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Societal quality of small-scale fisheries in Mediterranean Sea

Yazdan Soltanpour

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Unité de recherche MOISA

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Societal Quality of Small-Scale Fisheries in the Mediterranean Sea

Présentée par Yazdan SOLTANPOUR
Le 18 Décembre 2019

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THESE

Présentée et soutenue publiquement par

Yazdan SOLTANPOUR

Pour l'obtention du diplôme de Docteur en économie

**SOCIETAL QUALITY OF SMALL SCALE FISHERIES
IN MEDITERRANEAN SEA**

Sous les directions de **1. M. Iuri PERI (Prof)**

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continue behind this hill of unknowns or it will end to an impasse. Either results are valuable. It will allow the prospective researchers either to avoid that path or to take it with more security.

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Yazdan Soltanpour

Montpellier, September 2019

Abstract

The environmental aspects of human produced goods have long been studied while research on social impacts of a product has remained marginal. In order to fill in this gap, this thesis targets the improvement of a social impact assessment tool baptized as Social Life Cycle Assessment (S-LCA). S-LCA is an approach close to the principle of Life Cycle Assessment with the objective of anticipating the potential effects of a change in a product's life cycle on the society. Different approaches have been employed by researchers in the domain since its recent introduction. It is necessary to reach a consensus for a common framework. Insights from sociological perspectives and systems theory have been taken and proposed for the improvement of S-LCA. The principal proposition is to focus on issues such as inclusion/exclusion of agents from their social and working environment.

To verify the validation of the proposed improvements, the case of small-scale coastal fishery has been chosen. Small-scale fisheries (SSF) consist a large part of labor in fishery sector. Politicians and researchers are interested to know how the number of active SSF would change by restricting fishers' activity such as introducing a quota policy or other marine ecosystem conservation strategies. To be able to respond to this question, this thesis has identified the interactions between fishers, their environment (lagoon and sea) and their governance system (EU policies and community norms). An Agent-based model (ABM) is devoted to analyze the interactions between fishers and their correspondent marine environment. Time series data are collected from secondary sources and through interviews with the fishers from fishing communities (Prud'homies) in department of Hérault- French Mediterranean Coast.

The results are presented in four articles that constitute four chapters of the thesis. The first paper is an introduction to SSF and the reason we should ever be interested in maintaining them. The second paper is a methodological development of S-LCA which proposes improvements to its on-going discussions. The third and fourth paper are applications of these propositions and their verification in the case of Sète social-ecological fishery system. In particular, the third paper focuses on the interactions of fishers with their marine ecosystem and the fourth paper focuses on the interactions that the fishing community has with its governance system.

Resumé

Les impacts environnementaux des produits ont longtemps été étudiés, tandis que la recherche sur les aspects sociaux est restée marginale. Afin de combler cette lacune, cette thèse vise à l'amélioration d'un outil d'évaluation de l'impact social baptisée Analyse du cycle de vie sociale (ACV-S). L'ACV-S est une approche proche de celle d'Analyse du Cycle de Vie environnemental avec comme objectif d'anticiper les effets potentiels d'un changement du cycle de vie d'un produit dans la société. Différentes méthodologies ont été utilisées par les chercheurs du domaine depuis son apparition récente. Il est nécessaire de parvenir à un consensus pour un cadre commun. Des idées issues des perspectives sociologiques et de la théorie des systèmes ont été identifiées et proposées pour l'amélioration de l'ACV-S. La proposition principale est de se concentrer sur des questions telles que l'inclusion / exclusion d'agents de leur environnement social et de travail en tant qu'indicateur.

Afin de vérifier l'applicabilité des améliorations proposées, le cas de la petite pêche côtière a été choisi. La petite pêche côtière comprend une grande partie des effectifs du secteur de la pêche. Les politiciens et les chercheurs aimeraient savoir comment le nombre de petits pêcheurs évoluerait en limitant l'activité de pêche en raison par exemple de l'introduction d'une nouvelle politique de quotas ou bien d'une aire marine protégée. Pour pouvoir répondre à ces questions fréquemment posées, cette thèse a permis d'identifier les interactions entre les pêcheurs, leur environnement (lagon et mer) et leur système de gouvernance (les politiques Européennes et les normes locales). Un modèle à base d'agents (ABM) est consacré à l'analyse des interactions entre les pêcheurs et leur environnement marin. Le cœur de la méthodologie repose sur la mesure de l'inclusion et de l'exclusion des agents de leur environnement de travail. Les données de séries chronologiques ont été collectées à partir de sources secondaires et complétées par le biais d'interviews de pêcheurs de communautés de pêcheurs (Prud'homies) dans le département de l'Hérault sur la côte méditerranéenne française.

La recherche est présentée dans quatre articles qui constituent quatre chapitres de la thèse. Le premier document est une introduction à la petite pêche artisanale et explique les raisons pour lesquelles nous devrions toujours nous efforcer la maintenir. Le deuxième article est un développement méthodologique de l'ACV-S qui propose des contributions aux débats en cours. Les troisième et quatrième articles sont des applications de ces propositions et leur mise à l'épreuve dans le cas du système socio-écologique de la pêche de Sète. En particulier, Le troisième article porte plus précisément sur les interactions des pêcheurs avec leur écosystème

marin et le quatrième sur les interactions de la communauté des pêcheurs avec son système de gouvernance.

Abstract

Le problematiche ambientali e la misurazione degli impatti connessi ai beni prodotti dall'uomo sono ampiamente studiate in letteratura, mentre, solo di recente, le implicazioni che la produzione umana ha in termini sociali sono al centro del dibattito scientifico. Questa tesi si propone di colmare questo gap nella conoscenza attraverso l'adozione di una metodologia di valutazione concepita con l'intento di misurare gli impatti sociali di un prodotto. Tale metodologia deriva dall'introduzione della variabile sociale nel modello conosciuto come Analisi del Ciclo di Vita (LCA). La S-LCA ha l'obiettivo di valutare i potenziali effetti di un cambiamento nel ciclo di vita di un prodotto sulla società. Molteplici adattamenti metodologici vengono proposti dai ricercatori e appare necessario raggiungere un consenso per definire un modello di valutazione condiviso e riconosciuto dai diversi stakeholder. Al fine di individuare un modello di S-LCA pertinente e condiviso si è ritenuto di affrontare lo studio secondo le prospettive sociologica e della teoria dei sistemi, focalizzando l'analisi sulla problematica connessa all'inclusione / esclusione degli agenti dal loro ambiente sociale e lavorativo.

