all the fields containing data describing characteristics of a *text* will be grouped in the text table. All the fields containing data describing characteristics of an *article* will be grouped in the article table. Other tables of the relational database are: *supranational organization*, *country*, *state*, *instrument*, *object*, *administration*, *control*, *sanction*. The two tables *reference* and *include-exclude* are constructions to set up complex relationships.

To enable access of the data contained in the *text* table from the *article* table, we create a relationship between the *text* and the *article* tables. These relationships operate through identification fields in each table (e.g., *id_text*). Each record (for example each text of the *text*

table) has a unique ID. This ID can be automatically generated by the database to ensure its unicity. The relationship between the *article* and *text* tables operates when the `id_text` contained in the *article* and *text* tables are the same.

Relationships between all the other tables of the database work the same way, with the relevant IDs, depending on the tables between which the relationship is set and the kind of relationship.

The anchor-buoy construction

Every action concerning the setting up of the database (creation of tables, fields, relationships) occurs in the *Manage Database* section (File, Manage, Database). It is important to understand that this is the database centre of control. Changes made there influence the construction of the database and can have dramatic consequences. Once saved, there is no way to go back (unless you have copied the file of the database elsewhere, just before modifying it).

This is a screenshot of the relationships stemming from the *text* table, with other tables of the database, with the *text* table serving as an anchor, and the other tables as buoys. All buoys are ‘copies’ of their proper anchor, called occurrences. For example, the link between the *text* and the *article* table is here orchestrated between the anchor `T01_TEX_TEXT` and the buoy `T01a_tex_ARTICLE` (see figure 1). The anchor of the *article* table is `T03_ART_ARTICLE` (see figure 2).

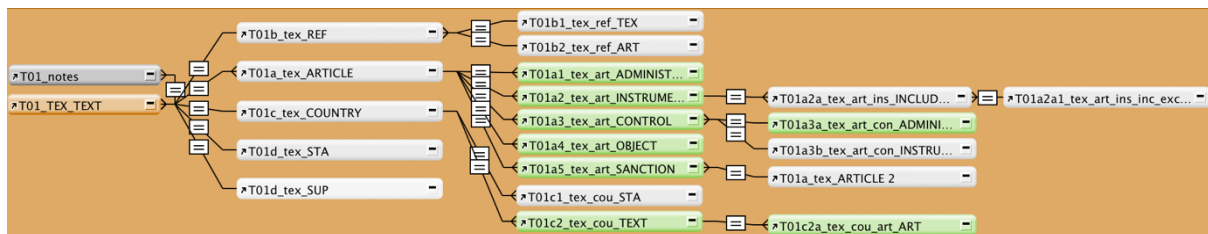


Figure 1: Anchor-buoy diagram for `T01_TEX_TEXT`. Screenshot of ‘Manage database’

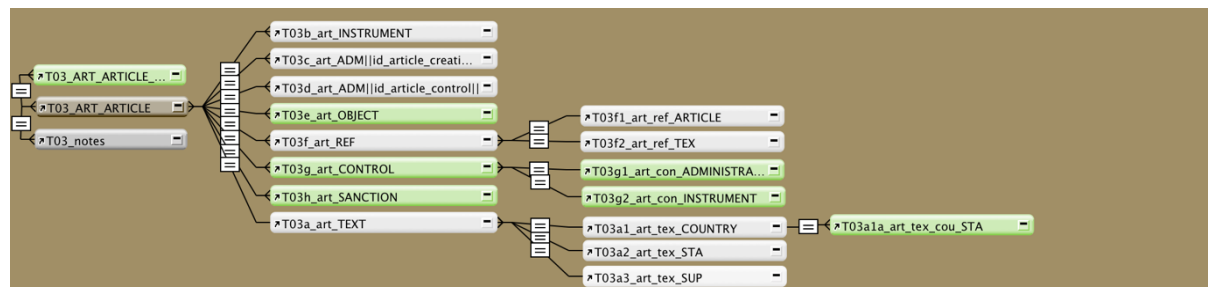


Figure 2: Anchor-buoy diagram for `T03_ART_ARTICLE`. Screenshot of ‘Manage database’

It is important to understand that the anchor-buoy method is a construction to facilitate the organization of potentially complex relationships between tables, but the tables as such are not copied. The data is stored in a single table (the anchor), but the data is made available in other table occurrences. It is therefore possible to access data contained in the *article* table from T01_TEX_TEXT via T01a_tex_ARTICLE but not from T03_ART_ARTICLE as there are no relationships between T01_TEX_TEXT and T03_ART_ARTICLE.

Each name of the buoys reflects the path taken to link the data back to the anchor. For example, T01a_tex_ARTICLE 2 (figure 1) is misnamed. It should be T01a5a_tex_art_san_ARTICLE. In capital letters is the name of the table of which it is an occurrence, lowercase letters refer to the path. This way, it is possible, when working on a layout (see next section), to identify which table occurrence should be used for our specific purpose.

The use of an ID in a relationship is obligatory (as seen earlier), but other criteria can be added for specific uses. These are called multicriteria relationships, that enable to filter upstream the results that will appear via this relationship.

In Figure 1 and 2, table occurrences coloured in green are those used in different layouts to construct portals, which are objects on the layout enabling to view a set of data comprised in another table. Specific criteria are used to define the relationships between these table occurrences, depending on the use of the portal.

Distinction between tables and layout

A layout is the interface used to visualize the data entered in the database. It is what the user of the database sees. All that has been detailed above is hidden. For storage reasons, a layout must be attached to the anchor table occurrence (never to buoys). An anchor table occurrence can be represented via several layouts. Layouts are about what and how data should be displayed. Different layouts will be used for different usages.

Layouts' centre of control is accessible via File, Manage, Layouts. For each table, at least three layouts have been created. For example, for the *text* table, there are the *new_TEXT*, the *form_TEXT* and the *list_TEXT* layouts. The first is used to create a new text record, the second displays a large set of data for each record, and the last enables to scroll from one text to the other.

The top-left screenshot shows the 'New legal text' form. It includes fields for 'Legal source' (federated), 'Country ID' (UK), 'State ID' (SC), 'Code of text' (UK_SC_2014_RE_161), 'Title of text' (The Single Use Carrier Bags Charge (Scotland) Regulations 2014 no 161), 'Date of vote' (03/06/2014), and 'Type of text' (Statutory). There are also sections for 'Attachments' and 'Object' (Plastic bags, Pesticides, Wastewater, Other).

The top-right screenshot shows the 'Legal text details' page for the same text. It displays the title, date voted (03/06/2014), enforcement delay (20/10/2014), and a list of 13 related articles with columns for 'N°', 'Status', 'Role', and 'Imp. needed?'. The related articles include definitions, object definitions, recipients, and enforcement instruments.

The bottom screenshot shows the 'List of legal texts' table. It contains the following data:

Sup. org. :nl	Country :nl	State :nl	Code text :nl	Date vote :nl	Object :nl	Title
	UK	SC	UK_SC_2014_RE_161	03/06/2014	Plastic bags	The Single Use Carrier Bags Charge (Scotland) Regulations 2014 no 161
	UK	SC	UK_SC_2015_RE_159	31/03/2015	Plastic bags	The Single Use Carrier Bags Charge (Fixed Penalty Notices and Amendment) (Scotland) Regulations 2015 no 159
	UK	SC	UK_SC_2020_RE_118	01/04/2020	Plastic bags	The Single Use Carrier Bags Charge (Scotland) Amendment Regulations 2020 no. 118
	UK	EN	UK_EN_2015_SI_776	19/03/2015	Plastic bags	The Single Use Carrier Bags Charges (England) Order 2015

Figure 3: Screenshots of new_TEXT, form_TEXT and list_TEXT in the browse mode

Layouts can be edited on the right-hand side of the status toolbar with the 'Edit layout' button'. In the default setting, layouts can be viewed in a form view, list view, and table view.

Different modes in the database

Three main modes enable to pursue different objectives in the database.

The browse mode (used in figure 3), enables to visualize the data, and to modify it.

The layout mode (see figure 4) enables to modify the layout. Modifications made in the layout mode impact how data is visualized in the browse mode.

The screenshot shows the 'Legal text details' form in layout mode. At the top, there's a header with a scale icon and the title 'Legal text details'. Below the header, there are several dropdown menus and input fields for 'Code', 'Supra org', 'Country', 'State', 'Legal source', and 'URL_text'. The main form area contains fields for 'Title', 'Off. journal', 'Date voted', 'Status', and 'Binding'. A table titled 'Articles' is present, with columns for 'N°', 'Status', 'Role', 'Imp. needed?', and 'Imp. received?'. On the right side, there's a sidebar with a table for 'attachments_text[1]' and a 'Note' section.

Figure 4: Screenshot of form_TEXT in the layout mode

Last, the find mode (see figure 5) enables to realise multicriteria research in the database. It is accessed by clicking on the magnifying glass in the status toolbar.

The screenshot shows the 'Legal text details' form in find mode. The layout is similar to the layout mode, but it includes search icons (magnifying glasses) in the input fields for 'Code', 'Country', 'State', 'Legal source', 'URL_text', 'Title', 'Off. journal', 'Date voted', 'Status', and 'Binding'. The 'Articles' table also has search icons in its columns. The sidebar on the right has a search icon and the text 'Note'.

Figure 5: Screenshot of form_TEXT in the find mode

Specific layout tools to facilitate the use of the database

Specific layout tools are available to automatize some tasks, enable data visualisation or to guarantee that users will use specific terms. Figure 6 shows a few examples of these tools.

The screenshot shows a web interface for 'Legal text details'. At the top, there are navigation icons and a title. Below the title, there are several dropdown menus for 'Country' (UK), 'State' (SC), and 'Legal source' (federated). A 'PDF' icon is visible. The main content area is divided into several sections:

- Title:** The Single Use Carrier Bags Charge (Scotland) Regulations 2014 no 161
- Off. journal:** Ref. publication in official journal
- Type:** Statutory instrument
- Date voted:** 03/06/2014
- Ent. delay:** Yes of 0 months from 20/10/2014
- Status:** In force
- Binding?:** Yes
- Enforcement delay:** has passed

On the left, there is a 'Portals' section with a list of related articles. A blue arrow points to this list with the label 'Portals'. In the center, there is a 'Buttons linked to a script' section with a blue arrow pointing to it and the label 'Buttons linked to a script'. On the right, there is a 'Container field' section with a blue arrow pointing to it and the label 'Container field'. Below the main content, there is a table with columns 'N°', 'Status', and 'R. title'. The table contains several rows of data, including 'r.02', 'r.03', 'r.04', 'r.05', 'r.06', 'r.07', 'r.08', and 'r.09'. A blue arrow points to the 'R. title' column with the label 'Lists'. At the bottom right, there is a 'Note' section with a blue arrow pointing to it and the label 'Note'.

Figure 6: Commented screenshot of form_TEXT in the browse mode

As evoked, portals enable to visualize lists of data stored in a related table. Embedded lists are useful to constrain the user to use only terms comprised in this list. It can also force the user to use values from a related field. Buttons linked to a script automatizes a set of tasks. The *new article* button for example enables to open a *new_article* layout and to copy and paste the *id_text* of the text record to paste it in the *id_text* field of the article record, guaranteeing the relationship between the two. Last, container field enable to attach documents (Word, PDF, etc.). All of these different tools are set up in the layout mode.

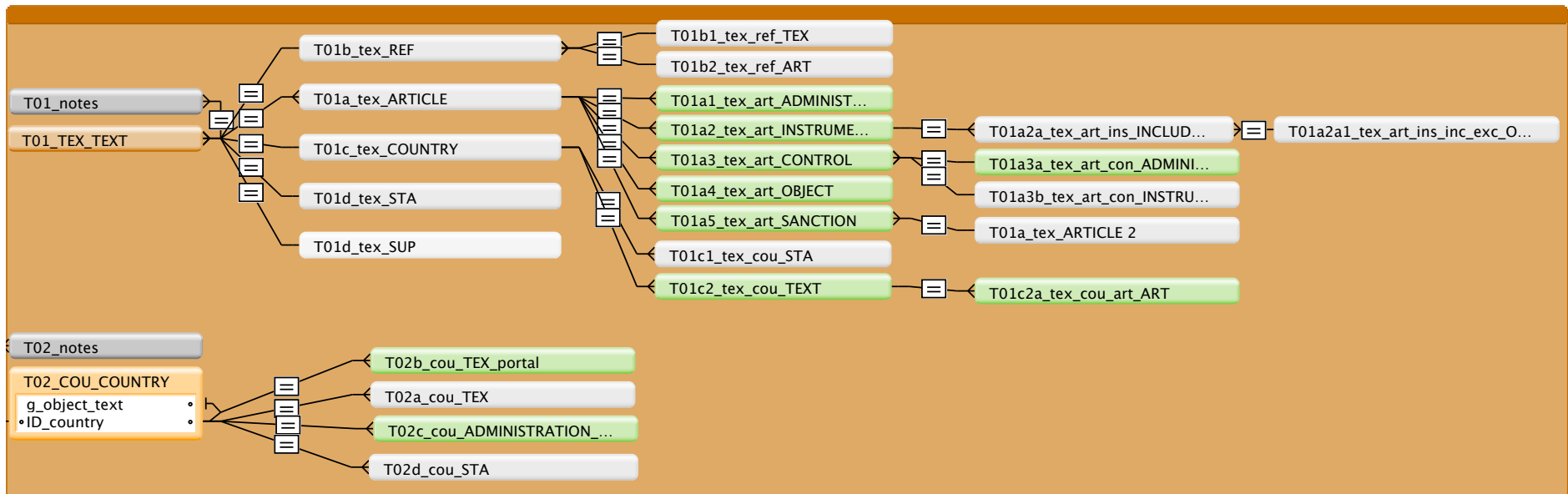
NB: the ID fields are hidden, as their values are of no interest for the user. It doesn't mean that these fields are empty. It is also possible to link values such as the code of the text to the relevant ID to facilitate the user's experience.

NB2: the only ID in the database which is not generated automatically by the computer is *id_country*. The codes used for the countries are two-letter ISO codes.

Annex VIII Structure of the database

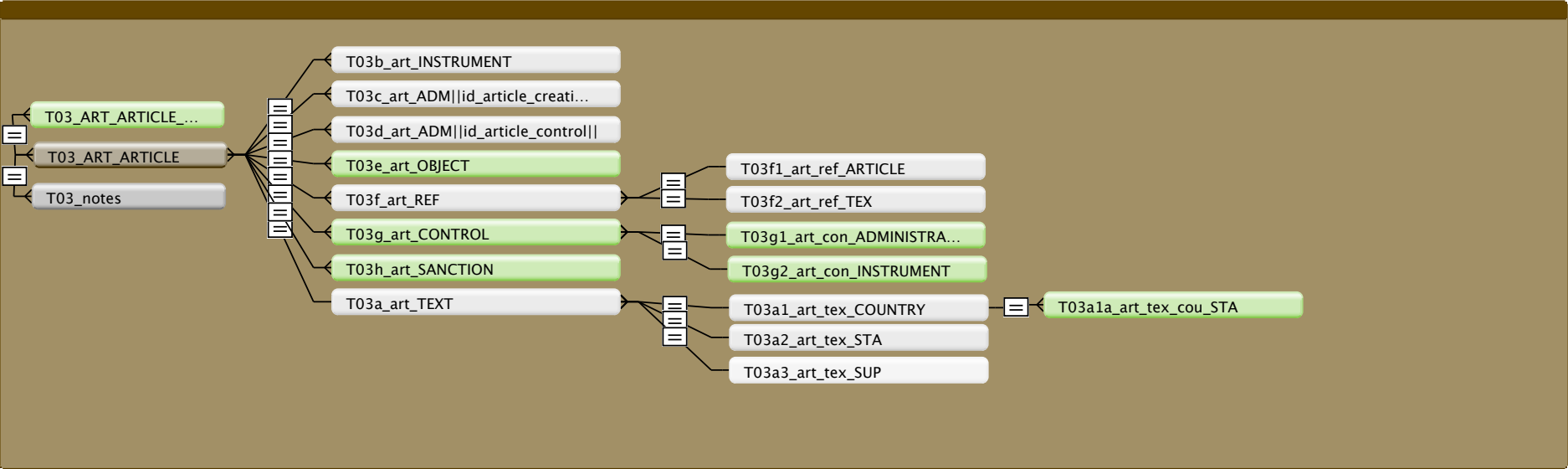
This annex presents the structure of the database. While the conceptual model enabled to design the entities and the relationships of the future database, it isn't sufficient to obtain an operative database.

The software used to develop the database, Filemaker Pro Advance, functions on the basis of anchors and buoys. Anchors are the table (entity) in focus, and the buoys all the related tables required to enable the functioning of the database. Anchors are represented at the left of the diagram, and buoys at the right of the anchor.



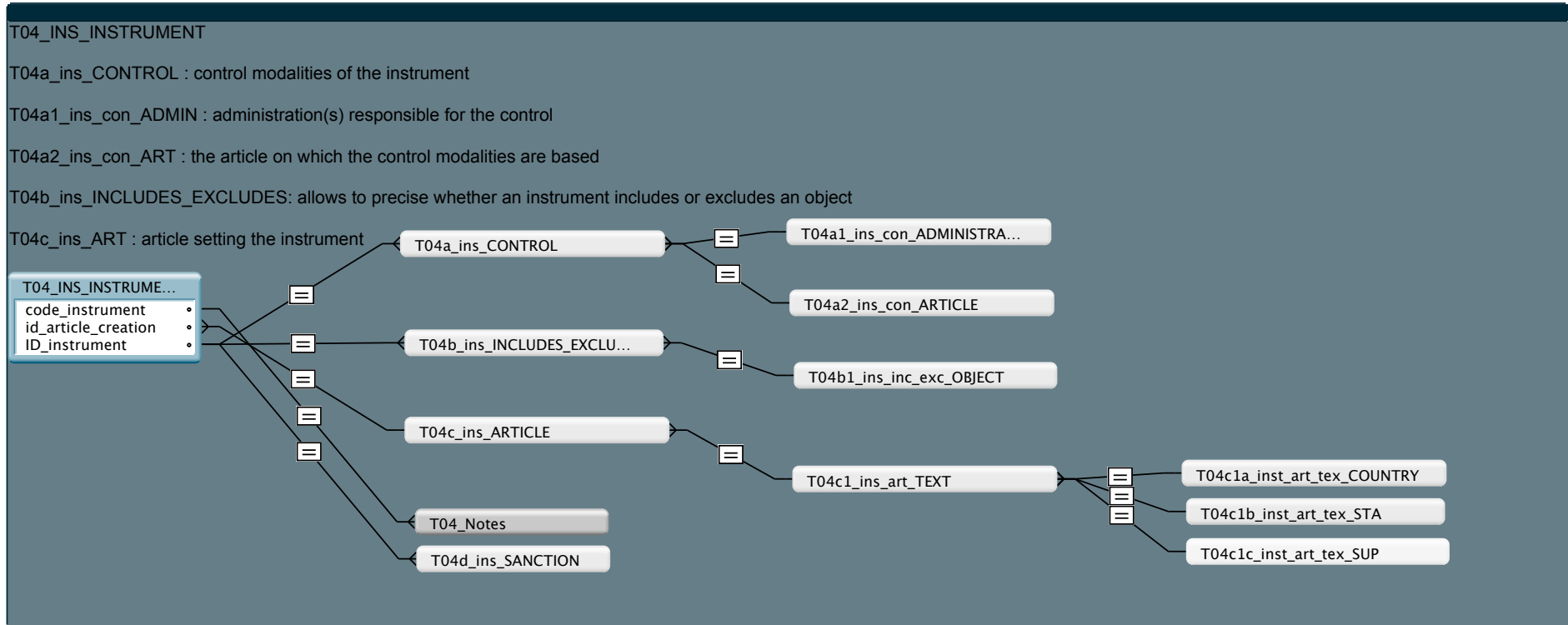
Anchor-buoy diagram n°1: TEXT and COUNTRY tables

The diagram n°1 represents the structure of the TEXT and COUNTRY tables. Related tables are coded in grey or in green when they enable the visualization of data contained in other tables through portals. Buoys are table occurrences of related tables. The name of each buoy enables to track back the path followed to reach the anchor. The name of the table occurrence is in capital letters.

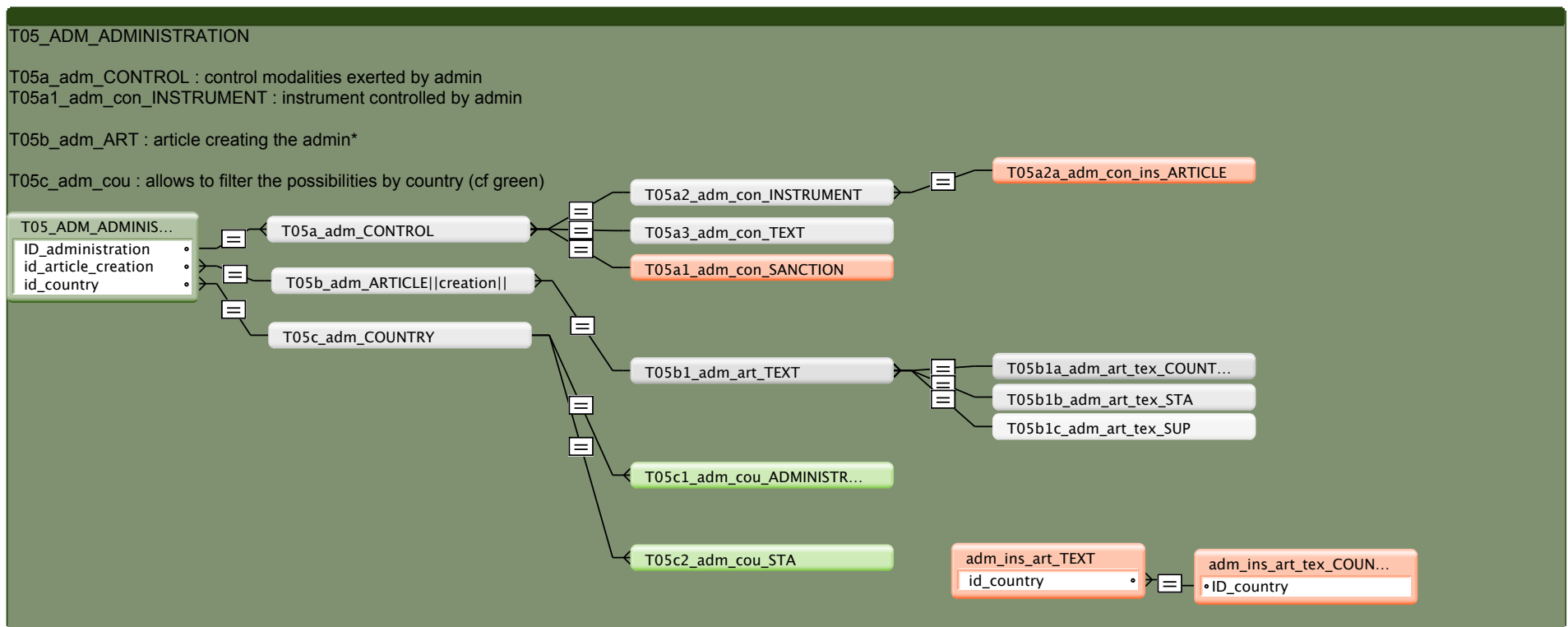


Anchor-buoy diagram n°2: ARTICLE table

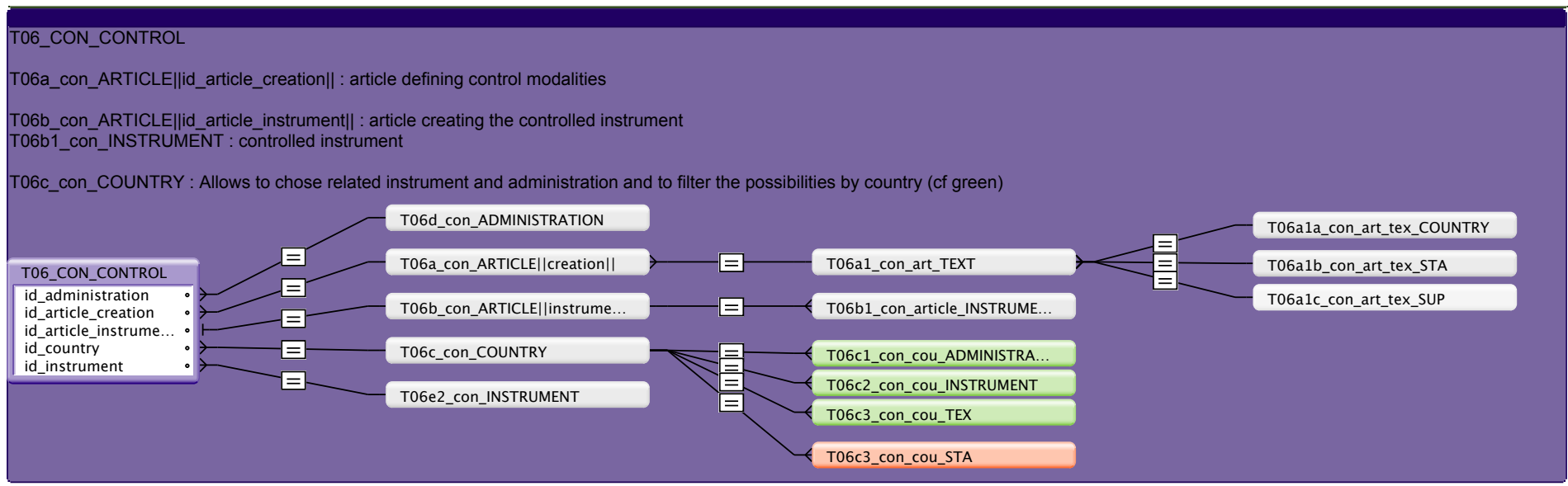
The following diagrams represent the relationships, from the standpoint of each anchor.



Anchor-buoy diagram n°3: INSTRUMENT table



Anchor-buoy diagram n°4: ADMINISTRATION table



Anchor-buoy diagram n°5: CONTROL table

T07_OBJ_OBJECT

T07a_obj_ARTICLE||completedby|| : article completing object definition

T07b_obj_INCLUDES_EXCLUDES : allows to precise if the instrument includes or excludes the object

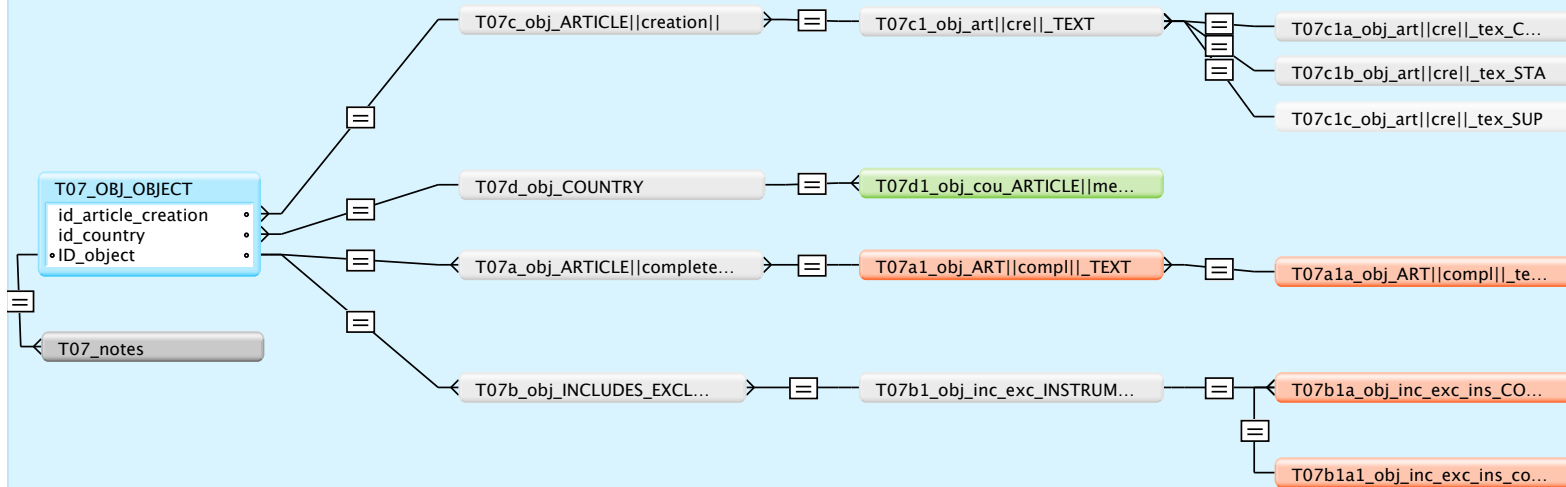
T06b1_obj_inc_exc_INSTRUMENT : instruments linked to object

T07c_obj_ARTICLE||creation|| : article creating the object

T07d_obj_COUNTRY : country related to the object. Allows to filter the articles on the country base

T07_obj_SANCTION

T06_con_OBJECT



Anchor-buoy diagram n°6: OBJECT table

T08_SAN_SANCTION

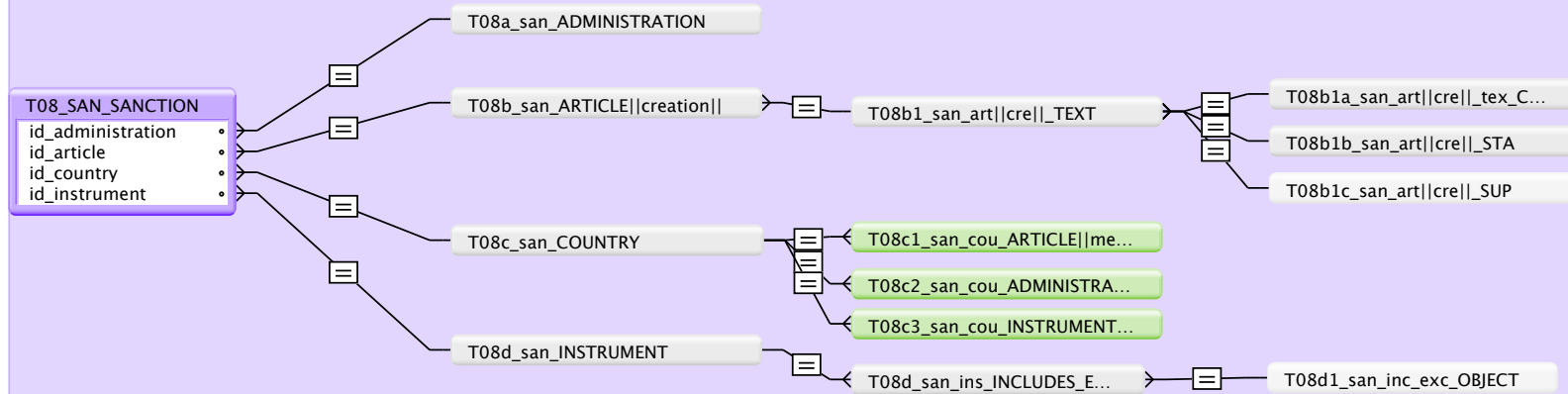
T07a_obj_ARTICLE||completedby|| : article completing object definition

T07b_obj_INCLUDES_EXCLUDES : allows to precise if the instrument includes or excludes the object

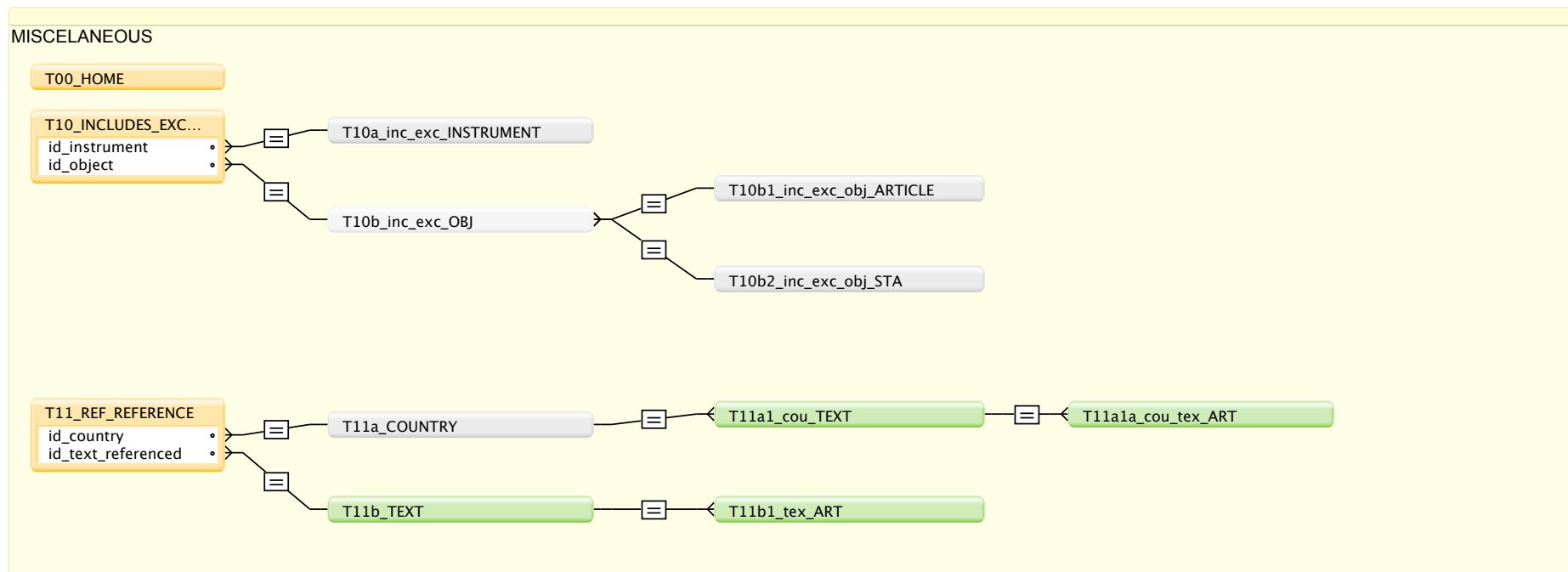
T06b1_obj_inc_exc_INSTRUMENT : instruments linked to object

T07c_obj_ARTICLE||creation|| : article creating the object

T07d_obj_COUNTRY : country related to the object. Allows to filter the articles on the country base



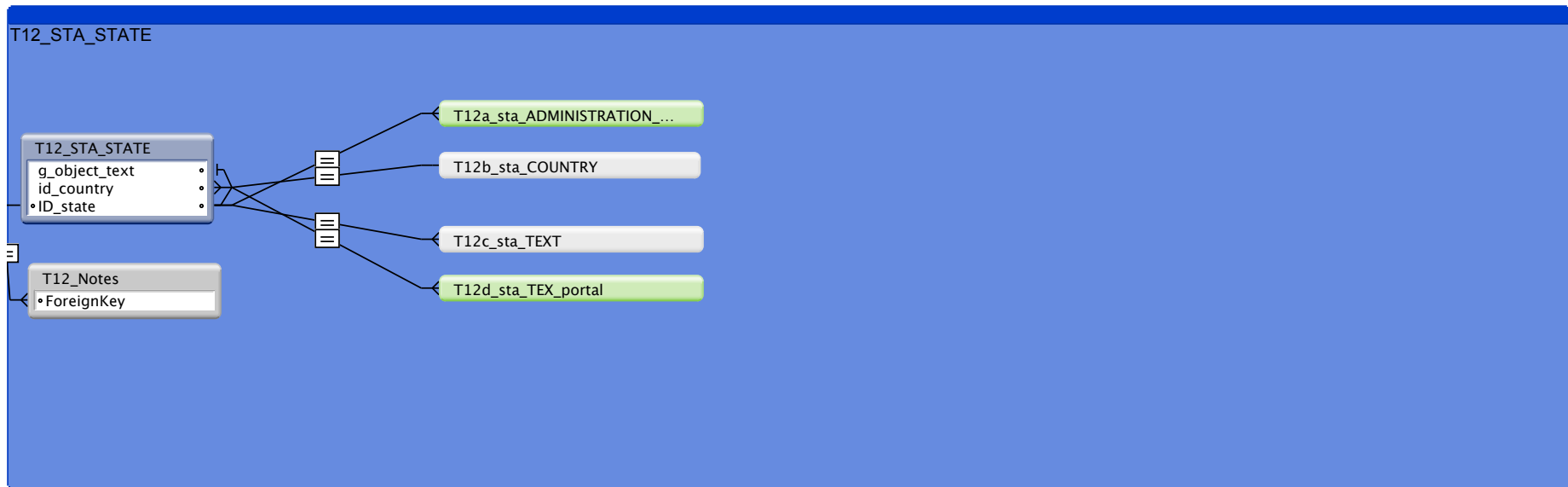
Anchor-buoy diagram n°7: SANCTION table



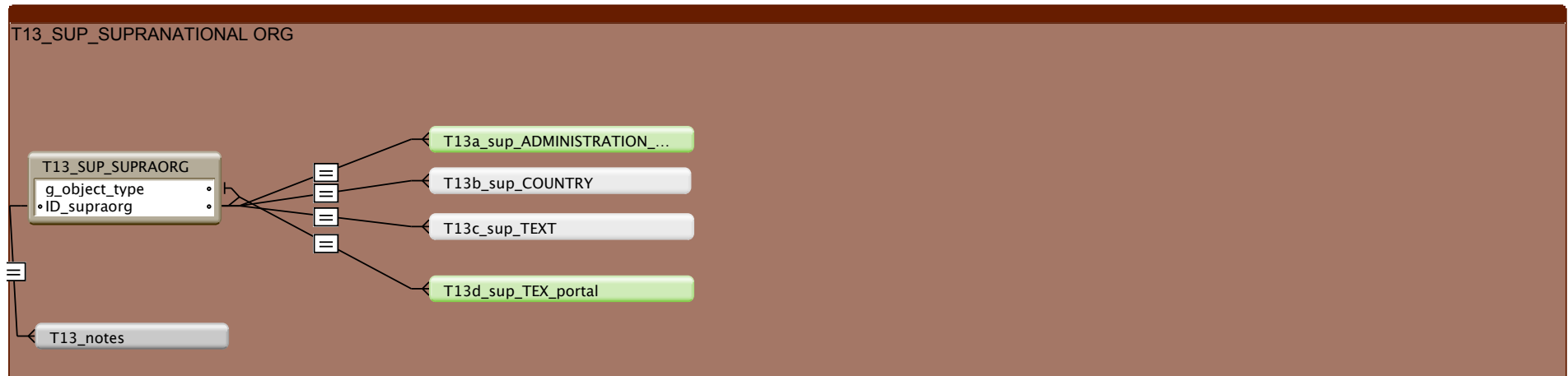
Anchor-buoy diagram n°8: INCLUDES_EXCLUDES and REFERENCE tables

The INCLUDES_EXCLUDES table enables to relate a policy instrument to its object, by characterizing the object is included or excluded from the scope of application of the specific object.