Al fine di validare l'adozione del modello proposto, si è individuato il caso della piccola pesca costiera. La piccola pesca costiera occupa, con oltre il 80% a livello mondiale (FAO 2019) gran parte degli addetti nel settore della pesca e appare cruciale per i *policy makers* e gli studiosi la valutazione dei cambiamenti indotti dalla modifica di variabili normative ambientali e sociali. Con questo intento sono state identificate le interazioni tra i pescatori, il loro ambiente naturale e il loro sistema di governance (le politiche europee e le norme locali). Un modello basato su agenti (ABM) è stato adottato per l'analisi delle interazioni tra i pescatori e l'ambiente marino. I dati necessari sono stati raccolti da fonti secondarie e attraverso interviste con i pescatori appartenenti alle cosiddette *Prud'homies* (comunità di pescatori) nel dipartimento di Hérault, nella costa mediterranea della Francia. Il modello d'analisi si basa sull'inclusione e l'esclusione degli agenti dal loro ambiente di lavoro.

I risultati della ricerca sono presentati in quattro articoli che costituiscono quattro capitoli della tesi. Il primo articolo introduce al concetto di pesca artigianale e presenta i principi secondo i quali questo modello di pesca dovrebbe essere preservato. Il secondo articolo è dedicato alla definizione e creazione di un modello di S-LCA adattato all'oggetto dello studio. Il terzo e il quarto articoli sono dedicati alla implementazione del modello di S-LCA proposto e alla validazione dello stesso nel sistema socio-ecologico di piccola pesca costiera nell'area di Sète (Francia). In particolare, il terzo articolo si concentra sulle interazioni dei pescatori con il loro

ecosistema marino e il quarto articolo guarda alle interazioni tra la comunità di pescatori e alla governance del sistema.

List of abbreviations

ABM	Agent-Based Modelling
AgTraIn	Agricultural Transformation by Innovation
AMOP	Association Méditerranéenne des Organisations de Producteurs
AoP	Area of Protection
CAS	Complex Adaptive System
Cépralmar	Centre d'étude pour la promotion des activités lagunaires et maritimes
CFP	Common Fishery Policy
CPR	Common-Pool Resource
CSR	Corporate Social Responsibility
EACEA	Education, Audiovisual, and Culture Executive Agency
EBM	Equation-Based Modelling
EC	European Commission
EMFF	European Maritime and Fisheries Fund
EU	European Union
FAO	Food and Agriculture Organization
FLAGs	Fisheries Local Action Groups
GFCM	General Fisheries Commission for the Mediterranean,
GT	Gross Tonnage
HP	Horse Power
IFREMER	Institut français de recherche pour l'exploitation de la mer
INRA	Institut National de la Recherche Agronomique
ISO	International Organization for Standardization
kw	Kilo watt
LCA	Life Cycle Assessment
LCCA	Life Cycle Cost Analysis
LCIA	Life Cycle Impact Assessment
LSF	Large-Scale Fishery
MEDAC	Mediterranean Advisory Council
MSY	Maximum Sustainable Yield
RAC	Regional Advisory Council
SES	Social-Ecological System
SETAC	Society of Environmental Toxicology and Chemistry
SIA	Social Impact Assessment
S-LCA	Social Life Cycle Assessment
SMBT	Syndicat mixte du bassin de Thau
SQT	Social Quality Theory
SSF	Small-Scale Fishery
SWB	Subjective Well-Being
UNEP	United Nations Environment Programme

Table of Contents

Chapter I_ An introduction to the thesis.....	1
1. Introduction	2
2. Scope of the research.....	3
3. Epistemology and Methodology.....	5
3.1. Small and large scale fisheries	5
3.2. Change.....	5
3.3. Social and natural changes	6
3.4. Boundaries of analysis.....	7
3.5. System thinking.....	8
3.6. Social perspectives	9
3.7. Social-ecological systems.....	11
3.8. Data Collection.....	12
4. Thesis structure.....	13
Chapter II_ Small-scale fisheries.....	15
Defining small-scale fisheries from a social perspective	16
Abstract	16
1. Introduction	16
2. Should we be in favour of all SSF?	17
3. Materials and methods.....	19
4. Results and discussions	20
4.1. Operational and Technical.....	20
4.2. Socio-Economic Perspective	21
5. Conclusions	23
Chapter III_ Epistemology and Method development	25
Area of Protection in S-LCA: Human Well-being or Societal Quality.....	26
Abstract:	26
1. Introduction	27
1.1. Area of Protection	30
1.2. Human well-being	31

1.3.	Societal Quality	32
2.	Research Method.....	34
3.	Results	35
3.1.	Epistemological challenges of S-LCA	35
3.2.	Nature of social change	36
3.3.	Preferences and action.....	38
3.4.	The rebound effect.....	41
3.5.	Aggregation of social data.....	42
4.	Discussion	44
4.1.	Social life cycle and its actors	45
4.2.	Time, space and society.....	47
5.	Conclusions	49
Chapter IV_Fishers – Environment Interactions		52
Conceptual model for the analysis of fishery social-ecological system: case of port of Sète		53
Abstract		53
1.	Introduction	53
2.	Method.....	57
3.	Results	59
3.1.	Conceptual Framework	59
3.2.	Model Specification	60
3.2.1.	Fish stock’s behavior.....	60
3.2.2.	Boats’ behavior.....	61
3.3.	Dataset.....	62
3.4.	Verification and validation.....	63
3.5.	Model development.....	67
4.	Conclusions	68
Chapter V_Fishers - Governance System Interaction.....		70
Co-management of fishery from negotiation lens: Case of Prud’homies		71
Abstract		71
1.	Introduction	71
1.1.	Case study.....	72
1.2.	Prud’homies.....	74

2. Methodology	75
3. Results	77
3.1. Types of interactions	78
3.2. Prud'homie – EU interactions	79
4. Discussion	80
4.1. Society - community dichotomy	81
4.2. The two main parties in fishery management.....	81
4.3. The role of negotiation in co-management.....	82
4.4. Exclusion/inclusion in governance.....	85
4.5. Power and voice	86
5. Conclusions	87
 Chapter VI_ Conclusions.....	 89
1. Introduction	90
2. Contributions of this thesis.....	91
2.1. SSFs' position in the fishery system	92
2.2. Epistemological precision for a social impact analysis	93
2.3. One single social impact indicator	95
2.4. Governance system.....	96
3. Constrains and prospective studies.....	97
References	100
Formations suivies.....	125

List of tables

Table 1. Comparison of large scale and small scale fisheries based on environmental and socio-economic factors.....	18
Table 2. Different characteristics for artisanal fishery of European fleet in the Mediterranean Sea.....	20
Table 3. Parameters for the Definitions of SSF.....	22
Table 4. The characteristics of first and second-order change in organizations (Levy 1986).....	37
Table 5. Conceptual framework of the case study.....	59
Table 6. Attributes of the fishery sub-system.....	61
Table 7. Landings of fish at port of Sète	63
Table 8. Landings of fish and shellfish at lagoons of Thau and Ingril	63
Table 9. Share of fishing area frequented by each user &.....	66
Table 10. Changes incidence with-in the fleet (1989-2018)	66
Table 11. Three cases of Prud'homies	74
Table 12. Bundles of rights associated with positions	86