The REFERENCE table enables to put in relation articles and text implementing, amending or repealing each other.



Anchor-buoy diagram n°9: STATE table



Anchor-buoy diagram n°10: SUPRANATIONAL ORGENISATION table

Annex IX Using the database: first steps and good practices

Some users may have a limited interest in how the database works, but have an interest in the use of the database to navigate or research the database, add or extract data to / from the database. This section explains how to achieve these different tasks.

IMPORTANT: if you are going to add or to modify data, you must log in the database with your personal account, to allow the traceability of the metadata. Adding an account is explained in the previous section.

Navigating the database

The welcome page of the database (see figure 7) enables you to access the list of the records in any of the different tables. If you click of *text*, you will access a list of all the texts entered into the database (see figure 8).

Figure 7: Welcome page of the database

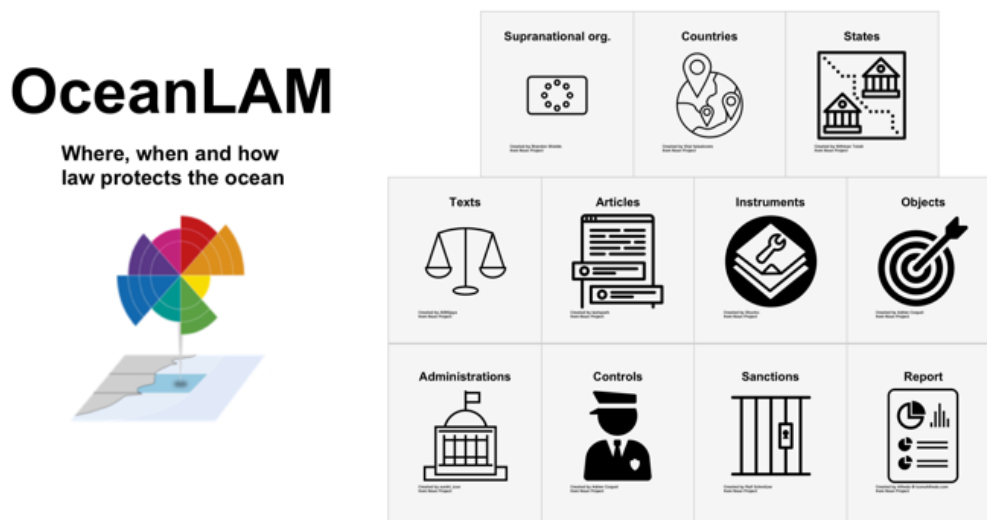





Figure 8: List of texts

Sup. org.	Country	State	Code text	Date vote	Object	Title	S
	IE	N/A	IE_2007_SI_167	27/04/2007	Plastic bags	S.I. No. 167/2007 — Waste Management (Environmental Levy) (Plastic Bag) (Amendment) (No. 2) Regulations 2007	Ir
	IE	N/A	IE_2007_SI_66	19/02/2007	Plastic bags	S.I. No. 66/2007 - Waste Management (Environmental Levy) (Plastic Bag) (Amendment) Regulations 2007	N
	IE	N/A	IE_2012_SI_159	17/05/2012	Pesticides	S.I. No. 159/2012 - European Communities (Plant Protection Products) Regulations 2012.	
	IE		IE_2012_SI_155	17/05/2012	Pesticides	European Communities (Sustainable Use Of Pesticides) Regulations 2012	
SN number of texts: 5							
	SN	N/A	SN_2015_LOI_09	04/05/2015	Plastic bags	Loi n° 2015-09 du 04 mai 2015 relative à l'interdiction de la production, de l'importation, de la détention, de la distribution, de l'utilisation de sachets plastiques de faible micronnage et à la gestion rationnelle des déchets plastiques.	N

Once on this page, you can access to the detail of a text by clicking on it. You can also sort the texts per country, per status of per object, by clicking on these buttons .

On the top left hand side, there are two buttons you will find everywhere in the database. This one  enables you to navigate to other list views. This one  leads you to the last accessed page.

On each detailed page, you have several additional navigation options, detailed in figure 9 for the Legal text detail page. Such options are available on other detail views of the database.

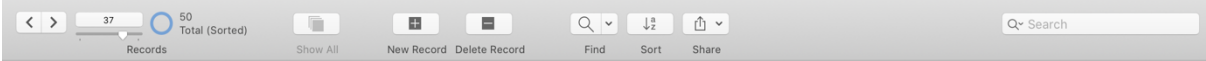
Figure 9: Navigation options in legal text details

The screenshot displays the 'Legal text details' interface. At the top, there are navigation buttons (hamburger menu and back arrow) and a '+ Add a text' button. Below this is a search and filter section with dropdowns for 'Country' (SN), 'State' (N/A), and 'Legal source' (national). The main content area shows the title of the law: 'Loi n°2020-04 du 08 janvier 2020 relative à la prévention et à la réduction de l'incidence sur l'environnement des produits plastiques'. It includes fields for 'Off. journal', 'Date voted', 'Enf. delay', 'Status', and 'Binding?'. On the right, there are options to 'Download document' (PDF icon) and a table for 'Text of the law as published in JORF'. At the bottom, there is a table of '10 related articles' with columns for 'N°', 'Status', 'Role', and 'Imp. needed?'. Annotations with arrows point to various elements: 'Access the detail form of other texts' points to the list of codes on the left; 'Visualize data in other tabs' points to the tabs below the main content; 'Download document' points to the PDF icon; and two arrows point to the 'Click here and go to the detail of article 1' and 'Open article 1 in a new window' links in the related articles table.

The find mode: researching the database

One of the main interests in the relational database is the capacity to run multicriteria searches. The “search” mode, called here the “find” mode can be access thanks to the button “find” in the status toolbar, located at the top of the window (see figure 10).

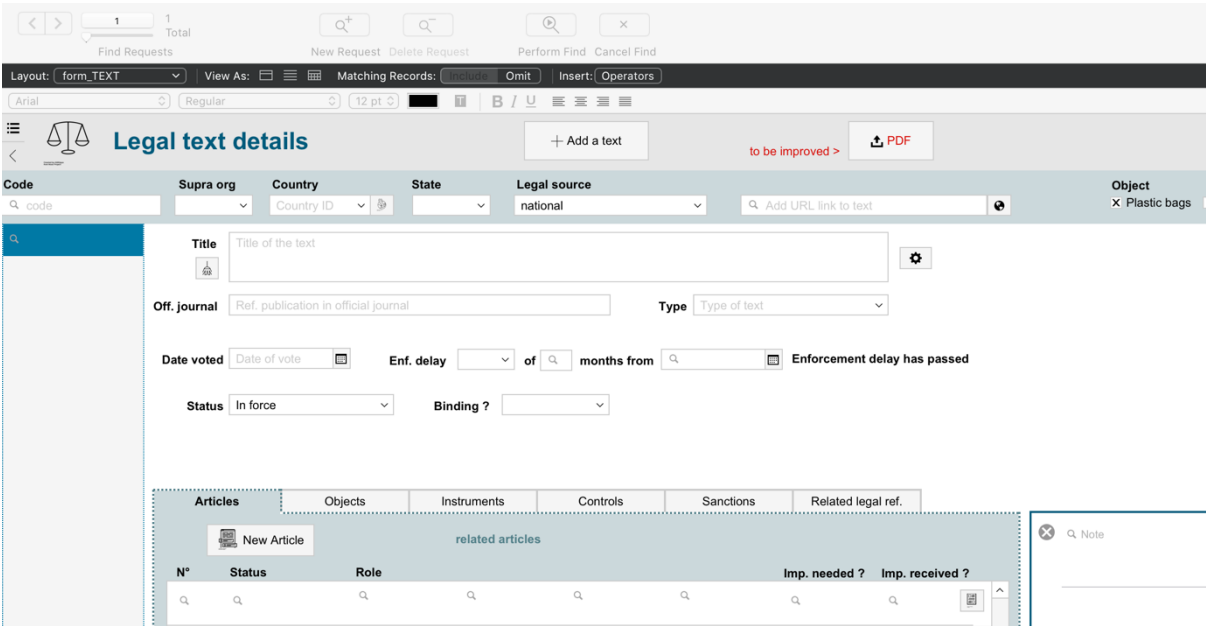
Figure 10: The status toolbar



The click on the “find” button leads you to a form looking alike the form you were currently navigating in, to the exception that no data is displayed. You can then add whatever criteria you want to make the search on. Figure 11 shows a search on texts corresponding to three criteria: texts currently in force, regulating plastic bags, at a national level. At the top of the window, you can also choose to run the research while omitting the records corresponding to some criteria and not to others. This “find” mode is really flexible.

Once you have selected all your criteria, click on Perform find.

Figure 11: Running a multicriteria search in the database: the “Find” mode



The database then displays the results of your search (see figure 12). Here, 12 records out of 50 correspond to the three chosen criteria (*cf.* status toolbar). You can then navigate through these records.

To go back to the whole set of records, click on “show all” in the status toolbar.

Figure 12: Results of the multicriteria research

When exploring the dataset, it is important to first look whether the displayed data has already been filtered through a research. On the figure 10, 50 records out of 50 are displayed. Once a search has been run, the number of displayed records changes (*cf.* figure 12).

Adding data to the database

The database has been constructed so that the user has a minimum of actions to do to add data, many of the actions have been automatized.

For this reason, it is important to follow a few rules. Adding data without respecting these rules could lead to the crash of the database.

1. Never delete records using the “delete record” button in the status toolbar. Records are related one to the other. Deleting one record would also delete relations with other records. Records can be deleted on a case to case basis, by someone who is familiar with the functioning of the database.
2. To add a new record, never use the “new record” button in the status toolbar, but the dedicated buttons on the layouts. These dedicated buttons run scripts that automatize a few essential tasks for the good functioning of the database.
3. To add a new record, go to the detail form of the closest upstream related table to click on the button “add text/article/instrument/sanction/administration/control/etc.”

- a. To add a text/state, the closest upstream related table is country
 - b. To add an article, the closest upstream related table is text
 - c. To add an instrument/object/sanction/administration/control, the closest upstream related table is article
 - d. To add a country/supranational organisation, click on “add country” or “add supraorg” in the country/supranational organisation details form.
4. Codes are used as references for many records. Respecting the organisation of these codes facilitates the utilisation of the database
- a. Code for texts: “two letter code for the country_year the text is adopted_type of text_number of text”.
Example with the Senegalese « Loi n° 2015-09 du 04 mai 2015 relative à l’interdiction de la production, de l’importation, de la détention, de la distribution, de l’utilisation de sachets plastiques de faible micronnage et à la gestion rationnelle des déchets plastiques. ». The code is SN_2015_LOI_09
 - b. Code for articles: “the code for the related text-the number of the article”. For articles from 1 to 9, add a 0.
Example for article 2 of the prementioned text: SN_2015_LOI_09-02
 - c. Code for instruments: “the code for the article -type of instrument”.
Example for the interdiction provided for at article 2 of the prementioned text: SN_2015_LOI_09-02-interdiction
 - d. Code for objects (object name): “the code of the related article.a distinction of this object”
Example for the object described at article 3 of the prementioned law, “plastic bag over 30 microns”: SN_2015_LOI_09-03.over 30

Respecting these simple rules will maintain the database in shape, and facilitate your work, as some data will be automatically copied and pasted.

In some fields, you are not free to add the data you want (lists, checkbox sets, radio button sets). This has been decided for uniformity reasons.

Export of data

Data can be exported from the database under different modes: into another Filemaker file, as PDF, as Excel, CSV, *etc.*

If you wish to export data as PDF, click on File, export data as, and choose PDF.

For other formats, it is preferable to go through File, export records. You can then choose the type of file you want to export the data in, and the type of fields.

NB: for repeating fields, only the first repetition is exported. For fields organised in checkbox sets, if several checkboxes are ticked, you will need to enlarge the excel cells to visualize the data.

Annex X Covid-19 impacts on the PhD thesis

Attendance to the research lab

The first shutdown, starting in March 2020, occurred five months after the beginning of the PhD thesis. For the following six months, occasions to go to the research lab were scarce. The lab reopened in September 2020 for two months, until the November shutdown. For the following six months, teleworking has been the rule, as the lab was open only for people needing an access to laboratories. Summing up, out of the first two years of the PhD, about one and a half was spend teleworking from home.

This situation has been an obstacle to both informal and formal exchanges with other students or researchers, resulting in social and professional isolation. It has also been an obstacle to the settlement of a favourable working atmosphere.

Field research and collaborations

Two one-month stays in Senegal were scheduled in November 2020 and March 2021, to conduct field research on the obstacles to the implementation and enforcement of environmental law. Neither of these stays occurred, due to the long-lasting closure of borders between France and Senegal. Borders eventually reopened, but too late in regard to the thesis calendar.

Collaborations outside of the lab were also impeded by the pandemic. Most conferences were made online, where inter-personal conversations are more difficult.

Additionally, a research stay in Scotland was scheduled in June 2020, in the University of Strathclyde. It was cancelled due to the pandemic. It would have been the occasion to discuss common law specifics with law professors and to build a network for future collaborations.

Subject reorientation

The cancelation of both the field research in Senegal and the research stay in Scotland, and without any clear vision of the time at which these trips would have been possible, the subject of the research has been deeply modified.

From “is environmental law implemented and enforced”, the question is now “is in force law likely to protect the environment?”. This subject reorientation required additional work and a remobilization of motivation.

Annex XI About dendrograms: from conception to limits of use

A dendrogram is a tree diagram commonly used in biological taxonomy to represent a hierarchy of categories based on similarity. Their computation allows to highlight various degrees of similarity between different objects, to be explained by independent variables.

The use of dendrograms to measure the similarity of the legal approaches of the case-study countries has been considered at several occasions in this work, based on the type of objects, of sanctions or of instruments used. This analysis would have enabled to explore whether the belonging to a specific legal tradition, or the level of development each country, is correlated to the adoption of certain types of plastic bag regulation strategies. It would also have enabled to identify different types of strategies, through their commonalities.

Two main obstacles were met in the application of dendrograms to the analysis of law, as developed here.

First, it required to extract data from the database. The data had systematically to be cleaned by hand to enable its treatment, due to extraction issues (*e.g.*, non-repetition of the country field, concatenation in one cell of the different levels of the regulation – *i.e.* production; importation; exportation; distribution; commercialisation; use). Once cleaned, the data was imported into R.

Second, the structure of the data was problematic to analyse the legal strategies as a whole. An analysis of the similarities of legal strategies as a whole would have required to have one line of data per country, with one value for each of the variable (such as type of object, type of instrument and type of sanction). The issue encountered here is that for each country, there are several instruments, each referring to multiple included and excluded objects, and related to one or several sanctions. Therefore, there are, for each country, several values for each variable. The construction of a dendrogram based on a country analysis would have required to simplify the data to the extreme, which would have drained the interest of the analysis.

As no solution was found to find a compromise between the possibility to compile a dendrogram and interest provided by the analysis, the computation of dendrograms to measure and illustrate the similarities between the plastic bag regulation strategies adopted by different countries has been abandoned.