List of Figures

Figure 1: An analogy of society with mechanical system	9
Figure 2. Schematic representation of methodology	35
Figure 3. The position of societal quality perspective among other S-LCA AoPs.....	47
Figure 4. Interactions between the sub-systems of a fishery social-ecological system.....	54
Figure 5. Case study area, port of Sète and its surrounding	55
Figure 6. Evolution of Fleet at Port of Sète (number of boats)	56
Figure 7. The two main phases of methodology	58
Figure 8. Location of area of study, south of France.....	73

Chapter I

An introduction to the thesis

1. Introduction

In the 70s and the 80s the technological progress in the marine and fishery industry had encouraged the fishers for higher levels of catch and a shift towards larger scale fishery. The depletion of fish stock has slowed down this pace. In this context, small-scale fishers (SSF) play an important role in sustaining small communities in where fishing practices are carried out in respect to the marine resources. If access to fisheries is lost, the individuals emigrate and the community loses crucial social, human, and economic capital, which further exacerbates depopulation trends (Bjarnason and Thorlindsson 2006; Chambers et al. 2017). The matter of social well-being is often discussed in socio-economic projects to make sure the costs and benefits of setting up a change are shared fairly among all those involved. At a time when industrialization is transforming the lifestyles and values of every society on earth, scientific knowledge regarding human well-being is vital in determining whether material affluence should be the dominant concern in attaining a desirable quality of life (Diener and Suh 1997).

The SSF is an interesting interdisciplinary case of study in social science and natural resource management (Ommer and Handling 2018) in an environment of dominant high modern narratives of change (Johnson 2006). The development of specific techniques of fisheries production used in particular fisheries is shaped by existing environmental conditions, available boats and gear, market pressures (and opportunities), transport infrastructure, and social relations in and around fisheries system (Campling et al. 2012). At the same time, boat owners' choice of techniques can have substantial social impacts (Howse et al. 2012). Ethnographic research in fisheries has long illustrated the importance of the social relations, recognizing that a diversity of relationships such as dependency, obligation, support, reciprocity, exploitation, and collective action in fishing communities can determine both a persons' wellbeing outcomes and fisher behavior (Pollnac, 1988; Jentoft et al. 1998; Coulthard 2012).

The autonomous system of governance practiced by this social group has been the case study of many economists, sociologists and ecologist. Elinor Ostrom (1990) has chosen the small-scale fisheries "because the process of self-organization and self-governance are easier to observe in this type of situation than in many others". The marine fishery value chain is simpler than many other food products. The process of production in fishery (catch) requires relatively less inputs, thus fewer types of actors are involved and less interactions occur between them which offers the social scientist an interesting research population.

2. Scope of the research

Studies from several economic paradigms have already addressed the matter related to SSFs' confrontation with the changes in the economic and political setting and the marine ecosystem. They have employed obviously concepts common to their own discipline. In the following paragraphs, through a short review of neo-classical economics, new institutional economics and bio-economical models, the parts that have been adopted from these paradigms and what was missing are highlighted.

In the neo-classical economics, innovation appears as a result of a rational decision of resource allocation in a competitive market. The subject of economic allocation and competition is not new. But it is to mention that the matter of allocation appears while there are heterogeneous entities in the same environment. Diversity creates the key element for dynamic of evolution to take place (Yildizoglu, 2009). This thesis shares the assumption viable in economic studies, that fishers have access to detailed information, are capable to analyze and take opportune decisions and that each fisher's goal is to maximize his personal benefit. However, two other parameters are also included: I) learning capacity of fishers, II) mutual social benefits exchanged between a fisher and its community.

Ethnographic scholars (such as Palmer 1993) believe that indigenous practices are an accumulation of individual profit maximizing behavior. They hold that fishers' actions are not based on purely economic motivations, although fishers often "talk as if the only thing that really matters to them is money ... fishers are clearly influenced by many other social and cultural factors as well" (Acheson, 1975 cited by Palmer 1993). These factors include the maintenance of relationship with competitors, time spent away from home and family, maintaining family traditions, adventure, independence, healthfulness, future employment opportunities for relatives, a sense of belonging and self-actualization (Coulthard 2012).

As it is introduced in New Institutional Economics (NIE), there are three contexts in which a transaction is carried out: market, firm, or a hybrid of them. In the market every individual, equipped with his/her rationality, would enter the competitive market and carry out the transaction of his/her interest. While in a firm there is a hierarchy which decides the actions. All the resources are managed by a person or a group of people who usually own the resources (the property right). In the hybrid model, such as cooperatives and in a larger sense communities exploiting a common pool resource, the common resources are managed by delegates while each person has the right to manipulate to a certain point its property. The option that a society adopts depends on the transactional costs it faces. They are interdependent, and thus the

decision of one influences directly the other. In this sense, parties to transactions are bilaterally dependent. Therefore, they are interested in negotiating on the eventual actions other parties would take in order to adjust their own actions, reducing the risk of losing their access to resources and assuring the benefit they are making at present. At the level of a society, value preserving governance structures are sought to infuse order realize mutual gain and to mitigate conflict (Williamson 2002). These governance regulations have the goal of reducing the transaction costs by setting the basic ground for everybody (the rule of the game).

The juridical system decides how to organize the institutional environment based on the context in which the product system evolves. EU level policies (EC 2002), taking into account the Maximum Sustainable Yield (MSY), search to regulate the competition and sustain the marine resources. While at the local level, in many cases the primary incentive for the conservation of marine resources, such as the use of periodic closures, is the management of social relationships (Cohen and Foale 2013). *Homo economicus*, in seek of maximization of profit, has an interest in the stability of the governance system, where the actions of actors are predictable. In this thesis the governance system, is divided into two categories: the social norms and the state policies. One would strengthen the other, accumulating/concentrating their adherents for mutual goals, assuming that the strength of a rule depends to the share of people who follow it. If the majority of the population respect the rules it would continue to survive, otherwise it would fade off and even those who once supported that rule would no more follow it. Eventually, the world consists of individuals who their (inter)actions make the rules which govern the society. In this climate, there is an increasing competition and conflict between small-scale and commercial scale operators for the remaining fish resources.

Bio-economic models have been developed in the present context of interactions between human and nature to offer scenario simulations for the assessment of the impact of governance strategies. For a review of bio-economic models that have been developed in the field of European fishery sector one may refer to the works of Padella and Finco (2009) and Prellezo et al. (2012). They cover extensively the dynamics between biological and economic factors but ignore the social norms that govern the fishers' interactions despite their acknowledgement (van Putten et al. 2012). The indicators that they consider as social are closely related to economic ones (gross value added, crew share, employment) (Prellezo et al. 2012). This lack of inclusion of social indicators in the management of CPR and the importance dedicated to it in recent years by addressing issues such as social well-being together with the economic growth in European reports (cf. Stiglitz *et al.*, 2009) have encouraged me to contribute to the on-going process of

developing an assessment tool for social effects of a change in a product system. Nevertheless, before entering a dead-end discussion on what are the most appropriate social indicators, the sociological studies have been reviewed to define what a society is and what measures reflect the quality of a society (refer to next section: epistemology and methodology).

3. Epistemology and Methodology

In this section the main concepts that would be employed all through the thesis would be reviewed. This thesis has taken its basic philosophy from the works of: Wittgenstein (1921), on what it concerns pragmatism and capacity of words in transferring logic, Polanyi (1944), in concepts of social transformation and the embeddedness of economy in society, Watzlawick et al. (1974), by clarifying first and second order change and the difference between transition and transformation. The three of them have one character in common and that is following constructivism, seeing the reality made by social interactions. The subjects that are treated in this thesis are not objective matters which can be discussed with the same epistemological view of natural sciences (positivism).

3.1. Small and large scale fisheries

The actual context has been reviewed with a skeptical eye and started the thesis in the quest to answer the fundamental questions of “why should we ever be interested in small-scale fisheries?”, “do SSFs improve the quality of the society?” and “is there a significant difference between the social impacts that SSF and LSF project on society?” (more details in paper 1). The division between SSF and LSF is not simply done using the length indicator, but based on Theory of Logical Types (Whitehead and Russel 1913) where: 1) logical levels must be kept strictly apart to prevent paradox and confusion; and 2) going from one level to the next higher (i.e., from member to class) entails a shift, a jump, a discontinuity or transformation of the particular way of behaving (Watzlawick et al. 2011). As presented in the previous section, SSF due to their attributes such as close interconnection with other fishers, need to act in harmony as one single entity while the LSFs are individual economic agents who act in a relatively independent environment. These attributes entail different behaviors and thus a need of classification into two main classes of SSF and LSF (more discussion in paper 4).

3.2. Change

The topic of this thesis is constructed around the word “change”. This concept is, explicitly or implicitly, present from the very beginning till the last paragraph. Key questions (posed by Strauss 1993/2011) that drew the lines of the research in the broad sense are: “what is changing,

what aspect of it, in what direction (for worse or for better) and at what rate?” or more particularly “how is (the) change related to (social) order or disorder?” Strauss and other interactionist scientists focalized on the matter of stability of social structures and tracked down the changes to see to whom it will provide benefit and who would be deprived from the resources that they had once access to. To detect precisely where the change is occurred we have to define initially what is a change and if there is only one kind of it. Based on the works of mathematician, Evariste Galois (1832) on “group theory”, and the development of the role of group theory in the field of social sciences by Watzlawick et al. (1974), we have discussed “how the change in the fishery context is perceived?” Watzlawick et al. (1974) and also Ashby (1999) and Levy (1986) argued that there are two levels of change. The properties of the first order and second order change are presented in table 4. The first order change, which concerns the changes interior to the group and among its members, keeps the overall system unchanged. This is what it’s referred to as transition: minor improvements and adjustments that keeps the nature of the group stable. Members may change place but the system functions as before. On the other hand, the second order change concerns the changes of the system to a new state of being (transformation). As there is a discontinuity between the process of change, we can’t track the change quantitatively. This is due to different logics that rule the two states. Therefore, Bertrand Russel jointly with Alfred North Whitehead (1913) have proposed the Theory of Logical Types, to distinguish the two levels of change and to prevent antinomy and paradox in the analysis of changes. He states that a class is of a logical type higher than its members and no class can contain itself as a member (*ibid*). Thus, we need to discuss the second order changes as meta to the first order changes.

3.3. Social and natural changes

Including the environmental, economic and social aspects is not an attempt to squeeze the three axes of sustainable development into one single tool of evaluation but there is no other choice except considering them all together in studying the sustainability of a CPR. The interaction between the environment and the social structure (including the market and political framework) is inevitable. Thus, analyzing the changes of one requires studying the other two. This fact simplifies the combination of the three structures, the natural, the social and the economic. If economy is then considered as part of social agreements it may be integrated into the social aspect, limiting the study into two sides of natural and societal rules. The rules that govern the structure and internal exchanges of the two sides are distinctive. Natural laws are defined by the logic of first kind of change (Levy 1986) (refer to table 4) with interactions

applicable to theory of groups (Galois 1832) such as multiplication, addition, division and subtraction while in the case of social laws, not only the first order change is applicable but also the second order change which is change in the paradigm. These are to say, as it has been discussed more in detail in the second paper, that the instrument that is to be developed to evaluate the sustainability may not be two separated tools, one being applied to the environmental aspect and the other to the social aspect, but they can be only comprehensible when combined together (refer to embeddedness theory; Granovetter 1985). Having two separate tools raises difficulties and unresolved problems such as boundary of the product system and the functional unit. There is an implicit interest to maintain an identical (or an equivalent) boundary of the product system for the analysis of the three axes of sustainable development, the LCA, S-LCA and life cycle cost analysis (LCCA). The system in question is not the same for LCA and S-LCA separately and therefore two distinctive boundaries are to be designed one specifying the natural boundaries including the ecological systems engaged in the product system and the other that of the society including the stakeholders involved. Contrary to the majority of the S-LCA studies, in which the society is considered as the stakeholders (mainly workers) involved in the production and destruction, in this thesis the society consists of the community (or communities) in which the production or destruction of the product pathways passes through. In the community, even members who are neutral in the production and destruction (in the sense of consumption, recycling or deterioration) are also included. This definition of society thus, explicitly comprises the non-working members of the society (children and elder people) and implicitly the future generation.

3.4. Boundaries of analysis

A significant part of S-LCA literature's discussion is where to set the boundaries of the assessment. A part of the discussion of this thesis (section 4 of chapter 3) is also dedicated to this issue. The beginning and the end of the social life cycle of a product is not as evident as the environmental life cycle of the product which is from cradle to grave. Since the social identity of a product remains long after the material abolition of the product, the "life cycle" of a product in social terms needs to be defined differently than that of environmental assessment. Usually the end of life of a product will give birth to another generation of that kind of product, with even more complex connections. Let's take the example of cell-phones' impact on society; the consequences of introducing such a product goes beyond health, wealth and the indicators defined to capture the human rights of the workers. It impacts the inter-relational structure of human society. For instance Chatterjee (2014) counted 20 effects of mobile phone use on