Annex XII Method 1: summary table of indicator scores per entity

			CV	EN	FR
1. Preconditions for the start of the indicator assessment					
Name	Scoring				
In force text	0: ends assessment 1: assessment continues		1 Currently in force plastic bag reg.	1 Currently in force plastic bag reg.	1 Currently in force plastic bag reg.
2A. Assessment of comprehensiveness					
Name	Scoring	Sc. Max			
Targeted activity	Calculation on this basis: 4: production 3: importation 2: exportation / commercialisation / distribution 1: use	10	10 Production, importation, commercialisation and use banned	2 Obligation to charge on commercialisation	10 Ban on the production, importation, commercialisation and use
Comprehensiveness of the object	Rated on a 4 levels scale 0: there is no definition of the reg.'s object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.	3	2 See article 3, lei 99-VIII of 2015. Oxo-fragmentable bags are not included.	2 See article 2, S1 n°776 of 2015. Oxo-fragmentable bags are not included.	3 See article 1, décret n°379 of 2016. Oxo-fragmentable bags are included.
Scope of the exception	Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours ; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.	3	1 The exception on biodegradable bags is large in scope, so is the exception for specific uses. All exceptions are clearly defined.	1 All exceptions are clearly defined but they cover a wide array of situations.	2 The exception of biodegradable / compostable bags is limited in scope.
			16		
2B. Assessment of forcefulness					
Name	Scoring				
Force of the instrument	Calculation on this basis: 1: cooperative and informational instruments 3: market-based instrument 4: existence of a ban	8	5 Provision for a ban, an obligation to charge (no longer in force) and of informational instruments	3 Provision for an obligation to charge.	4 Provision for a ban.
Provision for controls	Rated on a 4 levels scale 0: no control is provided for; 1: controls are provided for, but no administration is explicitly in charge of such controls; 2: controls are provided for, an or several administrations are in charge of the controls. The process is not defined; 3: controls are provided for, the administration is identified, and the process is clearly defined.	3	2 See article 15, lei 99-VIII of 2015 above mentioned. The process is not described.	3 See part 3, S1 n°776 of 2015.	2 See art. 3, décret n°279 of 2016.
Provision for sanctions	Calculation on this basis: 0: no sanction is provided for 1: display 2: low fine 3: seizure, confiscation, temporary closure 4: high fine 5: prison	15	4 Fines range from 50 000 to 400 000 escudos (see article 15, lei 99-VIII of 2015). The min. wage in CV is approx. 15000 escudos per month.	5 The maximum amount for the fine is £5000. There is no minimum amount. A publicity notice may be given to a seller imposed with a civil sanction	4 The maximum amount for the fine is either €3000 or €15000. There is no minimum amount.

1. Preconditions for the start of the indicator assessment		
Name	Scoring	
In force text	0: ends assessment 1: assessment continues	
2A. Assessment of comprehensiveness		
Name	Scoring	Sc. Max
Targeted activity	Calculation on this basis: 4: production 3: importation 2: exportation / commercialisation / distribution 1: use	10
Comprehensiveness of the object	Rated on a 4 levels scale 0: there is no definition of the reg.'s object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.	3
Scope of the exception	Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours ; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.	3
		16
2B. Assessment of forcefulness		
Name	Scoring	
Force of the instrument	Calculation on this basis: 1: cooperative and informational instruments 3: market-based instrument 4: existence of a ban	8
Provision for controls	Rated on a 4 levels scale 0: no control is provided for; 1: controls are provided for, but no administration is explicitly in charge of such controls; 2: controls are provided for, an or several administrations are in charge of the controls. The process is not defined; 3: controls are provided for, the administration is identified, and the process is clearly defined.	3
Provision for sanctions	Calculation on this basis: 0: no sanction is provided for 1: display 2: low fine 3: seizure, confiscation, temporary closure 4: high fine 5: prison	15

IE		SC		SN	
1	Currently in force plastic bag reg.	1	Currently in force plastic bag reg.	1	Currently in force plastic bag reg.
2	Taxation on commercialisation.	2	The obligation to charge applies at commercialisation.	2	See article 4, loi n°4 of 2020. The import of plastic bags requires a permit and the production must answer to standards (recyclability). These last two are not taken into account, as they do not intend to modify the number of bags in circulation.
1	Plastic is not defined. See section 9, statutory instrument 36 of 2001.	1	Plastic is not defined. See regulation 3, Regulation n°161 of 2014.	1	Plastic is not defined. See article 3, loi n°4 of 2020.
1	All exceptions are clearly defined but they cover a wide array of situations.	1	All exceptions are clearly defined but they cover a wide array of situations.	0	The exception based on the material criteria is obscure.
3	Provision for a taxation scheme	3	Provision for an obligation to charge.	4	Provision for a ban, permit and standards.
3	See articles 9 and 17, S1 n° 605 of 2001.	3	See part 3, Regulation n°161 of 2014.	2	Multiple administrations are in charge of the controls. See article 25, loi n°4 of 2020. The process is not defined.
9	The maximum amount of the fine is 1500€, there is no minimum amount. To the maximum, a 12 months imprisonment can be pronounced.	2	The fine cannot exceed £200. The discounted amount is of £100.	13	Provision for the display of the sanction, for the seizure, confiscation and temporary closure, for fines and imprisonment. Fines range from 36000 to 30 000 000 FCFA.

Annex XIII Method 2: summary table of indicator scores per entity

Method 2			CV	EN	FR
1. Preconditions for the start of the indicator assessment					
Name	Type of data	Scoring			
In force text	Binary	0: ends assessment 1: assessment continues	1 Currently in force plastic bag reg.	1 Currently in force plastic bag reg.	1 Currently in force plastic bag reg.
2A. Assessment of comprehensiveness					
Name	Type of data	Scoring			
Targeted activity	Semi-quantitative	Rated on a 4 levels scale 0: there is no distinction as to the life-cycle stage at which the reg. applies; 1: the reg. only applies at downstream stages (commercialisation and/or use); 2: the reg. applies at some upstream stages (production, import); 3: the reg. applies at all stages.	3 The regulation applies at production, import, commercialisation and use.	1 The regulation applies to commercialisation only.	2 Ban on the production, importation, commercialisation and use. Production for export is allowed for some plastic bags.
Comprehensiveness of the object	Semi-quantitative	Rated on a 4 levels scale 0: there is no definition of the reg.'s object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.	2 See article 3, lei 99-VIII of 2015. Oxo-fragmentable bags are not included.	2 See article 2, SI n°776 of 2015. Oxo-fragmentable bags are not included.	3 See article 1, décret n°379 of 2016. Oxo-fragmentable bags are included.
Scope of the exception	Semi-quantitative	Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours ; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.	3 The exception on biodegradable bags is large in scope. Numerous use-based exceptions. All exceptions are clearly defined.	1 All exceptions are clearly defined but they cover a wide array of situations.	2 The exception of biodegradable / compostable bags is limited in scope.
2B. Assessment of forcefulness					
Name	Type of data	Scoring			
Force of the instrument	Semi-quantitative	Rated on a 4 levels scale 0: non-binding (informational or cooperative) instruments only are provided for; 1: market-based instruments are provided for; 2: command-and-control instruments are provided for; 3: several types of instruments are provided for.	3 Provision for a ban, an obligation to charge (no longer in force) and informational instruments	1 Provision for an obligation to charge.	2 Provision for a ban.
Provision for controls	Semi-quantitative	Rated on a 4 levels scale 0: No control is provided for; 1: Controls are provided for, but no administration is explicitly in charge of such controls; 2: Controls are provided for, an or several administrations are in charge of the controls. The process is not defined; 3: Controls are provided for, the administration is identified, and the process is clearly defined.	2 See article 15, lei 99-VIII of 2015 above mentioned. The process is not described.	3 See part 3, SI n°776 of 2015.	2 See art. 3, décret n°279 of 2016.
Provision for sanctions	Semi-quantitative	Rated on a 4 levels scale 0: No sanction is provided for; 1: There are a limited number of sanctions which are limited in force; 2: The sanctions provided for have a significant force; 3: There are several types of sanctions, among which some have a significant force.	2 The fines which are provided for have a significant force. See article 15, lei 99-VIII of 2015 for amounts.	2 The maximum amount for the fine is £5000. There is no minimum amount. A publicity notice may be given to a seller imposed with a civil sanction	2 The maximum amount for the fine is either €3000 or €15000. There is no minimum amount.

Method 2			IE	SC	SN
1. Preconditions for the start of the indicator assessment					
Name	Type of data	Scoring			
In force text	Binary	0: ends assessment 1: assessment continues	1	1	1
			Currently in force plastic bag reg.	Currently in force plastic bag reg.	Currently in force plastic bag reg.
2A. Assessment of comprehensiveness					
Name	Type of data	Scoring			
Targeted activity	Semi-quantitative	Rated on a 4 levels scale 0: there is no distinction as to the life-cycle stage at which the reg. applies; 1: the reg. only applies at downstream stages (commercialisation and/or use); 2: the reg. applies at some upstream stages (production, import); 3: the reg. applies at all stages.	1	1	1
			The taxation applies to commercialisation only.	The regulation applies to commercialisation only.	The ban only applies to commercialisation only.
Comprehensiveness of the object	Semi-quantitative	Rated on a 4 levels scale 0: there is no definition of the reg.'s object; 1: the definition is vague and / or imprecise; 2: the definition is clear but uncomprehensive; 3: the definition is both clear and comprehensive.	1	1	1
			Plastic is not defined. See section 9, statutory instrument 36 of 2001.	Plastic is not defined. See regulation 3, Regulation n°161 of 2014.	Plastic is not defined. See article 3, loi n°4 of 2020.
Scope of the exception	Semi-quantitative	Rated on a 4 levels scale on the basis of the type and scope of the exceptions 0: the exception is vague, with blurry and porous contours ; 1: the exception is precisely defined but large in scope; 2: the exception is precisely defined but small in scope; 3: there is no exception to the regulation.	1	1	0
			All exceptions are clearly defined but they cover a wide array of situations.	All exceptions are clearly defined but they cover a wide array of situations.	The exception based on the material criteria is obscure and overly comprehensive.
2B. Assessment of forcefulness					
Name	Type of data	Scoring			
Force of the instrument	Semi-quantitative	Rated on a 4 levels scale 0: non-binding (informational or cooperative) instruments only are provided for; 1: market-based instruments are provided for; 2: command-and-control instruments are provided for; 3: several types of instruments are provided for.	1	1	2
			Provision for a taxation scheme.	Provision for an obligation to charge.	Provision for a ban, permit and standard.
Provision for controls	Semi-quantitative	Rated on a 4 levels scale 0: No control is provided for; 1: Controls are provided for, but no administration is explicitly in charge of such controls; 2: Controls are provided for, an or several administrations are in charge of the controls. The process is not defined; 3: Controls are provided for, the administration is identified, and the process is clearly defined.	3	3	2
			See articles 9 and 17, SI n° 605 of 2001.	See part 3, Regulation n°161 of 2014.	Multiple administrations are in charge of the controls. See article 25, loi n°4 of 2020. The process is not defined.
Provision for sanctions	Semi-quantitative	Rated on a 4 levels scale 0: No sanction is provided for; 1: There are a limited number of sanctions which are limited in force; 2: The sanctions provided for have a significant force; 3: There are several types of sanctions, among which some have a significant force.	3	1	3
			The maximum amount of the fine is 1500€, there is no minimum amount. To the maximum, a 12 months imprisonment can be pronounced.	The fine cannot exceed £200. The discounted amount is of £100.	Provision for the display of the sanction, for the seizure, confiscation and temporary closure, for fines and imprisonment. Fines range from 36000 to 30 000 000 FCFA.

Annex XIV Data management plan

All the data compiled during this research is available on the database. The database file will be made available on the data repository DataSuds during the Fall 2022. It will be available in open access.

Billant, Odeline, 2022, "Plastic bag regulation database", <https://doi.org/10.23708/ZM80DR>, DataSuds, V1

The dictionary of data (see annex V) will also be uploaded on DataSuds, to accompany the future users of the database.

Annex XV Article méthodologique en français

Droit de l'environnement et analyses numériques - ou comment mesurer la protection de l'océan par le corpus juridique ?

Environmental law and numerical analyses - measuring the protection of the ocean by the legal corpus?

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Mots clés

droit de l'environnement numérique, collecte de données, constitution de base de données, comparaison numérique, analyse dynamique

Key words

numerical environmental law, data collection, database design, numerical comparison, dynamic analysis

Résumé

Garantir la capacité du droit à protéger l'environnement est un enjeu majeur. Néanmoins, l'absence de méthodologies et d'outils adéquats est un frein à la compréhension de « où, quand et comment » le droit protège les océans.

Bien que l'utilisation d'indicateurs dans l'analyse de phénomènes complexes soit maintenant répandue dans de nombreuses disciplines, c'est une approche émergente en droit, qui plus est en droit de l'environnement.

La méthodologie présentée ici opérationnalise l'utilisation d'indicateurs pour mesurer le rôle du droit dans la protection des océans. À partir de l'exemple de l'application de cette méthode à l'analyse de la réglementation des sacs en plastique dans 7 pays atlantiques, nous démontrons que cette contribution du droit au développement des humanités numériques permet d'améliorer la lisibilité du droit à l'extérieur des sphères juridiques, et d'approfondir la compréhension des forces et des faiblesses du droit actuel dans sa capacité à protéger les océans.

Abstract

Ensuring the law's ability to protect the environment is a major challenge. Nevertheless, the lack of adequate methodologies and tools is a hindrance to understanding “where, when and how” the law protects the oceans.

Although the use of indicators in the analysis of complex phenomena is now widespread in many disciplines, it is an emerging approach in law, especially in environmental law.

The methodology presented here operationalizes the use of indicators to measure the role of law in the protection of the oceans. Using the example of the application of this method to the analysis of plastic bag regulations in 7 Atlantic countries, we demonstrate that this contribution of law to the development of digital humanities improves the readability of law outside of legal spheres, and deepens the understanding of the strengths and weaknesses of current law in its ability to protect the oceans.

Introduction

Pour garantir la capacité du droit à gérer les défis et les risques posés par les pressions humaines sur l'environnement marin, la communauté scientifique et les décideurs politiques ont besoin de sources de connaissances sur les lacunes actuelles de la protection juridique. Au niveau international comme au niveau national, les textes juridiques visant à protéger l'océan ont fleuri ces dernières décennies. Néanmoins, en l'absence de méthodologies et d'outils adéquats, il est impossible de déterminer dans quelle mesure cette augmentation du nombre de textes cache des vides de protection, ou contribue à une meilleure protection de l'environnement.

Dès 1992, la Conférence de Rio a appelé les États à « développer et identifier des indicateurs de développement durable afin d'améliorer la base d'information pour la prise de décision à tous

les niveaux »¹¹⁷⁸. Si l'utilisation d'indicateurs s'est développée dans de multiples disciplines, y compris en amont de la Conférence de Rio, leur recours pour l'analyse du droit est émergent (Davis, Kingsbury, et Merry 2012), et dominé par des initiatives relevant du droit économique ou de la mesure de la corruption. L'usage d'indicateurs dans l'analyse du droit de l'environnement est pourtant prometteur. De par leur capacité à fournir une information facilement compréhensible sur la base d'un jeu de données complexe (Hammond 1995), ils permettent de faciliter l'accès au droit, qui est une condition de son application. Les analyses numériques du droit ne se bornent néanmoins pas à la mise en œuvre d'indicateurs. Le développement de bases de données relationnelles adaptées à cet objet d'étude permet également de compléter les approches traditionnelles au droit et de faciliter l'analyse comparative de réglementations complexes.

Dans cette dynamique, nous proposons une nouvelle méthode d'analyse visant à évaluer qualitativement et quantitativement le rôle potentiel du droit à la protection de l'environnement. Pour que le droit soit susceptible de protéger l'environnement, il doit être englobant dans sa façon d'aborder le problème en jeu et contraignant dans son application. Dès lors, l'analyse du contenu des textes de droit est essentielle pour pouvoir déterminer dans quelle mesure le droit, s'il était appliqué, pourrait protéger l'environnement. L'analyse comparée des textes adoptés dans différents pays face à une même menace pour l'environnement marin permet ainsi de mettre en lumière toute la complexité et la diversité du droit dans un langage universel.

Pour l'heure, cette méthodologie a été développée et testée sur la thématique de la réglementation des sacs en plastiques, dans sept pays bordant l'océan Atlantique (Cap-Vert, Brésil, États-Unis d'Amérique, France, Irlande, Royaume-Uni et Sénégal). L'importante diversité des cas d'étude, tant sur le plan culturel, économique que géographique, permet de tester la méthode dans une variété de situations. La réglementation des sacs en plastique a quant à elle été choisie pour plusieurs raisons. Le plastique est une des trois sources principales de la pollution tellurique, qui représente 80 % de la pollution en mer¹¹⁷⁹. Leur réglementation à la source est dès lors un important levier de protection des écosystèmes marins. Parmi les objets

¹¹⁷⁸ Conférence des Nations Unies sur l'Environnement et le Développement, 1992, Agenda 21, chapitre 40.

¹¹⁷⁹ Manila Declaration on Furthering the Implementation of the global Programme of Action for the Protection of the Marine Environment from Land-based activities, UNEP/GPA/IGR.3/CRP.1/Rev.1, Intergovernmental Review Meeting on the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, Third session, Manila, 25-27 January 2012.

plastique à usage unique, les sacs ont été les premiers à être réglementés, dès 2001 en Irlande. Aujourd'hui, près de 130 pays réglementent les sacs en plastique (UNE 2018), offrant de larges perspectives d'application de la méthode. Enfin, la comparaison de la diversité et de la complexité des réglementations des sacs en plastique pourrait éclairer la rédaction d'un futur traité international sur les plastiques à usage unique, qui pourrait voir le jour d'ici à la fin de la décennie¹¹⁸⁰.

Sans entrer dans les détails des résultats obtenus, cet article vise à présenter le cadre conceptuel et méthodologique et les enjeux du développement d'une approche numérique à l'analyse de la protection de l'océan par le corpus juridique.

Fondements d'une analyse numérique du droit

Si le développement d'analyses numériques du droit peut s'avérer prometteur, il se place dans la continuité du développement des humanités numériques (1.1). D'un point de vue juridique, un enjeu du droit comparé numérique est de garantir la comparabilité entre les différents objets et pays analysés (1.2). D'un point de vue technique, la mise en œuvre d'une analyse numérique du droit nécessite un travail interdisciplinaire, autant pour définir l'objet de l'évaluation que pour développer des outils numériques (1.3).

Le droit dans les humanités numériques : premières expériences

L'élaboration de mesures du droit et d'indicateurs du système juridique est un champ d'investigation relativement nouveau (Davis, Kingsbury, et Merry 2015). Néanmoins, un large éventail d'approches a été développé jusqu'à présent. Chacune de ces expériences a relevé le défi technique de déterminer ce qu'il faut mesurer au regard de ses propres objectifs (Reiling, Hammergren, et Di Giovanni 2007). C'est pourquoi, les éléments de mesure et les indicateurs définis varient considérablement d'une expérience à l'autre.