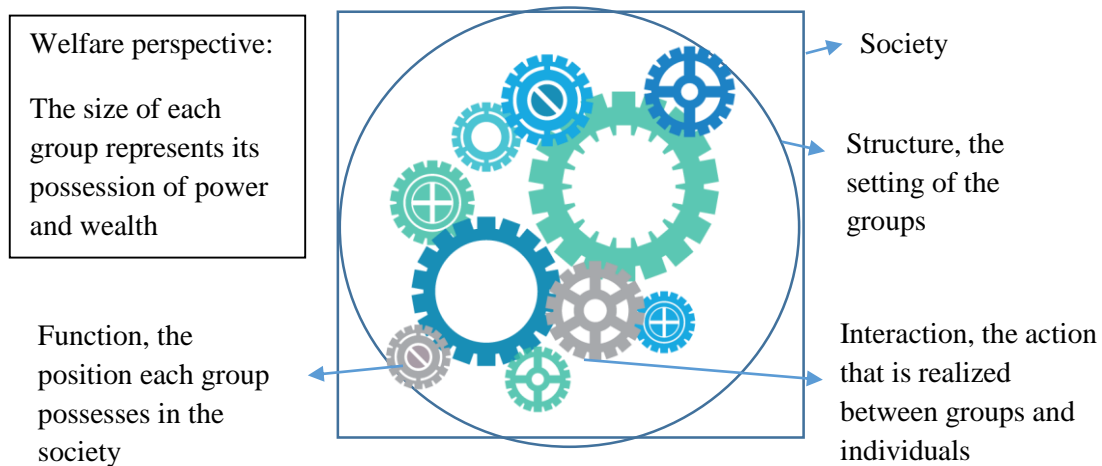
society. Apart from communicational role, he pointed out the use of mobile phones' effect on education, surveillance, social relations and identity. When we look more closely at other product's roles in a society we realize that all products create more or less such impacts. Take for example the large surface supermarkets. In this case, the frequency of shopping decreases, consequentially consumers' daily interaction with the society through shopping.

Nevertheless, the crucial question is not just whether we are dealing with the total system or where we draw the system boundary, but what the proper entities and attributes of the system should be (Chen 1975). Therefore, it sounds necessary to define what the ultimate goal is before defining the boundaries of the system to be analyzed. Responding to this question would remove the ambiguities concerning the boundaries and the stakeholders to be included in the social input analysis. The S-LCA needs to reach a normative consensus on what definitional characteristics constitute social performance along product life cycles, before designing technically measurable indicators (Kühnen and Hahn 2018).

3.5. System thinking

The notion of life cycle induces that the flow of the goods has to follow a cycle to reach once again the starting point, transferring the signals of different parts to each other. However, in a system conceptual thinking a component may simultaneously have interactions with other components not only as a deliverer but at the same time as a receiver. Therefore, in a social system it's hard to identify the downstream and the upstream of each point, unless they are prioritized based on certain point of view. For example, a supplier of raw materials would be negotiating with several customers to define the optimum price. This aspect of a product system is covered by the concept of value chain defined by economists which imply that there is a flow of product from supplier to customer. While in the social assessment, the social interactions that causes that flow of product (social values, regulations, ... determine the demand) count. A system conceptual thinking implements that the downstream and the upstream of each point are interconnected. The components of a system, similar to a set of clock gears are enchainned to each other (figure 1). like a set of clock gears which are enchainned to each other.

Figure 1: An analogy of society with mechanical system



Source: Authors' visual interpretation of sociological perspectives¹

Cybernetics is an approach that accentuates the interactions of different components under a system theory rather than studying individual relations or the community structures. Studies in cybernetics insist on the role of communication as the principle factor to transformation. Based on the principles of cybernetics (Weiner 1948) circular causal relationships shape loops of change. In this feedback mechanism, the system realizes the shortcomings of reaching its goals, takes appropriate actions and then analyses it again to find the faults. This process of self-monitoring and organization guarantees the adaptation of the system to its surrounding and thus its survival and continuity. The word cybernetics comes from the Greek word of “κυβερνάω” (kuberna) of what pertains to governance. This pragmatic approach to governance, where actions are planned based on the perceived failures is more effective than an idealistic planning where actions are programmed in advance based on human relative knowledge.

3.6. Social perspectives

In this sub-section main sociological perspectives known in sociology and economic paradigms addressing social matters are reviewed. In this short review, we go through the social impact assessment methodologies that are proposed.

The participatory approach to social assessment suggests to look at the priorities of the community and to monitor how they would change in the process of policy, or project implementation or production. By this vast definition, almost anything can potentially be a social impact so long as it is valued by or important to a specific group of people (Vanclay et

¹ Source of picture of gears: www.naesys.com/

al. 2015). With a hope of finding a universal social impact measure, the second paper of this thesis has turned to sociology to figure out how the sociologists measure the impacts of a change. Like the different descriptions of the elephant by the blind men in the Indian story², each sociological paradigm has looked at the society at a specific level and with a distinct lens.

Three sociological perspectives (structural, functional and interactionist) have been examined to select a proper conceptual framework that fits the analysis of the case of study. The selection of S-LCA as the methodology, was based on few properties that this methodology holds: object-based, system-based approach, definition of functional unit³, and the clarification of loops of interaction. The absence of an overall consensus and the ambiguity of certain concepts of this methodology have provided a ground for researchers to propose their own improvements so that the method would correspond to their case of analysis. To my extent, I have also allowed myself to modify the concepts of the S-LCA so that it will correspond to the field of fishery social analysis. Labor Issues along the life cycle of the product are the main measures that are analyzed in the majority of the S-LCA studies. Human rights is at the core of these assessments. A great number of the studies search the most tangible indicators of human rights such as child labor, hours of work and the health risks associated to work. They clearly address the individual's well-being. The appropriateness of these measures has been discussed in paper 2 by deliberating issues that the sociologists target at time of examining the social effects of an event. The three main sociologic views, functionalism structuralism and interactionism, have been examined. The functionalists examine the changes that the products would create on the functions of different groups in the society, the structuralism would look how would the presence of the product change the structures of the society and the interactionism would address the changes in the meanings of the individuals' actions.

The economists have also incorporated the social issues in economic studies. "Social capital theory" is one main theory interpreted in different manners. In "foundations of social theory", James Coleman (1990) discusses how the social structure is influenced by the relations of individuals. Later sociologist such as Degenne and Forsé (1999) introduced "social networks" and presented two ways to approach the question of relations: that of community, which looks at the unifying matter and that of the circle which generalizes the notion of interpersonal links.

² Refer to the poem of Godfrey Saxe (1816-1887), the blind men and the elephant

³ Functional unit is the basic unit that all the calculations of life cycle analysis is based on. The matter of functional unit has not been treated in this thesis, which deserves a large discussion.

The network analysis regards the interpersonal connections as the core of the society while researchers employing social capital see all members of the society connected by trust (or disconnected due to lack of trust). Social cohesion, on the other hand, is a state of having a character which can be attributed to social capital. It's rather a psychological matter and is based on group member's self-reported closeness to others and their perception of their own standing in the group (Carrasco and Bilal 2016). Many studies often subsume social cohesion into social capital, with some researchers proposing that social cohesion and network systems represent two valid views on social capital (Lindstrom, 2014). Both (social cohesion and social capital) are collective and ecological dimensions of society to be distinguished from the concepts of social networks and social support, which are characteristically measured at the level of the individual (Berkman and Kawachi 2000). The common mistake is to see collective social capital as the sum of individual social capital (Portes & Landolt, 1996).