Parmi l'ensemble des expériences de mesure du droit analysées, trois approches se dégagent : celles relatives à la mesure de l'existence du droit, au fonctionnement d'un système juridique ou aux effets du droit.

¹¹⁸⁰ Le 2 mars 2022, la cinquième session de l'Assemblée des Nations unies pour l'environnement du Programme des Nations unies pour l'environnement s'est achevée par l'adoption du projet de résolution "Mettre fin à la pollution plastique : Vers un instrument international juridiquement contraignant" 5e réunion de l'Assemblée des Nations Unies sur l'environnement (ANUE-5.2).

La mesure de l'existence du droit se décline par la mesure de certains constituants du droit pour en comparer les caractéristiques intrinsèques. Par exemple, Siems présente des initiatives allant de l'analyse du nombre de mots contenus dans les textes juridiques au nombre de pages (Siems 2011). D'autres initiatives, telles que l'*Environment Democracy Index* (Worker et De Silva 2015) ou le *Doing Business Index* (World Bank Group 2020), se basent sur la mesure du contenu du droit, pour en comparer les approches au regard d'une même problématique.

Les mesures du fonctionnement du système juridique reposent par exemple sur la mesure de l'application du droit¹¹⁸¹, ou sur les influences réciproques entre le système juridique et la société¹¹⁸².

Enfin, les initiatives mesurant les effets du droit s'attachent à mesurer, par le biais de la perception, la prévalence de la corruption ou la qualité de la gouvernance¹¹⁸³. L'initiative plus récente coordonnée par M. Prieur mérite d'être mentionnée ici. Elle développe, sur la base de questionnaires soumis à des experts, une méthode de mesure de l'effectivité du droit de l'environnement (Prieur, Bastin, et Mekouar 2021).

Ces initiatives débouchent, pour beaucoup, sur l'édiction de « scores » permettant ensuite la comparaison dans le temps ou entre différents pays.

Toutes ces initiatives se sont heurtées à des obstacles théoriques et techniques qu'il convient de lever, ou du moins d'éclaircir.

Les obstacles théoriques fréquemment mentionnés font état du caractère immesurable du droit, prescriptif et fondé sur des valeurs, au contraire des autres sciences descriptives et fondées sur des nombres. Le caractère réducteur et simplificateur des méthodes numériques est également critiqué, ne permettant pas une compréhension en profondeur de la complexité du droit (Ruhl 1996). Ce point n'est pas spécifique à la mesure du droit, la validité et les limites de la méthode utilisée étant une préoccupation dépassant les frontières disciplinaires.

¹¹⁸¹ Dans le secteur de la finance, l'étude « *Law and Finance* » est régulièrement citée, ou critiquée, comme une étude fondatrice (La Porta et al. 1998).

¹¹⁸² Le programme SLADE visait l'acquisition de données permettant d'évaluer les influences réciproques du droit et de la société dans six pays d'Amérique latine et d'Europe dans les décennies suivant la seconde guerre mondiale. Ce programme a dû être avorté faute de financement permettant l'analyse des données collectées. Voir (Merryman 2000).

¹¹⁸³ Voir par exemple le *Rule of Law Index*, développé par le *World Justice Project*, le *World Governance Index* soutenu par la Banque Mondiale ou encore le *Corruption Perception Index* développé par *Transparency International*.

Dans l'ensemble, ces critiques remettent moins en question le caractère possible ou souhaitable de la mesure du droit, que le recours à des méthodes quantitatives comme seules méthodologies d'analyse du droit (Merryman 2000; Restrepo Amariles 2015). Les statistiques, tout comme les indicateurs, doivent être considérées comme des outils analytiques qui, comme tout outil, peuvent être utilisés pour certains usages mais pas pour tous. Elles ne remplacent pas, mais complètent plutôt les limites des autres outils existants utilisés pour approfondir la connaissance du droit.

Dans le domaine spécifique du droit de l'environnement, plusieurs chercheurs ont travaillé sur l'application du droit de l'environnement (Kramer 2016; Martin et Kennedy 2015) sur les stratégies développées par les États pour renforcer l'impact du droit environnemental (Gunningham 2011) ou sur la perception de l'application des règles de droit contribuant à la protection de l'environnement (Prieur, Bastin, et Mekouar 2021). En Europe, des initiatives se développent également en ce sens sous l'impulsion de la Commission Européenne avec les *Environmental Implementation Reviews* et sous l'impulsion d'un réseau européen pour l'application du droit¹¹⁸⁴.

La méthodologie que nous proposons ici s'inscrit dans cette dynamique.

Garantir la comparabilité : un enjeu du droit comparé numérique

La comparaison de systèmes de droit différents – connue sous le terme de droit comparé – est une discipline ancienne, relevant de différentes écoles de pensée et complexe du fait de l'existence de différents systèmes juridiques.

Néanmoins, les spécificités du droit de l'environnement par rapport aux autres branches du droit facilitent ce processus (Darpo et Nilsson 2010; Robinson 1997). En effet, la plupart des réglementations sont initiées au niveau international, et les processus politiques associés peuvent être identifiés dans tous les pays du monde. Tel est le cas des études d'impact environnemental ou des règles relatives aux industries polluantes qui existent dans le monde entier. Dans ce cas, la transposition d'une convention internationale contraignante au niveau national génère des similitudes fréquentes en droit national. Sur cet aspect, les spécificités du droit de l'environnement et de la mondialisation du droit facilitent donc la comparaison. Grâce

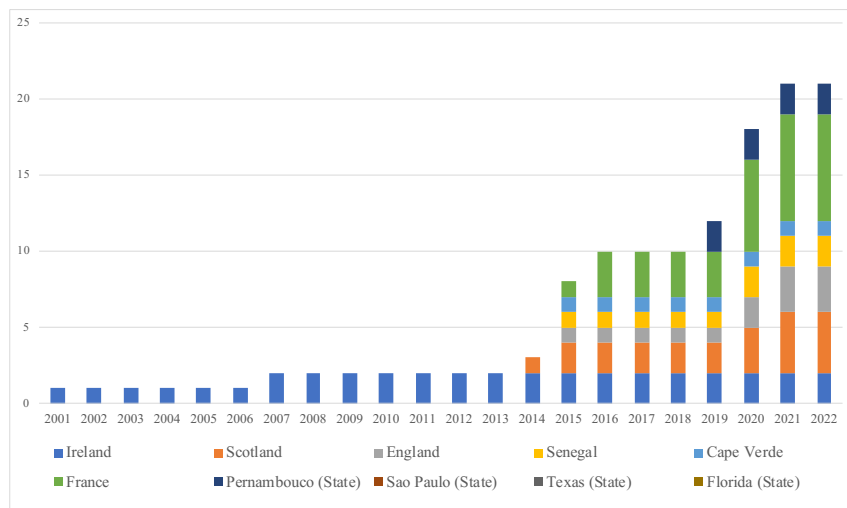
¹¹⁸⁴ IMPEL, European Union Network for the Implementation and Enforcement of Environmental Law, <https://www.impel.eu>.

à la généralisation des interactions et des échanges au-delà des juridictions étatiques (Frydman et Twining 2015) et à la diffusion des processus politiques (Dolowitz et Marsh 2000), il est désormais possible de concevoir des méthodes permettant de comparer le droit à l'échelle mondiale.

Certains sujets, tels que la pollution plastique, ne sont pas encore gouvernés par une convention internationale. Dans ce cas, il s'agit de comparer les réponses juridiques apportées par un ensemble de pays à un problème environnemental partagé.

Par exemple, le graphique 1 montre, pour les 10 entités¹¹⁸⁵ dont la réglementation des sacs en plastique a été analysée, le nombre cumulé de textes juridiques adoptés sur cette thématique.

Graphique 1 : nombre cumulé de textes juridiques adoptés par année, dans les 10 entités analysées sur la thématique de la réglementation des sacs en plastique.



Données collectées par les auteurs

Le choix des pays d'étude peut avoir une influence importante sur le niveau de difficulté de la comparaison. Les différences de langue, d'organisation étatique, ou l'appartenance à des familles juridiques variées peuvent être autant de défis à surmonter. De plus, les institutions ayant la compétence de la réglementation peuvent varier d'un pays à l'autre ou d'une thématique à l'autre. Par exemple, en France, la réglementation des pesticides est une

¹¹⁸⁵ Ces dix entités sont l'Angleterre, le Cap Vert, l'Écosse, l'état de Floride (États-Unis), la France, l'Irlande, l'état du Pernambuco (Brésil), l'état de Sao Paulo (Brésil), le Sénégal, l'état du Texas (États-Unis).

compétence partagée avec l'Union Européenne¹¹⁸⁶, contrairement à la réglementation des sacs plastique¹¹⁸⁷.

L'enjeu ici est davantage de comparer les réponses juridiques apportées à une problématique environnementale donnée que de comparer les institutions en charge de les appliquer. Dès lors, l'approche fonctionnelle apparaît comme une clé de la comparabilité entre des contextes politiques, juridiques et thématiques divergents.

En effet, c'est le propre de l'analyse fonctionnelle que de considérer la problématique socio-économique comme le point de départ de l'analyse comparée (Siems 2018), plutôt que de partir d'une question hypothétique ou théorique (Siems 2011). Le support de comparaison est alors constitué de l'ensemble des textes juridiques en vigueur traitant de cette question dans les différentes juridictions étudiées. Si la question avait été de comparer les réponses apportées par les sociétés dans leur ensemble à une problématique environnementale donnée, alors il aurait fallu intégrer à l'analyse les formes extra-juridiques d'organisation économique, sociale et politique (Bignami 2016).

L'approche fonctionnelle n'est pas exempte de critiques. Par exemple, une loi dysfonctionnelle pourrait rester en vigueur, et ainsi masquer la réponse inadéquate apportée à la question donnée (Siems 2018). Par ailleurs, certaines thématiques du droit, fortement influencées par des particularités géographiques, socio-politiques ou culturelles, se révèlent moins adaptées à une approche fonctionnelle (Gutteridge 1949). C'est pourquoi un soin particulier sera apporté au choix des questions clé et plus largement aux choix méthodologiques de cette recherche, *via* une approche interdisciplinaire.

¹¹⁸⁶ Voir Règlement (CE) 1907/2006 du Parlement européen et du Conseil du 18 décembre 2006 concernant l'enregistrement, l'évaluation et l'autorisation des substances chimiques, ainsi que les restrictions applicables à ces substances (REACH), instituant une agence européenne des produits chimiques, modifiant la directive 1999/45/CE et abrogeant le règlement (CEE) n° 793/93 du Conseil et le règlement (CE) n° 1488/94 de la Commission ainsi que la directive 76/769/CEE du Conseil et les directives 91/155/CEE, 93/67/CEE, 93/105/CE et 2000/21/CE de la Commission, JO L 396 du 30.12.2006, p. 1.

Voir également Règlement (CE) 1107/2009 du Parlement européen et du Conseil du 21 octobre 2009 concernant la mise sur le marché des produits phytopharmaceutiques et abrogeant les directives 79/117/CEE et 91/414/CEE du Conseil, JO L309 du 24.11.2009, p. 1

¹¹⁸⁷ Voir Directive (EU) 2015/720 du Parlement Européen et du Conseil du 29 avril 2015, modifiant la directive 94/62/CE en ce qui concerne la réduction de la consommation de sacs en plastique légers, Journal Officiel de l'Union Européenne 115, 06/05/2015 p. 11

Une nécessaire interdisciplinarité

Développer une méthode d'analyse numérique en droit de l'environnement nécessite de dépasser les frontières disciplinaires tant pour définir l'objet de l'évaluation (les questions clé) que pour développer des outils numériques.

L'objectif de la méthode étant de montrer en quoi le droit participe à la protection de l'environnement marin, des échanges itératifs avec des scientifiques spécialisés en biologie, biogéochimie ou plus largement en sciences de la mer, sont nécessaires pour déterminer la problématique qui va faire l'objet d'une analyse numérique. Une fois la thématique générale déterminée (ex. la pollution plastique), il s'agit de sélectionner une ou plusieurs questions clé, plus précises, permettant une analyse juridique (ex. la réglementation des sacs en plastique).

Si le choix de la problématique générale relève de la compétence des collègues biologistes et affiliés, la sélection des questions clés relève d'un travail interdisciplinaire allant au-delà du cercle des sciences de la nature. L'apport des sciences humaines et sociales est déterminant pour garantir la comparabilité des questions choisies dans des contextes socio-économiques, juridiques et politiques différents (Galligan 2010).

Une démarche interdisciplinaire est également nécessaire tout au long de la recherche. L'utilisation d'outils numériques, allant de l'élaboration d'une base de données relationnelle, au traitement statistique des données en passant par la représentation graphique des résultats requiert des compétences spécifiques, mêlant familiarité avec l'analyse juridique et avec le maniement des nombres.

Or, ces formations sont traditionnellement cloisonnées (White et Stone 1978), et peu de personnes disposent de cette double compétence. L'élaboration et l'utilisation des outils numériques et quantitatifs de la recherche sont pourtant des étapes sensibles, pouvant grandement influencer les résultats à venir. Dès lors, plusieurs auteurs soulignent l'importance du travail en collaboration entre des juristes d'une part et des personnes spécialisées en bases de données ou traitement statistique d'autre part (Donald 2015). Allant plus loin, Wulf encourage chacun à acquérir des connaissances approfondies dans la discipline de l'autre (Wulf 2016). La facilitation de ce dialogue nécessite la mise en place d'un cadre méthodologique permettant l'analyse dynamique des textes de droit.

Cadre méthodologique d'une analyse dynamique des textes de droit

Traditionnellement, le droit est analysé de manière textuelle et descriptive, tenant à l'écart les techniques quantitatives et statistiques. Cela s'explique d'une part par l'aversion partagée des juristes pour les nombres (Silver et Rocconi 2015), et par la structure même du droit, imbriquant par essence des éléments différents. Ainsi, la représentation écrite des textes de droit ne permet pas une visualisation des liens multidimensionnels qui structurent le droit.

L'analyse dynamique du droit vise à mettre en lumière ces liens et ces structures, pour permettre leur analyse qualitative, quantitative et statistique. Pour cela, le cadre méthodologique de cette recherche s'appuie sur la conceptualisation et la création d'une base de données relationnelle, structurant les liens multidimensionnels du droit (2.1). Par ailleurs, l'ambition de mesurer le potentiel de protection offert par le droit requiert le développement d'un cadre conceptuel permettant de définir de futurs indicateurs (2.2). *In fine*, la compilation des données dans un indice du potentiel de protection offert par le droit met en valeur la complémentarité des analyses qualitatives et quantitatives (2.3).

De la représentation ontologique à la création d'une base de données relationnelle

La conception d'une base de données relationnelle est un préalable à la poursuite d'analyses dynamiques du droit, en permettant de mettre en valeur la complexité du droit pour la rendre analysable. Ce processus s'est déroulé en trois étapes, respectivement la représentation ontologique des textes de droit, l'élaboration du modèle conceptuel, et enfin la mise en place du modèle physique de la base de données.

Le développement d'une base de données relationnelle nécessite de décomposer le phénomène observé en ensembles (ou classes) de données similaires décrites par des attributs (ou propriétés) et des relations entre les différents ensembles. En informatique et en sciences de l'information, ce processus est décrit par le mot "ontologie". Les ontologies sont la description des parties composant un système et des relations entre ces parties. Elles constituent un "niveau sémantique" dans le processus de développement des bases de données, avant les niveaux "conceptuels" ou "physiques" plus techniques. Par exemple, voici une description ontologique du processus par lequel le droit protège les océans de la pollution plastique :

'Pour lutter contre la pollution plastique, un pays peut adopter un ou plusieurs textes juridiques interdisant les sacs plastiques, composés de plusieurs articles. La mise en œuvre de cette interdiction peut nécessiter l'adoption d'autres textes. Pour que l'interdiction soit appliquée, des contrôles doivent être organisés avec la possibilité de prononcer des sanctions. Le respect des règles peut être facilité par la définition précise de l'objet de l'interdiction. Le recours aux exceptions doit être limité. Des instruments politiques autres que l'interdiction peuvent être utilisés, comme la taxation et l'obtention de permis".

Des ensembles et des relations émergent de cette description, et le lecteur peut commencer à imaginer une liste d'attributs pour chaque ensemble. Par exemple, les attributs de l'ensemble de textes pourraient être la date d'adoption et le titre du texte. Les autres ensembles qui émergent sont les ensembles « articles », « sanctions », « contrôles », « objet », « instrument ». Les caractéristiques de chaque relation émergent également. Par exemple, un seul pays peut (contrainte non obligatoire) adopter un ou plusieurs textes (contrainte de quantité) ; au contraire un texte juridique est composé (contrainte obligatoire) de plusieurs articles (contrainte de quantité).

L'élaboration du modèle conceptuel est l'étape suivante. Il s'agit ici de traduire la représentation ontologique du phénomène analysé en un schéma sur lequel se baser pour le développement de la future base de données.

Ce processus est essentiel, car une base de données mal conceptualisée peut manquer de robustesse, complexifier son utilisation ou introduire un biais dans l'analyse du système. La modélisation conceptuelle est également un outil de communication utile entre des personnes d'horizons différents dans une approche interdisciplinaire, car son schéma simplifie la compréhension d'un phénomène complexe.

Cette étape se déroule par tâtonnements, l'identification des défaillances d'un schéma conduisant à une reconceptualisation, jusqu'à ce qu'aucune défaillance ne puisse être identifiée. À titre d'exemple, un défaut émerge de la représentation ontologique ci-dessus. Si la base de données était développée suivant ce schéma, elle ne pourrait répondre qu'à des requêtes sur la réglementation des sacs plastiques. Une autre base de données devrait être développée pour étudier d'autres objets. Les sacs en plastique ne devraient pas apparaître en tant que tels, mais plutôt comme un attribut d'un ensemble plus vaste de données appelé "objet". Une autre limite

émerge de cette représentation ontologique : en reliant chaque ensemble à l'ensemble 'texte', la recherche dans la base de données perd en robustesse. Les analyses en droit nécessitent la citation de l'article pertinent du texte juridique plutôt que la seule citation du texte. Dans ce contexte, les ensembles doivent donc être en relation directe avec l'ensemble 'article', lui-même lié à l'ensemble 'texte'.