3.7. Social-ecological systems

Fishing is an economic activity embedded into a social and environmental context. Embeddedness (Granovetter 1985) points to the role of values and culture of an embedding community. The notion of embeddedness is used to distinguish local communities in terms of the extent to which particular activities—for example, fish harvesting and processing—are embedded in (or disembedded from) the larger local community due to the globalization of production and marketing (Apostle et al., 1998). This emphasizes the need for fine-grained, long-term historical and ethnographic research on particular common-pool resource situations and their contexts (McCay 2004).

Berkes and Nayak (2018) have proposed a complex-adaptive systems (CAS) approach for the analysis of fishery social-ecological systems (SES) which is characterized by linkages (values), feedback (rebound effects), and attention to uncertainty and scale (inability of aggregation data). CAS agents have properties and behaviors. They interact with and influence each other, learn from their experiences, and adapt their behaviors so they are better suited to their environment (North et al. 2013). Attempts in predicting the social impacts of an intervention in an environment is believed to be impossible in complex adaptive systems (Wilson 2002, p.352). That is due to their changing, complex, and usually nonlinear causal relationships, but we may understand the structure and dynamics of these systems in broad patterns, or propensities (Ostrom et al. 2002). In multiscale systems in which observation is costly, analysis is difficult, and so the prediction about specific results of intervention in the environment. The emerging approach to deal with complexity in human-in-nature systems recognizes them as

uncontrollable and focuses on characteristics that confer resilience and capacity to transform (Walker et al 2004). Folke (2016) defines the resilience of social and ecological systems as, “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, and feedback, and therefore identity”. Community resilience is defined as community’s collective capacity to function in, respond to, and potentially influence an environment characterized by continuous change, uncertainty, and crisis (Maclean et al. 2014).

Agent-based modelling (ABM) is able to consider the evolutions of social actors and the ecological environment. More specifically in the case of CPR, as it is the subject of this research, ABM is recommended for the analysis of CAS. In contrast with equation-based modeling (EBM) (known also as mathematical modelling), ABMs are able to explain how a whole (irreducible to its parts) emerges from interactions among micro-components of a system which the components do not exhibit those properties alone. Thus, contrary to the EBMs which decompose a system into its main parts and model their relationship, in an ABM, a system, due to the difficulties of indicating its social values into mathematical relations are understood once the inputs and outputs are well defined (Ashby 1999). A system is “a combination of interacting elements organized to achieve one or more stated purposes” (ISO/IEC 15288, 2008). The fishery system is identified by studying, in a sequence of time, the stimulus as the input of the system and the behavior of its agents as its outputs.

3.8. Data Collection

Due to issues such as accessibility to data, budget and time limits the design of the agent-based model takes different forms. The extent of the assessment, in many cases, depends to the resources of the evaluator, the time and budget available. Two general trends for the collection of inventory data are mentioned by the S-LCA methodological sheets (2013): generic data and site specific data. Generic data are typically country-level data used as a screening device to identify the domains of negative social outcomes. Site specific data collection can then proceed in the domains highlighted by the generic data. Gathering primary data from individuals through questionnaires was not proposed by the S-LCA Methodological Sheets. This kind of data mainly provides information on the individual’s state of well-being, such as livelihood, perceived health, trust, etc. Those interested in studying a society as a single entity, tend to gather information at higher level. In that case, more generic data, such as bankruptcy rate, crime rate, suicide rate, number of cooperatives, number of social security beneficiaries, *etc.* consist the data. Secondary data may provide all the required information in this regard.

However, that may lead the researcher to satisfy himself/herself with the available data and omit some matters which are important in the social norms and target culture.

Another advantage of data gathered by other organizations (rather than the researcher himself) is the format of time series. These historical data are collected in the time period specific to that data. For instance, the data on amount and price of fish sold in the fish auction halls are registered daily by the hall and transferred to FranceAgriMer for public use. On the other hand, data that are provided by the fishers on their landings are biased cognitively due to lack of memory or tendency to confirm the researcher's predefined answer. The choice of the cases to be included in the study was to cover the largest variety of fishery organization in South of France. The 3 Prud'homies included one that only was active in the lagoons, consisting specifically vessels less than 6.5 meters long. The second Prud'homie included LSF such as trawlers and tuna fishing boats. The third case of Prud'homie, similar to many others on the French south western Mediterranean coast, included both areas of fishing, lagoons and the sea.

4. Thesis structure

The following chapters consist of four papers in which the research was developed. They are presented as they have been submitted to their relative journal. Those which are published (chapter II and III) would not undergo further modifications. However, chapter IV and V are the last version of papers which are not yet accepted for publication and are subject to modifications based on the feedbacks received from the journal reviews. The papers and their relative journals are as following:

Chapter II: Defining small-scale fisheries from a social perspective, Yazdan Soltanpour, Clara Monaco, Iuri Peri, published in "Quality-Access to Success" Journal Volume 18, S2, 2017

Chapter III: Area of protection in S-LCA: human well-being or societal quality, Soltanpour, Y., Peri, I. & Temri, L. published in *Int J Life Cycle Assess* (2019)

Chapter IV: Conceptual framework of social-ecological system of fishery at port of Sète, Soltanpour, Y., Peri, I. & Temri, L. submitted to *Système Alimentaire-Food Systems*

Chapter V: Co-management of fishery from negotiation lens: Case of Prud'homies, Soltanpour, Y., Peri, I. & Temri, L. submitted to *Maritime Studies*

Finally, chapter VI is dedicated to the overall conclusion of the work and suggestions for prospective studies.

Chapters II and III clarify the conceptual framework of the research and the case study. Social indicators which are to be employed in the whole work are elaborated in these chapters. The

epistemological aspects of a societal quality analysis have been discussed. Social life cycle approach has been taken as the environment where the social indicators could be developed. Chapters IV and V analyze the interactions of the fishing community with the ecological and political system. The reactions that the fishing community adopts in the face of changes in the fish stock are modeled. Number of fishers in different fishing vessel categories are analyzed in face of the declining fish stock. In the political sphere, the interactions of the fishing communities and their representatives (the Prud'homies) are discussed in the European context. The negotiations that happened in the course of the last three decades are reviewed and the role and the position of Prud'homies in the management of marine resources are debated.

Chapter II

Small-scale fisheries

Defining small-scale fisheries from a social perspective

Abstract

Depletion of marine resources as well as increasing in demand of fish is a widespread justification for the political intervention at international level on “small” vessels. The size of the vessel is the main attribute for what is defined as small-scale fisheries. This paper presents however a different perspective for the segmentation of fishing fleets based on social parameters. At the beginning we pose the question whether we should be in favour of all small-scale fisheries? Then we review the different typologies that have been used till now in other studies. We argue that a global classification of fleet based on size of vessel does not satisfy the diverse goals of all the studies in the field of fisheries. The cutting line between small-scale and large scale has been debated and it’s difficult to find a general consensus at international level. In general the segmentation is adapted in accordance with the goal of the research. In this study we focus on the small-scale fisheries of the European Union countries of the Mediterranean Sea. The parameters proposed in this study may serve the eventual socio-economic research on small-scale fisheries. Ultimately, the right definition of SSF would have implications for the political sphere on which fisheries to support in order to achieve ecological, economic and social sustainability.