Le modèle conceptuel est également l'occasion d'identifier plus précisément le type de liens entre les différents ensembles : par exemple, inclusion ou exclusion ; parent/enfant ; obligatoire/non obligatoire ; un à un/ plusieurs à un/ plusieurs à plusieurs. C'est à cette étape que l'ensemble des rubriques est défini.

Enfin, le modèle physique est la traduction du modèle conceptuel en un système opérationnel, compréhensible par le logiciel de la base de données. Il nécessite de programmer une méthode d'identification (ID) de chaque ensemble, à la fois consultable et unique. Les relations entre les différents ensembles sont créées à travers ces ID¹¹⁸⁸.

Pour être pleinement opérationnelle, la base de données doit ensuite être remplie avec les données pertinentes. Cela nécessite la collecte des textes juridiques dans les bases de données internationales, telles que ECOLEX¹¹⁸⁹, EUR-Lex¹¹⁹⁰ ou FAO-Lex¹¹⁹¹ ou telle que Légifrance¹¹⁹² au niveau national. L'analyse de ces textes permet de faire émerger les différentes classes et les valeurs des différents attributs, pour le remplissage de la base de données¹¹⁹³.

¹¹⁸⁸ Dans le cadre de l'expérimentation de la méthode, actuellement en cours sur la problématique des sacs plastiques dans 7 pays, le logiciel Filemaker Pro Advance 16 a été choisi pour accueillir la base de données.

¹¹⁸⁹ ECOLEX, <https://www.ecolex.org/fr/>, consulté le 21/02/2022.

¹¹⁹⁰ EUR-Lex, <https://eur-lex.europa.eu/homepage.html?locale=fr>, consulté le 21/02/2022.

¹¹⁹¹ FAOLEX, <https://www.fao.org/faolex/fr/>, consulté le 21/02/2022.

¹¹⁹² Légifrance, <https://www.legifrance.gouv.fr>, consulté le 21/01/2022.

¹¹⁹³ Les données collectées dans le cadre de l'expérimentation sur la réglementation des sacs plastique dans 7 pays sont disponibles dans l'entrepôt de données DataSuds. Billant Odeline, 2022, "Plastic bag regulation database", <https://doi.org/10.23708/ZM80DR>, DataSuds, V1.

2.2 Cadre conceptuel de la mesure du potentiel de protection du droit

Le point commun entre les textes juridiques réglementant une source de pollution, quel que soit le contexte politique, juridique ou socio-économique, est l'objectif de couper cette source de pollution.

Il peut y avoir, dès le départ, un écart entre l'intention déclarée et les dispositions techniques contenues dans le texte (écart de conception). Deux autres écarts peuvent apparaître : soit entre ce qui est prévu dans les textes et ce qui est appliqué sur le terrain (écart d'application), soit entre les effets résultant de l'application du texte et ce qui aurait été nécessaire pour résoudre le problème en jeu (écart d'efficacité). Notre recherche se concentre sur l'écart de conception.

Ce focus a été choisi pour plusieurs raisons. Premièrement, l'existence et les caractéristiques d'un écart de conception peuvent avoir un impact sur les écarts d'application et d'efficacité. Deuxièmement, l'analyse des lacunes en matière d'application et d'efficacité nécessite une approche interdisciplinaire qui n'a pas été possible ici pour des raisons de temps. Troisièmement, l'analyse de l'écart conceptuel souligne l'importance de la conception de la loi et met en avant les approches différenciées d'un même problème. Une fois ces approches différenciées cartographiées, il est possible d'analyser et de comparer les résultats, ou en d'autres termes les écarts d'application et d'efficacité.

Pour susciter le changement - ou le limiter - la loi doit être exhaustive dans sa compréhension du problème, et ferme dans son application. Une loi non exhaustive peut avoir tendance à manquer sa cible ou à laisser place à tant d'exceptions que l'existence d'une règle devient une exception en soi. Le potentiel de contrainte porté par la loi doit par ailleurs être suffisant pour susciter le changement, et garantir son respect.

L'analyse de l'exhaustivité de la règle revient à caractériser « ce sur quoi » porte la réglementation, en termes d'objet et de pratiques. Reprenant l'exemple de l'interdiction des sacs en plastique, elle peut s'appliquer à différentes étapes de son cycle de vie de la production à son utilisation, en passant par son importation, exportation, ou sa commercialisation. L'interdiction de la seule utilisation est moins englobante que l'interdiction de l'ensemble des étapes. La précision et le caractère englobant de la définition de l'objet de l'interdiction est également central. Une réglementation s'appliquant à un nombre très réduit de sacs plastiques est peu susceptible d'avoir un effet. Dans le même ordre d'idée, le nombre et le type d'exceptions à la règle influence directement le potentiel de protection de la règle.

De manière complémentaire, la fermeté avec laquelle la réglementation est susceptible d'influencer les comportements est dépendante de l'instrument utilisé, de l'existence de contrôles et des caractéristiques des sanctions prévues. De l'interdiction à la taxation en passant par l'obtention de permis, l'édiction de standards ou encore la sensibilisation du public, il existe une variété d'instruments pour influencer ou diriger les comportements des acteurs. Tous ces instruments n'ont pas le même potentiel de contrainte, en laissant différents degrés de liberté aux acteurs. Par exemple, au sein des instruments dits « contraignants », l'interdiction est beaucoup plus ferme que la taxation, qui permet l'utilisation de l'objet incriminé moyennant un certain coût.

2.3 Vers un indice du rôle potentiel de protection du droit : la complémentarité d'analyses qualitatives et quantitatives

Pour établir un indice du rôle potentiel de protection du droit il est nécessaire de réaliser des analyses quantitatives et qualitatives

La recherche qualitative « tente de saisir et de catégoriser les phénomènes sociaux et leurs significations » (Webley 2010), tandis que la recherche quantitative permet de « mesurer le degré de présence d'une caractéristique » (Kirk et Miller 1986). Ces deux approches sont complémentaires, éclairant différents aspects d'une même problématique (Wulf 2016). Par exemple, la recherche qualitative peut être utilisée lorsque la quantification n'est pas possible, ou pour apporter des nuances aux résultats quantitatifs. Les analyses qualitatives permettent également de présenter le sujet de l'analyse dans sa complexité, alors que les analyses quantitatives tendent à le simplifier pour en faire émerger les traits saillants (Wulf 2016).

Le développement simultané de ces analyses qualitatives et quantitatives aboutit à deux types de résultats. Le premier met l'accent sur la diversité et la complexité des réglementations nationales sur une même source de pollution, remettant en cause la capacité des pays à unir leurs forces. Le second met en lumière les points forts et les points faibles de la réglementation, en matière d'exhaustivité et de force potentielle. Tous deux contribuent à caractériser le potentiel de protection offert par les réglementations nationales dans leur lutte contre une source commune de pollution.

Ces analyses nécessitent l'élaboration de variables et d'indicateurs permettant de mesurer le caractère exhaustif et le potentiel de force de la règle. Une variable est une mesure dont la valeur peut changer à travers le temps ou l'espace, fournissant des informations sur les caractéristiques d'un concept donné. Un indicateur est un type de variable mesuré au regard d'un objectif donné. Un indicateur « révèle les positions relatives (par exemple d'un pays) dans un domaine donné » (OECD et JRC European Commission 2008).

Par exemple, une variable décrivant la force des sanctions pourrait être le type de sanctions (variable qualitative) ou le nombre de sanctions (variable quantitative), mais un indicateur devrait caractériser cette variable par rapport à l'objectif de maximiser le potentiel de force du droit. La variable qualitative du type de sanction serait ainsi transformée en un indicateur semi-quantitatif, attribuant des valeurs plus élevées aux sanctions plus contraignantes (par exemple, une peine de prison est considérée comme plus contraignante que le paiement d'une amende).

Les variables peuvent être codées de différentes manières. Les variables binaires (également appelées booléennes) sont codées soit 0 soit 1. 0 signifie l'absence, et 1 la présence. Les variables qualitatives sont une description textuelle des données. Pour faciliter leur agrégation, elles peuvent être notées selon une échelle quantitative (par exemple de 0 à 3) fixée arbitrairement : ce sont des variables semi-quantitatives. Enfin, les variables quantitatives sont des variables correspondant à un nombre.

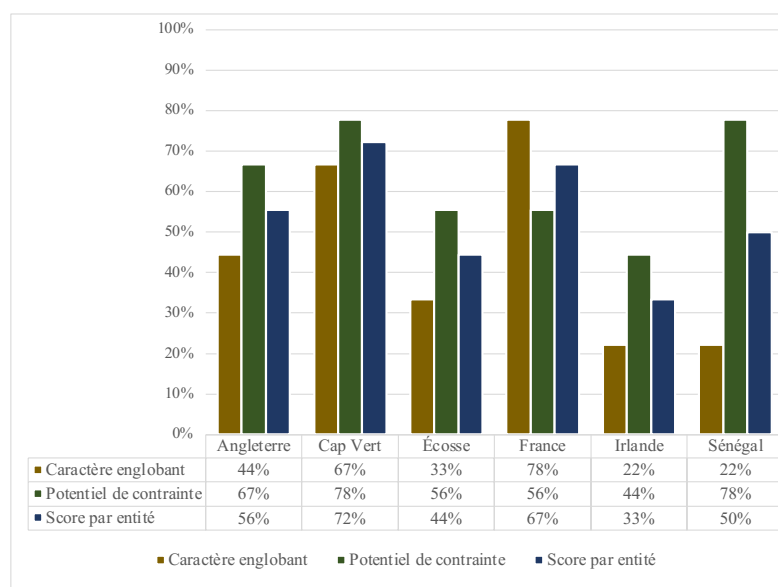
L'expérimentation sur la réglementation des sacs en plastique repose sur l'utilisation de variables semi-quantitatives. Le tableau 1 présente les différents indicateurs du caractère exhaustif de la règle et de son potentiel de contrainte, ainsi que l'échelle à 4 niveaux sur lesquels ils sont évalués.

Tableau 1 : Indicateurs et critères d'évaluation

Caractère exhaustif de la règle	
Nom	Calcul du score
Niveau d'application de la réglementation	0 : il n'y a pas de distinction faite sur la base du niveau à laquelle la règle s'applique 1 : la règle s'applique en aval (commercialisation, utilisation) 2 : la règle s'applique en amont (production, import) 3 : la règle s'applique à tous les niveaux.
Caractère englobant de l'objet	0 : il n'y a pas de définition de l'objet de la règle 1 : la définition fournie est vague et / ou imprécise 2 : la définition est claire mais non englobante 3 : la définition est à la fois claire et englobante
Champ d'application des exceptions	0 : l'exception est vague, avec des contours flous et poreux 1 : l'exception est précisément définie, mais son champ d'application est large 2 : l'exception est précisément définie et son champ d'application est restreint 3 : il n'y a pas d'exception à la réglementation
Potentiel de contrainte de la règle	
Nom	Calcul du score
Force de contrainte de l'instrument	0 : seuls des instruments volontaires sont prévus (informationnels ou coopératifs) 1 : seules des instruments de type incitations économiques sont prévus (ex. taxation) 2 : seule une interdiction est prévue 3 : différents types d'instruments sont prévus
Organisation des contrôles	0 : aucun contrôle n'est prévu 1 : des contrôles sont prévus, mais aucune administration n'est explicitement chargée de les mener 2 : des contrôles sont prévus, une ou plusieurs administrations sont en charge des contrôle ; la procédure n'est pas définie 3 : des contrôles sont prévus, l'administration en charge est définie ainsi que la procédure
Provision de sanctions	0 : aucune sanction n'est prévue 1 : il y a un nombre limité de sanctions, limitées en force 2 : les sanctions prévues ont une force significative 3 : il y a différents types de sanctions, dont certaines ont une force significative

L'agrégation des différents indicateurs sélectionnés permet d'obtenir, pour chaque pays d'étude et pour chaque question clé, un score du caractère exhaustif et du potentiel de force de la règle de droit. Ces scores peuvent ensuite être agrégés à l'échelle du pays, permettant de comparer le potentiel de protection de l'environnement garanti par le droit de différents pays. Le graphique 2 présente les résultats obtenus pour les 6 entités analysées ayant adopté une réglementation des sacs plastique.

Graphique 2 : Scores du caractère englobant, du potentiel de contrainte, et scores agrégés par entité.



Données collectées par les auteurs

Enjeux d'un droit de l'environnement numérique

L'application de cette méthode à l'analyse de la réglementation des sacs en plastique dans 7 pays bordant l'océan Atlantique a permis de mettre en lumière les enjeux d'un droit de l'environnement numérique. Si quelques difficultés méthodologiques restent à lever (3.1), cette expérimentation a également permis de montrer en quoi les outils développés peuvent faciliter l'accès au droit (3.2), et en quoi les résultats obtenus permettent de faire un pas de plus vers une meilleure protection de l'environnement (3.3).

Des difficultés méthodologiques restant à lever

Dans un pays donné, les textes juridiques protégeant l'environnement peuvent être adoptés à différentes échelles géographiques, de l'échelle municipale à l'échelle nationale, en passant par le niveau fédéré au sein des États fédéraux. La répartition de cette compétence varie en fonction des pays, et en fonction des thématiques étudiées. De plus, certaines sources de pollution, comme les polluants organiques persistants dont certains pesticides, sont également réglementées au niveau international. L'application de la méthodologie à une nouvelle thématique ou à un nouveau pays nécessite donc des recherches approfondies pour déterminer les spécificités liées au partage des compétences dans ce contexte particulier.

Dans cette recherche, l'analyse du droit adopté à l'échelle nationale est évaluée et pour privilégier la comparaison des réglementations adoptées par différents pays. Il faut toutefois souligner que de nombreuses règles sont désormais prises à l'échelle décentralisée ou fédérale. Ainsi, la réglementation des sacs en plastique par la ville de Sao Paulo, qui comporte une population de près de 12 millions de personnes¹¹⁹⁴ joue un rôle dans la protection de l'environnement. À ce stade du développement de la méthode, cette règle ne peut pas être prise en compte.

Pour l'instant, la capacité de la méthode à évaluer les normes dans les États fédéraux a été testée sur la base d'exemples. Ainsi, un nombre limité d'États fédérés ont été analysés au sein d'États fédéraux. L'objectif était ici de tester la méthode plus que d'obtenir des résultats, des recherches devront être développées pour compléter cette démarche. Dans le cas particulier de l'analyse de

¹¹⁹⁴ Instituto Brasileiro de Geografia e Estatística, <https://www.ibge.gov.br>, accessed 06/04/2022. À titre de comparaison, la population de cette ville avoisine celle du Sénégal, et représente près de vingt fois celle du Cap Vert.

l'interdiction des sacs en plastique, l'exemple de la réglementation aux États Unis d'Amérique est parlant. Au début de l'année 2021, dix états fédérés avaient adopté des interdictions de sacs en plastique, et un état avait adopté une réglementation basée sur la taxation¹¹⁹⁵. Dans les trente-neuf états restants, aucune réglementation fédérale ne régleme les sacs plastique à la source. Dans le cadre du test de cette méthode, deux états fédérés ont fait l'objet d'analyses. Cela a permis de montrer la faisabilité de la méthode.

En outre, l'adaptation de la méthodologie à l'analyse des approches développées par des pays de traditions juridiques différentes reste inexplorée. Alors qu'il a été supposé que les approches de la pollution plastique des pays de *common law* et de droit civil étaient comparables en raison de l'importance du droit statutaire sur les questions environnementales, cette hypothèse devrait être confirmée par des recherches supplémentaires. En outre, l'adaptabilité de la méthodologie aux pays appartenant à d'autres traditions juridiques, comme le droit asiatique, le droit coutumier, le droit russe, le droit musulman ou le droit scandinave, devra être explorée.

Malgré ces difficultés techniques, le développement d'indicateurs pour l'analyse du droit est une impulsion pour une nouvelle approche du droit de l'environnement marin.

Faciliter l'accès au droit : une condition d'une meilleure protection de l'environnement

Les apports de l'application de cette méthode à l'analyse du droit sont multiples.

Premièrement, le développement d'une base de données relationnelle adaptée à l'analyse du droit permet de faciliter l'accès aux données juridiques et d'y effectuer des recherches multicritères sur demande. Ainsi, il est possible d'accéder aux données contenues dans la base de données de deux manières : par la consultation et par la recherche selon des critères spécifiques.

La « consultation » est le moyen le plus direct pour accéder aux données de la base. La structure de la base de données permet de présenter les données sous différents formats. Il est ainsi possible d'offrir une vue horizontale de la réglementation sur différents tableaux (par exemple,

¹¹⁹⁵ National Conference of State Legislature, <https://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx>, accessed 06/04/2022.

articles, instruments et sanctions liés à un objet commun) par la création de rapports, ou une représentation verticale de données similaires dans différents pays (par exemple, les caractéristiques des instruments utilisés dans différents pays) par la création de listes.

La « recherche » permet de sélectionner un ou plusieurs critères à satisfaire ou à omettre simultanément dans la recherche. Cet outil permet d'effectuer des recherches dans la base de données adaptées à des besoins spécifiques. Il garantit un accès flexible à la base de données pour répondre à une diversité de questions de recherche.

L'extraction de données permet d'aller plus loin que la visualisation de ces relations internes, en permettant des analyses statistiques complémentaires sur la récurrence de schémas relationnels similaires entre pays, mais aussi le développement d'indicateurs.

Cette base de données ouvre donc des perspectives en termes de recherche, mais pourrait également faciliter l'accès à des données juridiques nationales dans le cadre d'évaluation globale de l'état de l'environnement. Si actuellement la phase d'entrée des données dans la base de données peut être fastidieuse, l'utilisation de l'intelligence artificielle pourrait fluidifier cette étape.

Deuxièmement, les analyses centrées sur le potentiel de protection offert par le droit, via l'analyse du caractère exhaustif des textes et du potentiel de contrainte, permettent de qualifier le contenu des textes au regard de leur objectif de protection. Elles permettent donc de mettre en avant et de comparer, qualitativement et quantitativement, les forces et les faiblesses du droit adopté par différents pays. En ce sens, les indicateurs du rôle potentiel de protection du droit peuvent faciliter le suivi, dans le temps et dans l'espace, de la non-régression du droit de l'environnement. Pour cela, la méthodologie devra être appliquée à un nombre croissant de pays et de thématiques, soulevant quelques défis techniques.