1. Introduction

For years scholars have been battling over defining scale in fisheries but still no clear or universal definition of small-scale fisheries (SSF) exists, nor the boundary where the one sector ends and the other begin (Carvalho et al., 2011). Similar to other relative expressions such as “rural areas” which their definition differs based on the place it is used; the expression “small-scale fisheries” is interpreted differently by scholars and politicians.

A FAO Working Group on SSF convened in Bangkok, Thailand, in 2003 concluded that it was not possible or useful to attempt to formulate a universal definition of small-scale fisheries (GFCM, 2013). However, two years later FAO (2005) has defined SSF as “traditional fisheries using relatively small amount of capital and energy, relatively small fishing vessels, but varying from gleaning or a one-man canoe in poor developing countries, to more than 20 meters trawlers, seiners, or long-liners in developed ones”. However, this is a relative definition, since

vessels and gears that are considered as artisanal in one region or country are considered non-artisanal in other areas and vice versa (Garcia-Florez et al., 2014).

The examination of small-scale fisheries as a category reveals that they can only be identified in relational terms, which creates a constant impression of elusiveness and categorical imprecision (Johnson, 2006). The interchangeability of terms normally associated to SSF – “artisanal”, “local”, “coastal”, “traditional”, “small”, “subsistence”, “non- industrial”, “low-tech”, “poor” – is indicative of the many values and characteristics underpinning their definition (Natale et al., 2015).

The European Union fisheries political goals are multiple and complex which have different implications such as sustainability of marine resources, conservation of cultural heritage and higher quality of food (Carrà et al., 2014, for further goals refer to Vindigni et al., 2013). For such goals, the matter of size would no longer be sufficient, but a more social perspective would be required. In the Green Paper on the Reform of the Common Fisheries Policy, the European Commission (2009) poses a question: “How should small-scale fisheries be defined in terms of their links to coastal communities? “

As a starting point, we pose a more basic question “should we be in favor of all small-scale fisheries?” Then we review the different typologies that have been used till now in other studies. Eventually, we would present a table of parameters and their cutting lines between SSF and Large Scale Fisheries (LSF).

2. Should we be in favour of all SSF?

Small-scale fisheries are accorded special recognition by the FAO (1995) Code of Conduct for Responsible Fisheries: “Recognizing the important contributions of artisanal and small-scale fisheries to employment, income and food security, States should appropriately protect the rights of fishers and fish workers, particularly those engaged in subsistence, small-scale and artisanal fisheries, to a secure and just livelihood, as well as preferential access, where appropriate, to traditional fishing grounds and resources in the waters under their national jurisdiction.”

The sustainability of artisanal fleets is a widespread policy objective in many EU Member States, and there cognition of the social and cultural role of artisanal fisheries is explicitly included in the European Commission’s Green Paper on the Reform of the Common Fisheries Policy (Garcia-Florez et al., 2014).

Consumers are attaching increasing importance to the sustainability of the products they purchase. The agribusiness sector is well aware of this trend and is making efforts to guarantee product’s sustainability. When the matter of sustainability rises, small-scale fisheries are regarded more environmentally sustainable due to their lower catching capacity, the type and size of gears employed, higher flexibility to sell the diversity of catches in the market which means less by-catch discard. On the other hand, issues such as employment, ownership over the local endowments, and conservation of cultural heritage are among the elements that are assigned as advantages of SSF maintenance.

Some of the environmental and socio-economic parameters have been compared between LSF and SSF in table 1.

Table 1. Comparison of large scale and small scale fisheries based on environmental and socio-economic factors

Factors		Small Scale	Large Scale	Source of data
Environmental	Estimation of annual by-catch discard	Almost None	7 million tonnes	Kelleher, FAO (2005)
	Annual catch	33 million tonnes	31 million tonnes	WorldBank/ FAO/ WorldFish (2010)
Socio-economic	Capital cost of each job on fishing vessels	\$250- \$2500	\$ 30,000- \$300,000	Thompson’s (1980)
	Average value of landings per person	Euro 23000	Euro 75000	(Macfadyen et al., 2011).

One has to bear in mind that the technical characteristics of vessels are not what we are interested to conserve for the next generations but the values that the artisanal fisheries hold.

We can’t confirm that all those fleet that are less than 12 meters length are environmentally sustainable and socially beneficial, and in contrast, the industrial benefit-seeking fisheries are to be blamed for the marine resources depletion (Pauly, 2006; Maynou et al., 2011; Leleu et al., 2014; Quetglas et al., 2016). As Schumacher (1973) emphasized the duality of size: “there is no single answer, for his different purposes man needs many different structures, both small ones and large ones, some exclusive and some comprehensive. For constructive work, the principle task is always the restoration of some kind of balance.”

World Wide Fund for Nature in 2008 in an article published with the title “Small Boats, Big Problems” states “while most governments say they want to halt subsidies that contribute to overfishing and overcapacity, many demand the right to continue subsidizing fishing by “small”

vessels. But small boats are already causing overfishing in fisheries around the world, and “small-scale” fleets can be major competitors in international trade. It also debates and rejects the arguments that are associated with SSFs;

- 1) small vessels are characteristic of fisheries that specially need public support in order to be economically viable;
- 2) small vessels are minor players in international commerce, and that subsidies to them carry only a very small risk of distorting competition;
- 3) fishing by small vessels is generally “eco-friendly”, and much less likely to lead to depletion than “large-scale, industrial fishing.”

3. Materials and methods

In this article we focus on the European countries in the Mediterranean Sea. Providing a common definition of artisanal fisheries for European Union is extremely difficult, because of the different interpretations by Member States as to what constitutes an artisanal fishery with in their national context which results in a variety of different definitions in different Member States (Macfadyen et al., 2011). The FAO tends to equate “artisanal” with “small-scale”, but states that the term “small-scale fisheries” is more frequently used by Anglophones and implies the use of small vessels with low levels of technology, whereas the term “artisanal fisheries” is often used in French and Spanish speaking areas to refer to traditional fishing methods using low levels of technology, but with little reference to size (Garcia-Florez et al., 2014). In the following table the definitions of artisanal fisheries which are used in the national legislations of four main European countries of the Mediterranean Sea are presented.

Table 2. Different characteristics for artisanal fishery of European fleet in the Mediterranean Sea

	Spain	France	Italy	Greece
Length of vessel	< 15m	< 12 m	< 12 m	< 15m
Gears	Polyvalent Without towing nor dragging	Polyvalent Without towing	Polyvalent Without towing	Polyvalent Without towing nor seine
Time spent at sea	< 8 h	< 24 h	< 24 h	< 48 h
Distance from the coast	< 12 NM	< 12 NM	< 12 NM	< 15 NM
Ownership	Owner, and also member of crew	Owner, and also member of crew	Owner, and also member of crew	Owner, and also member of crew

Source: MedArtNet, 2014

In the following we would present a typology of different terms which are been used in the scientific and political texts. In the successive part we propose the parameter which can be used in the different typologies to address the SSF. Cutting lines between SSF and LSF are extracted from other studies (table 3). However, these points are relative and may change based on the regional characteristics.