Un premier pas pour démontrer « où, quand et comment le droit protège l'environnement »

Le développement de cette méthodologie permet de donner l'impulsion d'une nouvelle approche du droit de l'environnement.

Les indicateurs développés ici mesurent le potentiel englobant et le potentiel de contrainte des régimes juridiques encadrant une source de pollution, dans le but d'identifier dans quelle mesure le texte juridique, tel qu'il a été adopté, est susceptible de protéger l'environnement.

Cette approche met en avant le fait que pour que le droit puisse être protecteur, il doit non seulement être applicable, et donc détenir tous les « ingrédients » nécessaires pour modifier les comportements visés, mais aussi s'attaquer à la problématique visée de manière englobante. Les premières applications de la méthodologie sur la réglementation des sacs en plastique dans sept pays ont montré qu'il existe de nombreuses failles dans ces deux dimensions.

Ces résultats pourraient servir à des fins diverses, l'objectif général étant de favoriser la protection de l'environnement en rendant visible le rôle joué par le droit de l'environnement dans sa protection.

Tout d'abord, les informations sur l'état de la protection potentielle offerte par les textes juridiques actuellement en vigueur, telles que fournies par les indicateurs développés, sont essentielles pour pousser à la réforme du droit et à l'adoption de textes plus englobants et plus contraignants en matière de protection de l'environnement. Ces informations, disponibles en libre accès, contribueront à l'information et à la participation du public, reconnu comme un pilier de la protection de l'environnement. La multiplication des thématiques analysées pourrait en outre permettre de mettre en évidence l'existence de schémas récurrents d'un pays à un autre ou d'une thématique à une autre.

Ensuite, la compilation et l'analyse systématiques des textes juridiques sur une thématique donnée permettront de suivre l'évolution du contenu du droit de l'environnement, qu'il s'agisse de sa progression ou de sa régression. Même si le principe de non-régression a été reconnu comme un principe du droit de l'environnement, ce dernier est fréquemment attaqué pour des motifs économiques, sanitaires ou sécuritaires.

Enfin, la mesure du potentiel de protection peut être considérée comme un premier pas vers la mesure de l'application du droit de l'environnement et de son efficacité en pré-identifiant ses points de faiblesse. Dès lors, cette mesure contribuera à renforcer l'utilité sociale du droit en rendant visible sa contribution à la protection de l'environnement.

Conclusion

Le développement du droit de l'environnement marin est un enjeu essentiel depuis le milieu du XXe siècle, avec pour objectif de protéger les mers et les océans en permettant de faire évoluer les comportements humains vers une plus grande régulation des écosystèmes (Smith, Vivero,

et Agardy 2015 ; Rayfuse 2017). L'océan, jouant un rôle central dans l'équilibre fragile du climat et fournissant des ressources non mesurées essentielles au développement humain¹¹⁹⁶, mérite d'offrir une base au développement d'une nouvelle approche à l'analyse du droit de l'environnement, visant à rendre visible la contribution du droit à la protection de l'environnement, et ses évolutions, positives ou régressives.

Les premières pierres de l'édification de cette méthode ayant été posées par une thèse l'appliquant à la réglementation des sacs en plastique dans 7 pays atlantiques, ces recherches sont actuellement poursuivies dans le cadre du projet AIME (*Artificial Intelligence and Marine environment*) pour automatiser l'extraction des informations juridiques en utilisant des techniques de traitement automatisé des langues en élargissant à la fois le nombre de pays et les thématiques.

Bibliographie

Bignami, Francesca. 2016. « Formal Versus Functional Method in Comparative Constitutional Law ». *Osgoode Hall Law Journal* 53 (2) : 442-71. <https://doi.org/10.2139/ssrn.2835721>.

Darpo, Jan, et Annika Nilsson. 2010. « On the Comparison of Environmental Law Emerging Theories in Environmental Law ». *Journal of Court Innovation* 3 (1) : 315-36.

Davis, Kevin E., Benedict Kingsbury, et Sally Engle Merry. 2012. « Indicators as a Technology of Global Governance ». *Law & Society Review* 46 (1) : 71-104.

———. 2015. « The Local-Global Life of Indicators: Law, Power and Resistance ». Dans *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law.* , 1-23. New York : Cambridge University Press.

Dolowitz, David P., et David Marsh. 2000. « Learning from Abroad: The Role of Policy Transfer in Contemporary Policy-Making ». *Governance* 13 (1) : 5-23. <https://doi.org/10.1111/0952-1895.00121>.

Donald, David C. 2015. « Law in Regression - Impacts of Quantitative Research on Law and Regulation ». *Columbia Business Law Review* 2015 (2) : 520-612.

Frydman, Benoît, et William Twining. 2015. « A symposium on global law, legal pluralism and legal indicators ». *The Journal of Legal Pluralism and Unofficial Law* 47 (1) : 1-8.

¹¹⁹⁶ Voir par exemple l'Objectif du Développement Durable n°14, « Conserver et exploiter de manière durable les océans, les mers et les ressources marines aux fins du développement durable ».

- Galligan, Denis. 2010. « Legal Theory and Empirical Research ». Dans *The Oxford Handbook of Empirical Legal Research*. par Peter Cane et Herbert Kritzer, 1112. Oxford : Oxford University Press.
- Gunningham, Neil. 2011. « Enforcing Environmental Regulation ». *Journal of Environmental Law* 23 (2) : 169-201.
- Gutteridge, Harold C. 1949. *Comparative Law, An Introduction to the comparative method of legal study and research*. 2nd Edition. Cambridge, United Kingdom : Cambridge University Press.
- Hammond, Allen. 1995. « Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development ».
- Kirk, Jerome, et Marc Miller. 1986. *Reliability and Validity in Qualitative Research*. Beverly Hills : SAGE Publications, Inc.
- Kramer, Ludwig. 2016. *Enforcement of Environmental Law*. Cheltenham, UK : Edward Elgar Publishing Ltd.
- La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, et Robert W. Vishny. 1998. « Law and Finance ». *Journal of Political Economy* 106 (6) : 1113-55.
- Martin, Paul, et Amanda Kennedy. 2015. *Implementing Environmental Law*. IUCN Academy of environmental law series. Camberley, United Kingdom : Edward Elgar Publishing Limited.
- Merryman, John Henry. 2000. « Law and Development Memoirs II: SLADE ». *The American Journal of Comparative Law* 48 (4) : 713-27.
- OECD, et JRC European Commission. 2008. « Handbook on Constructing Composite Indicators. Methodology and User guide ». Paris, France : Organisation for Economic Co-operation and Development.
- Prieur, Michel, Christophe Bastin, et Mohamed Ali Mekouar. 2021. « Mesurer l'effectivité du droit de l'environnement. Des indicateurs juridiques au service du développement durable ». 2. Brussels, Belgium : Chaire de Normandie pour la Paix.
- Rayfuse, Rosemary. 2017. *Research Handbook on International Marine Environmental Law*. Cheltenham, UK Northampton, MA : Edward Elgar Publishing Ltd.

- Reiling, Dory, Linn Hammergren, et Adrian Di Giovanni. 2007. « Law & Justice Institutions - Justice Sector Assessment Handbook: Carrying out a Justice Sector Diagnostic ». *American Society of International Law and the International Judicial Academy* 2 (2) : 100.
- Restrepo Amariles, David. 2015. « Legal indicators, global law and legal pluralism: an introduction ». *The Journal of Legal Pluralism and Unofficial Law* 47 (1) : 9-21.
- Robinson, Nicholas A. 1997. « Comparative Environmental Law: Evaluating How Legal Systems Address Sustainable Development ». *Environmental Policy and Law* 27 (4) : 338-47.
- Ruhl, J.B. 1996. « Complexity Theory as a Paradigm for the Dynamical Law-and-Society System: a Wake-Up Call for Legal Reductionism and the Modern Administrative State ». *Duke Law Journal* 45 (5) : 849-928.
- Siems, Mathias. 2011. « Measuring the Immeasurable: How to Turn Law into Numbers ». Dans *Does Law Matter? On Law and Economic Growth*. Sous la direction de Michael Faure et Jan Smits, 115-36. Cambridge, United Kingdom : Intersentia.
- . 2018. *Comparative Law*. 2ème. Cambridge : Cambridge University Press.
- Silver, Carole, et Louis Rocconi. 2015. « Learning from and about the Numbers Journal of Legal Metrics ». *Journal of Law* 5 (1) : 53-84.
- Smith, Hance D., Juan Luis Suárez de Vivero, et Tundi S. Agardy. 2015. *Routledge Handbook of Ocean Resources and Management*. London ; New York : Routledge.
- UNE. 2018. « Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations ». Nairobi : United Nations Environment.
- Webley, Lisa. 2010. « Qualitative Approaches to Empirical Legal Research ». Dans *The Oxford Handbook of Empirical Legal Research*. par Peter Cane et Herbert Kritzer, 1112. Oxford : Oxford University Press.
- White, Kenneth R., et R. Thomas Jr. Stone. 1978. « Quantitative Methods and the Legal Profession Commentary on Praxis ». *New York University Law Review* 53 (Issues 2 & 3) : 672-76.
- Worker, Jesse, et Lalanath De Silva. 2015. « The Environmental Democracy Index: Technical note ». Washington DC : World Resources Institute.
- World Bank Group. 2020. « Doing Business 2020 ». Washington DC : World Bank.

Wulf, Alexander J. 2016. « The Contribution of Empirical Research to Law ». *Journal Jurisprudence* 29 : 29-49.

Annex XVI Publications and communications during the PhD thesis

Publications

2020

Bonnin M., **Billant O.**, 2020, Medir a eficácia da legislação ambiental marinha: otimizar a proteção ambiental através do uso de ferramentas inovadoras, in Teles da Silva S. Duarte dos Santos M., Francisco Nagao Menezes F (Ed.). “Direitos, Cidadania e Desenvolvimento Sustentável”, Eseni Editora, Softwares E Empreendimento Educacionais Ltda, Sao-Paulo, Brésil

Billant O., Daffe A., Ndiaye F., Ly I. et Bonnin M., « La réglementation des sacs plastiques au Sénégal : une étape vers sa transition énergétique ? », *Revue Africaine du Droit de l’Environnement*, n°6, p. 127-141.

2021

Queffelec B., Bonnin M., Ferreira B., Bertrand S., Teles Da Silva S., Diouf F., Trouillet B., Cudennec A., Brunel A., **Billant O.**, Toonen H., « Marine spatial planning and the risk of ocean grabbing in the tropical Atlantic », *ICES Journal of Marine Science*, 2021, fsab006, <https://doi.org/10.1093/icesjms/fsab006>.

Billant O., Bonnin M., 2021, « Vers l’interdiction des sacs plastique en Afrique atlantique : une analyse numérique en droit de l’environnement », *Mondes en Développement*, n°193, De Boeck Supérieur, 2021, n°1, p.7-25.

Billant O., Bonnin M., “Regulating plastic bags along the Atlantic coast: a numerical experiment in environmental law”, 2021, *Confluence des droits*, en cours de publication.

2022

Ly I., **Billant O.**, Ndiaye F., Diedhiou M., Diallo M. A., Ndiaye B., Ndao Souleye, Ngaido M., Bonnin M., « Opportunités et limites de la PSM au Sénégal », in press.

Billant O., Bonnin M., « Droit de l’environnement et analyses numériques - ou comment mesurer la protection de l’océan par le corpus juridique ? », *HumaNum*, soumis.

Communications

2019

Bonnin M., **Billant O.**, “Ocean LAM: where, when and how law protects the ocean”, séminaire international de la Chaire Normandie pour la Paix, MSHN, Caen, 22 novembre 2019.

Billant O., Armstrong J., Barroca E., Vad J., “Atlantic Youth Ambassadors”, 6th Atlantic Stakeholder Platform Conference, Porto, 13 novembre 2019.

2020

Billant O., Vad J., “All-Atlantic Ocean Youth Ambassador Initiative”, iAtlantic Fellows webinar, 20 avril 2020, en ligne.

2021

Billant O., Daffé A., Ndiaye F., Ly I., Bonnin M., « La réglementation des sacs plastiques au Sénégal : une étape vers sa transition énergétique ? », Symposium Energies renouvelables, transition énergétique et enjeux climatiques en droit africain, 3 et 4 juin 2021, en ligne.

Billant O., Bonnin M., « La réglementation des sacs plastique autour de l’océan Atlantique, une expérimentation numérique en droit de l’environnement », Monaco Ocean Week, 22-26 mars 2021, en ligne.

Billant O., “Regulating plastic bags in countries bordering the Atlantic ocean: analyses of diverging strategies”, Séminaire inter-équipes du LEMAR, Plouzané, 5 février 2021, en ligne.

Annex XVII Valorisation and teaching during the PhD

Valorisation

- **Participation to a science popularisation conference**

Billant O., « Détours et tourments des déchets marins flottants : une approche juridique », The Sea Cleaners et Fondation Belem, Brest, 29 avril 2022.

- Selection as the French **Youth Ambassador for the Atlantic Ocean** (2019-2020), a programme endorsed by the European Commission through the AAORA-ANCHOR projects.
- Observer to the scientific committee of the Sea Cleaners, a non-governmental organization fighting plastic pollution in the ocean, <https://www.theseacleaners.org/fr/accueil/>.
- Intervention in a class of CE1 (seven years old) to explain the functioning of law. Part of the programme of Oceanopolis, les Eco-Conseillers de l’Océan.

Teaching

- **“Droit constitutionnel”**: L1 droit, 3 classes, total de 54 heures de cours
- **“Science politique”**: L3 AES, 1 classe, total de 7 heures de cours

Annex XVIII Glossary

This glossary provides definitions of commonly used terms in this work, and their translation in French. This work is necessary in the context of a bilingual work, and brings to light translation issues. In addition, linguistic dissymmetry illustrates the complexity of multilingual work, and the necessity to explicitly define each term's meaning.

Each word is analysed through definitions, translations and uses found in legal and non-legal dictionaries, articles, and books. For official translations of international law documents, official databases such as IATE (Interactive Terminology for Europe), UNTERM (the United Nations Terminology Database)¹¹⁹⁷ or Québec's governmental thesaurus¹¹⁹⁸ have been consulted. Reference to these words in the body of legal research is also used.

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¹¹⁹⁷ See <https://unterm.un.org/unterm/portal/welcome> accessed on 18/01/2022.

¹¹⁹⁸ See <http://www.thesaurus.gouv.qc.ca/tag/accueil.do> accessed on 18/01/2022.

Glossary entry 1: Compliance

Definition in English

The word compliance has several meanings in English, which reflect the adopted viewpoint. Either “obedience, submission, conformance” from the enforcer’s viewpoint or “assent, consent, acquiescence” from the regulatee’s¹¹⁹⁹. In both cases, compliance relates to the state by which one abides by the law, either voluntarily or through enforcement. In other terms, it is an “agreement to do what is ordered”¹²⁰⁰.

Example

A person using a plastic bag despite the in force ban on the use of plastic bags would not be in compliance with the law.

Translation in French

In French, the expression “in compliance with the law” could be translated in “*conformément à la loi*”¹²⁰¹ *ou au droit*. The translation of the verb “to comply” requires the use of a periphrase, such as “*être en conformité*”. As such, the European Union translates “legal compliance” by “*respect de la législation*”¹²⁰².

Translation issues

The word compliance doesn’t raise any particular translation issue.

¹¹⁹⁹ LYNTON Jonathan, *Ballentine’s Legal Dictionary/Thesaurus*, 1st edition, Albany : Rochester, N.Y., Cengage Learning, 1994, 736 p., p. 188.

¹²⁰⁰ COLLIN Peter H., *Dictionary of law*, 3rd ed., Reprinted., London, Peter Collin Publishing, 2002, 398 p., p. 48.

¹²⁰¹ BALEYTE Jean, KURGANSKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème édition., Paris, LGDJ, 2000, 645 p., p. 345.

DHUIQ Bernard et FRISSON Danielle, *Dictionnaire de l’anglais juridique*, Paris, Pocket, 2004, 672 p.

¹²⁰² Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC, OJ L 342, 22.12.2009 ; Règlement (CE) no 1221/2009 du Parlement européen et du Conseil du 25 novembre 2009 concernant la participation volontaire des organisations à un système communautaire de management environnemental et d’audit (EMAS), abrogeant le règlement (CE) no 761/2001 et les décisions de la Commission 2001/681/CE et 2006/193/CE , JO L 342 du 22 décembre 2009.

Glossary entry 2: Comprehensiveness

Definition in English

The word comprehensiveness relates to “the quality of being wide-ranging and large in scope”¹²⁰³. This word is not specific to the study of law. It is here used to characterise the breadth of the scope of the studied legal provisions.

Example

A comprehensive law targeting plastic pollution will be applicable to a large array of plastic objects, and provide for a low number of exceptions.

Translation in French

Translation in French requires the use of a paraphrase, as there is no direct translation of this word. As such, comprehensiveness can be translated as “*le caractère englobant de la règle*” or “*le caractère exhaustif de la règle*”.

Translation issues

There is no specific translation issue, if not the use of a paraphrase.

¹²⁰³ Oxford Dictionary, Lexico, <https://www.lexico.com/definition/comprehensiveness>, accessed on 14/02/2022.

Glossary entry 3: Effectiveness

Definition in English

The word effectiveness can be ambiguous. When used as the state of being effective, it can either be understood as “in force, in effect, in operation” or as “proficient”¹²⁰⁴. As such, it can equally be used to state the capacity of “having the power to produce (...) a desired result”¹²⁰⁵ or “the extent to which the activity’s stated objectives have been met”¹²⁰⁶.

Effectiveness is rarely defined in law dictionaries, more often defining the word effective.

Example

The question as to whether a ban or a taxation is the best solution to eradicate plastic pollution relates to the effectiveness of these policy instruments.

Translation in French

Several translations into French of effectiveness can be found. In the same dictionary, effectiveness is defined as *efficacité* (when translating from English to French) and as *efficient* (when translating from French to English)¹²⁰⁷. For another dictionary, effectiveness, efficacy and efficient are all translated into French as *efficacité*. Effectiveness and efficiency are not exact synonyms. Whereas both terms are related to the capacity to achieve an objective, there is an economic dimension to efficiency, through the maximization of outputs with a minimum of inputs¹²⁰⁸. The United Nations tend to translate effectiveness by *efficacité*¹²⁰⁹.

Translation issues

The word effectiveness poses definition issues in English and translation issues as it can cover a variety of meanings in both languages.

¹²⁰⁴ LYNTON Jonathan, *Ballentine’s Legal Dictionary/Thesaurus*, 1st edition, Albany : Rochester, N.Y., Cengage Learning, 1994, 736 p., p. 207.

¹²⁰⁵ COLLECTIF, *Harrap’s Chambers Compact dictionary of contemporary English*, London, Harrap’s, 2011, 928 p.

¹²⁰⁶ OECD, Glossary of Statistical Terms, accessed <https://stats.oecd.org/glossary/detail.asp?ID=4775> on 10/12/2021.

¹²⁰⁷ BALEYTE Jean, KURGANISKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème édition., Paris, LGDJ, 2000, 645 p., p. 97 et p. 392.

¹²⁰⁸ OECD, Glossary of Statistical Terms, accessed <https://stats.oecd.org/glossary/detail.asp?ID=4776> on 10/12/2021.

¹²⁰⁹ See United Nations Terminology Database <https://unterm.un.org/unterm/search?urlQuery=effectiveness>, accessed 18/01/2022.

Glossary entry 4: Efficiency

Definition in English

The word efficiency is seldomly defined in law dictionaries. Ballentine's Legal Dictionary defines efficient as "able to produce a result", which is very close to definitions of effectiveness¹²¹⁰. Harrap's and OECD's definitions are closer. The first defines efficiency as "producing satisfactory results with an economy of effort and a minimum of waste"¹²¹¹, whereas the second as "achieving maximum output from a given level of resources used to carry out an activity"¹²¹². Both definitions turn around the idea of either minimizing the effort or maximizing the output of a given action.

Example

The question as to whether a ban or a taxation is the cheapest solution to eradicate plastic pollution relates to the efficiency of these policy instruments.

Translation in French

The word commonly used to translate efficiency in French is *efficacité*, which is also used to translate effectiveness¹²¹³. *Efficience* can also be used¹²¹⁴. Québec's governmental thesaurus uses both¹²¹⁵.

Translation issues

Effectiveness and efficiency are complementary terms, which cover differentiated meanings. The first is related to the achievement of an objective, whereas the second adds a dimension of cost minimization and output maximization. Translating both words in French using *efficacité* is therefore impoverishes the meaning of the word. The French word *efficience* must be preferred.

¹²¹⁰ LYNTON Jonathan, *Ballentine's Legal Dictionary/Thesaurus*, 1st edition, Albany : Rochester, N.Y., Cengage Learning, 1994, 736 p., p. 207.

¹²¹¹ COLLECTIF, *Harrap's Chambers Compact dictionary of contemporary English*, London, Harrap's, 2011, 928 p.

¹²¹² OECD, Glossary of Statistical Terms, accessed <https://stats.oecd.org/glossary/detail.asp?ID=4776> on 10/12/2021.

¹²¹³ BALEYTE Jean, KURGANSKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème édition., Paris, LGDJ, 2000, 645 p., p. 97 et p. 392.

¹²¹⁴ Défini comme « Aptitude (d'une machine, d'une technique, d'une personne ou d'une entreprise) à fournir le meilleur rendement », <https://www.cnrtl.fr/definition/efficience>, 29/08/2022/

¹²¹⁵ See Québec's governmental thesaurus, <http://www.thesaurus.gouv.qc.ca/tag/recherche.do?terme=efficiency&x=0&y=0>, accessed 18/01/2022.

Glossary entry 5: Enforcement

Definition in English

Enforcement is a word commonly used in English, reflecting “the act of putting the law into effect”¹²¹⁶, or “the act of process of compelling compliance”¹²¹⁷. Therefore, enforcement relates to the process by which legally binding texts exert a force on regulatees. Through constraint or credible threat of constraint, enforcement brings regulatees to abide by the law ¹²¹⁸. “Enforcement” is in fact the enforcement of compliance¹²¹⁹, “encompassing both voluntary and involuntary mechanisms”. It is intended to both deter persons “from violating the regulations and to force violators to return to compliance”¹²²⁰. As such, it is a “complex social and political process”¹²²¹.

Example

Controls and sanctions are measures of enforcement, aiming to detect and deter non-compliance.

Translation in French

The verb ‘to enforce’ can be translated as « *appliquer, mettre en vigueur, faire exécuter* » and ‘enforcement’ as « *exécution, mise en vigueur* »¹²²² or as « *application, exécution, mise en application* »¹²²³.

The word implementation¹²²⁴ is also commonly translated in French by *application* although it relates to a different step in law adoption processes¹²²⁵. This linguistic dissymmetry requires to

¹²¹⁶ LYNTON Jonathan, *Ballentine’s Legal Dictionary/Thesaurus*, 1st edition, Albany : Rochester, N.Y., Cengage Learning, 1994, 736 p., p. 213.

¹²¹⁷ GARNER Bryan A., *Black’s Law Dictionary*, 10th edition, St. Paul, MN, Thomson West, 2014, 2052 p., p. 644.

¹²¹⁸ RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p.1.

¹²¹⁹ ARDIA David S., « Does the Emperor Have No Clothes? Enforcement of International Laws Protecting the Marine Environment », *Michigan Journal of International Law*, 1998, p. 497-567, p. 3.

¹²²⁰ RUSSEL Clifford S., HARRINGTON Winston et VAUGHAN William J., *Enforcing Pollution Control Laws*, vol. 13, Washington DC, Johns Hopkins University Press, 1986, 248 p., p.16.

¹²²¹ SULLIVAN Larry E. et SIMONETTI ROSEN Marie (dir.), *Encyclopedia of Law Enforcement*, vol. 1, Thousand Oaks, United States, Sage Publications, 2004, 1729 p., p. 22.

¹²²² BALEYTE Jean, KURGANSKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème édition, Paris, LGDJ, 2000, 645 p., p. 97 et p. 395.

¹²²³ DHUICQ Bernard et FRISSON Danielle, *Dictionnaire de l’anglais juridique*, Paris, Pocket, 2004, 672 p.

¹²²⁴ Seen the entry for implementation in this glossary.

¹²²⁵ See the diagram at the end of the glossary.

have recourse to other translations such as *mettre en vigueur* or *mettre en application* to translate enforcement, although these words aren't necessarily commonly used in France. Their use is nonetheless common in Québec¹²²⁶.

Translation issues

The translation of enforcement in French poses significant problems, as it melds up with the translation of implementation, which does not cover the same reality.

¹²²⁶ See Québec's Governmental Thesaurus, <http://www.thesaurus.gouv.qc.ca/tag/terme.do?id=8007>, accessed 18/01/2022.

Glossary entry 6: Forcefulness

Definition in English

The forcefulness of the regulation relates to the quality of being “strong and assertive; vigorous and powerful”¹²²⁷. This word is not specific to the study of law. It is here used to characterise the potential of force of a rule.

Example

A forceful law is sustained by the necessary legal arsenal to curb behaviors. It requires for example the provision for controls and sanctions.

Translation in French

There is no direct translation of the word forcefulness which would correspond in this context. Therefore, the use of a paraphrase, such as “*la fermeté avec laquelle la réglementation est susceptible d’influencer les comportements*” is required.

Translation issues

There is no specific translation issue, if not the use of a paraphrase.

¹²²⁷ Oxford Dictionary, Lexico, <https://www.lexico.com/definition/comprehensiveness>, accessed on 14/02/2022.

Glossary entry 7: Implementation

Definition in English

In a legal context, implementation refers to “the process of bringing any piece of legislation into force”¹²²⁸.

While the main idea and inspiration in pursuit of an objective is defined in statutory law, the means to enforce the provisions can be described and defined by a series of implementing texts, with the objective to “put[ting] law into effect”¹²²⁹. Therefore, implementation is a top-down process internal to law, requiring the design of legal texts precisising its scope and setting the tools that will be used to enforce the law. These texts are often referred to as *règlements d’application* in French as they contribute to the application of law, by defining its means. This process is nonetheless part of what we call “implementation”, as it provides the tools and limits of enforcement powers. In a common law context, regulatory law plays this role (also called delegate, subordinate or secondary legislation in the United Kingdom¹²³⁰).

Most frequently, implementation is pursued by executive bodies.

Example

Compliance with the law is brought through enforcement, which in turn relies on a clear definition of the object of the regulation, and enforcement means such as control and sanction. All the latter is not necessarily provided for in the *loi*, thus requiring implementing provisions.

Translation in French

There is no single translation for the word implementation in French. “*Mise en application*” is most often used¹²³¹, but it can also be translated as “*application*” or “*mise en application*”¹²³².

¹²²⁸ LAW Jonathan, *A Dictionary of Law*, 8th edition, Oxford, United Kingdom, OUP Oxford, 2015, 704 p.

¹²²⁹ As cited here in an EU law context: ANDERSEN Stine, *The Enforcement of EU law: The Role of the European Commission*, Oxford, United Kingdom, Oxford University Press, 2012, 272 p., p. 187.

¹²³⁰ DAVID René, JAUFFRET-SPINOSI Camille et GORÉ Marie, *Les grands systèmes de droit contemporains*, 12ème., Paris, Dalloz, 2016, 539 p., p. 309.

¹²³¹ BALEYTE Jean, KURGANSKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème édition, Paris, LGDJ, 2000, 645 p., p. 441.

DAHL Henry Saint, *Dahl’s Law Dictionary. Dictionnaire Juridique Dahl.*, 2nd edition, Paris, Dalloz-Sirey, 2001, 675 p., p. 509.

DHUIQC Bernard et FRISSON Danielle, *Dictionnaire de l’anglais juridique*, Paris, Pocket, 2004, 672 p.

¹²³² DAHL Henry Saint, *Dahl’s Law Dictionary. Dictionnaire Juridique Dahl.*, 2nd edition, Paris, Dalloz-Sirey, 2001, 675 p., p. 509.

DHUIQC Bernard et FRISSON Danielle, *Dictionnaire de l’anglais juridique*, Paris, Pocket, 2004, 672 p.

“*Mise en oeuvre*” is commonly used by the United Nations in a non-legal context¹²³³. In a legal context, the latter is closer to the notion of enforcement.

Translation issues

The same translations are used for enforcement and implementation.

¹²³³ United Nations Terminology Database, <https://unterm.un.org/unterm/search?urlQuery=implementation>, accessed 18/01/2021.

Glossary entry 8: Rule of law

Definition in English

This expression finds its origin in the analysis of the UK constitution by Professor Dicey (*Law of the Constitution*, 1885). As such, according to *A Dictionary of Law*, it is embodied in three concepts “the absolute predominance of regular law, so that the government has no arbitrary authority over the citizen; the equal subjection of all (including officials) to the ordinary law administered by the ordinary courts; and the fact that the citizen’s personal freedoms are formulated and protected by the ordinary law rather than by abstract constitutional declarations”¹²³⁴. This definition is shared by other legal dictionaries¹²³⁵.

Translation in French and translation issues

There is no commonly accepted translation for the expression “rule of law”. For example, it can be translated as “*Etat de droit*”¹²³⁶, as “*primauté du droit*”¹²³⁷, or as *principe de légalité*¹²³⁸.

¹²³⁴ LAW Jonathan, *A Dictionary of Law*, 8th edition, Oxford, United Kingdom, OUP Oxford, 2015, 704 p.

¹²³⁵ See for example: RICHARDS Paul et CURZON Leslie B., *Longman Dictionary of Law*, 8th edition, Harlow, Longman, 2011, 528 p., p. 272.
GARNER Bryan A., *Black’s Law Dictionary*, 10th edition, St. Paul, MN, Thomson West, 2014, 2052 p., p. 1530.

¹²³⁶ See *Traité sur l’Union européenne*, Maastricht, 1992.

¹²³⁷ See *Charte canadienne des droits et libertés*, partie I de la *Loi constitutionnelle de 1982*, constituant l’annexe B de la *Loi de 1982 sur le Canada (R-U)*, 1982, c11.

¹²³⁸ DAVID René, JAUFFRET-SPINOSI Camille et GORÉ Marie, *Les grands systèmes de droit contemporains*, 12ème., Paris, Dalloz, 2016, 539 p., p. 242.

Glossary entry 9: Statutory law / statute law

Definition in English

Simply put, statutory law (or statute law¹²³⁹) is “law that is promulgated by a statute, as opposed to law that is promulgated by the judiciary” known as case law. By metonymy, statutory law covers “the body of law contained in Acts of Parliament”¹²⁴⁰. A statute is “a law enacted by a legislature; an act”¹²⁴¹ or an “Act of Parliament”¹²⁴². Statutory law and statutes must not be confused with statutory instruments, which are “the most important form of delegated legislation”¹²⁴³, ruled in the United Kingdom by the Statutory Instrument Act (1946), and exercised by “the Queen in Council or a minister”¹²⁴⁴. Statutory instruments are also found in Ireland and in the United States as secondary legislation, the acts passed by the Oireachtas in Ireland and the Congress in the United States, compose the primary legislation.

Translation in French and translation issues

The functional equivalent would be *loi* or *acte législatif*¹²⁴⁵ in French law.

¹²³⁹ GARNER Bryan A., *Black's Law Dictionary*, 10th edition, St. Paul, MN, Thomson West, 2014, 2052 p., p. 1638.

¹²⁴⁰ LAW Jonathan, *A Dictionary of Law*, 8th edition, Oxford, United Kingdom, OUP Oxford, 2015, 704 p.

¹²⁴¹ LYNTON Jonathan, *Ballentine's Legal Dictionary/Thesaurus*, 1st edition, Albany: Rochester, N.Y., Cengage Learning, 1994, 736 p., p. 635.

¹²⁴² PENNER James E., *Mozley and Whiteley's Law Dictionary*, 12th edition, London; Charlottesville, Va, Oxford University Press, 2005, 392 p., p. 344.

¹²⁴³ PENNER James E., *Mozley and Whiteley's Law Dictionary*, 12th edition, London; Charlottesville, Va, Oxford University Press, 2005, 392 p., p. 344.

¹²⁴⁴ RICHARDS Paul et CURZON Leslie B., *Longman Dictionary of Law*, 8th edition, Harlow, Longman, 2011, 528 p., p. 444.

¹²⁴⁵ BALEYTE Jean, KURGANSKY Alexandre, LAROCHE Christian *et al.*, *Dictionnaire économique et juridique*, 5ème Édition, Paris, LGDJ, 2000, 645 p., p. 154.

DAHL Henry Saint, *Dahl's Law Dictionary. Dictionnaire Juridique Dahl.*, 2nd edition, Paris, Dalloz-Sirey, 2001, 675 p., p. 636.

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Titre : Libérer les océans du plastique par le droit : mirage ou horizon ?
Une expérimentation en droit numérique comparé sur les rives de l'océan Atlantique

Mots clés : Droit comparé numérique ; pollution tellurique ; sac plastique ; indicateur juridique ; base de données relationnelle

Résumé : La protection de l'environnement des impacts des activités humaines est l'un des grands défis pour le XXI^e siècle. En particulier, l'océan est confronté à de multiples pressions qui nuisent à sa santé et à sa résilience. La pollution terrestre - principalement causée par le plastique, les pesticides et les eaux usées - représente 80% de la pollution en mer.

Au niveau international et national, les textes juridiques visant à protéger l'océan ont fleuri ces dernières décennies. Néanmoins, en l'absence de méthodologies et d'outils adéquats, il est impossible de déterminer dans quelle mesure cette augmentation du nombre de textes cache des vides de protection, ou contribue à une meilleure protection de l'environnement.

En réponse, cette thèse développe et teste une méthodologie et des outils pour évaluer qualitativement et quantitativement le rôle potentiel du droit à la protection de l'environnement.

Ainsi, un cadre analytique a été conçu, basé sur l'analyse de deux aspects complémentaires des réglementations : leur caractère englobant et leur potentiel de contrainte. Ce cadre permet l'identification d'indicateurs juridiques. En outre, la conception spécifique d'une base de données relationnelle facilite des analyses comparatives multicritères.

La thématique choisie est la réglementation des sacs plastique, objets à usage unique emblématiques. L'approche spatiale est centrée sur l'analyse des textes juridiques adoptés par sept pays bordant l'Océan Atlantique (Brésil, Cap-Vert, France, Irlande, Sénégal, Royaume-Uni et États-Unis d'Amérique).

L'objectif de ce travail est de faciliter le dialogue entre le droit et les autres disciplines, ainsi que l'accès aux données juridiques.

Title: Freeing the oceans from plastic bag pollution through law: mirage or horizon?
An experiment in numerical comparative law on the shores of the Atlantic Ocean

Keywords: Numerical comparative law; land-based pollution; plastic bag; legal indicator; relational database

Abstract: Protecting the environment from damaging human activities is one of humanity's biggest challenges for the XXIst century. As the world's largest ecosystem, the ocean faces multiple threats damaging its health and resilience. Among these threats, land-based pollution – mainly caused by plastic, pesticides and sewage - represents 80% of pollution at sea.

Internationally and nationally, legal texts aiming to protect the ocean have sprouted these last decades. Nevertheless, in absence of adequate methodologies and tools, one cannot determine the extent to which this regulatory bloom hides protection voids, or contributes to an enhanced protection of the environment.

In answer to these challenges, this PhD thesis develops and tests a methodology and tools to qualitatively and quantitatively assess and score adopted legal frameworks' potential contribution to the protection of the environment.

This objective required the design of a new analytical framework, based on the analysis of two complementary aspects of the regulations: their comprehensiveness and their forcefulness. This framework sets the ground for the identification of legal indicators. In addition, the specific design of a relational database enables multicriteria comparative analyses.

The chosen thematic focus is the regulation of plastic bags, iconic single-use and widely regulated objects. The spatial focus is set on the analysis of the legal texts adopted by seven countries across the Atlantic Ocean (Brazil, Cape Verde, France, Ireland, Senegal, United Kingdom and United States of America).

Overall, this work's objective is to facilitate dialogue between law and other disciplines, and access to legal data.