4. Results and discussions

Different terms and expressions have been used to define that group of fisheries that respond to the requirements of sustainability. We have observed a general trend in the expressions and their definitions. In the following they have been categorized in two main groups based on the issues they emphasis.

4.1. Operational and Technical

This category of parameters comprises vessel characteristics, gear type, spatial aspects and fishing effort. It is very common to employ this category to classify fisheries activity. “Fleet Register On the NeT4” is the European database where physical characteristics of all the licensed vessels flying one of the European countries’ flag can be accessed. License validity dates, vessel length and weight, engine power, and port of activity are among the information

⁴ <http://ec.europa.eu/fisheries/fleet/>

that are presented in these sheets. Using such category of data as to define SSF are attracting due to the availability of data and their objectivity nature.

Council Regulation (EC) No 1198/2006 on the European Fishery Funds specifically refers to vessels in “small-scale coastal fisheries” being less than 12 meters and not using towed gear. The expression “coastal fisheries” emphasizes on the spatial dimension of proximity with the coast (Reyes et al., 2015, Vindigni et al., 2016) which based on the countries may be different (refer to table 2).

For example the French legislation (décret 2011-697 du 20 juin 2011 du Code général des impôts) defines the “small coastal fisheries” as fishery practiced with boats not longer than 12 meters, which do not use towing gears and their time spent in the sea does not exceed 24 hours. The Italian Ministry of Agricultural, Food and Forestry policies in the decree D.M. 14 settembre 1999, G.U. n. 31 del 8 febbraio 2000, § 1126); D.M. 30 maggio 2001, G.U. n. 135 del 13 giugno 2001, indicates the area of activity of artisanal fishery in 12 nautical miles distance from the coast which employ gears other than trawling, hydraulic dragging for bivalve mollusks or other towing gears which require a motor during the action of catch.

A broader definition of small scale fisheries would need to encompass, in addition to vessel size attributes such as vessel length, variables relating to their local operational range, their social role in coastal communities and the economics of the enterprise (Natale et al., 2015).

4.2. Socio-Economic Perspective

In the social point of view, the characteristic of the vessel practicing fishery loses its importance and the accent would go on the comportment of the crew and people active in the sector (stakeholders). In this perspective the term “small-scale” would no longer be proper but “artisanal” suits better. That means that a boat of 30 meters which respects certain socio-ethical parameters can also be considered as artisanal while that of below 12 meters length which does not comprise those parameters would be out of this category. If a group of fishers who each own a small boat decides to invest in a large vessel and leave their small fleet, even if the vessel is modern, and with a high catch capacity it can be nominated as artisanal as long as they don't create any tension in the decision making body, nature, market, and society. Thus the parameters which are important in this view are:

- 1) Community-based investment (employment of local labour and capital).
- 2) Local connections (acquaintance with other actors of fisheries in the relative).
- 3) Local trade (a considerate portion of landing goes to local market).

As it can be seen locality is the main feature that we consider for artisanal fisheries.

In table 3 the definition of each parameter and its relative cutting line between SSF and LSF are presented.

Table 3. Parameters for the Definitions of SSF

Category of parameter	Parameter	Definition	Cutting line between SSF and LSF	Source	Reasoning
Operational / Technical	Vessel length	The overall length of fleet	12 meters length	EU regulations Joao Ferreira (2012)	
	Gross Tonnage	The weight of fleet	17.2 Tonnes	Natale et al. (2015)	
	Engine power	KW engine power of fleet	Relatively low engine power		Energy use may also be used
	Gears	Trawlers, Dredgers (Mobile gears), Seiners-including lift nets (Purse seine), Exclusive long-liners, Exclusive netters (Passive gears)	Gears except trawl nets, large seine nets (other than lampara nets) for catching small pelagic fish, gear targeting large migratory species (purse seines, long-lines, drift nets, stationary nets, uncovered pound nets, tuna traps[madragues], tuna rods, trawl lines), hydraulic dredges for shellfish	Reyes et al. (2015) FAO-COPEMED (2005)	
	Polyvalence	Number of fishing licenses issued,	Several licenses SSF		Polyvalence fishery is associated with artisanal fisheries
	Number of fishers per boat	Number of crew	Up to 5 SSF		
	Daily landings	Average weight of fish products sold	Up to 20 kg SSF		Annual landing may be used based on availability of data (7 tonnes as the cut point)
	Daily time spent at sea	Hours of vessel in the sea	24 hours		It's better to equilibrate it by the prevailing weather conditions and geomorphology
	Fishing trips	Number of going out to the sea	< 170 days		In case the hours of fishing activity is not clear, this will be used
	Fishing (catch) capacity*	Gross Tonnage of fish which can be captured in a year balanced/equilibrat	Above 50 tonnes large, under that SSF	O'Riordan (2009) Auguste Dupouy (1955)	

		ed by the prevailing weather conditions and Geomorphology		from Reyes et al. (2015)	
	Discards	Throwing back into the sea the unwanted or small-size catches	Zero discard		SSF are assumed that are able to sell the variety of catch to the fresh local market
	Energy use	KW engine power of fleet	Relatively low energy use		
Socio-Economic	Employment	The crew are provided either from the local labor force or strangers	If higher than 50% of the labor are locals it is considered as SSF	Natale et al. 2013	As a livelihood measure together with ownership
	Ownership	Self-owned are SSF	If more than 50% of capital is brought by the crew it's considered as self- owned		
	Cooperation	Number of fishers acquainted,	Artisanal fisheries tend to have higher numbers	Our proposition	The institutional organization of SSF allows them to decide locally
	Trade	Marketing channels	Relatively short marketing canal	Our proposition	Fresh supply is associated to SSF

* Researchers have chosen between catch capacity and landing based on data availability.

5. Conclusions

Small-scale fisheries are generally under-studied in Europe comparing to large-scale fisheries. We must consider a high heterogeneity and complexity of fishery sector in order to demonstrate the ecological and social sustainability of this often-overlooked fisheries segment but there are not enough data for obtaining a precise and comprehensive description of small-scale fleets, because they cover a large variety of methods of catch, fishing gears, target species, diversity and specific conditions under which they operate. These differences do not easily permit to represent a homogenous set of criteria at technical, biological, socio-economic, and institutional level.

In this article we have argued that it is not the technical characteristics of vessels that we are interested to conserve for the next generations but the values that the artisanal fisheries hold. Therefore, the indicators that have to be employed in order to monitor the right track of the policies has to comprehend the social areas that are to be protected. Artisanal fisheries are defined as those fisheries which acknowledge socio-ethnic parameters of the region where they operate. Local employment and ownership, cooperation and the supply of local markets with fresh products are among the social values that could be associated to artisanal fisheries.

In the case of European Union fisheries in the Mediterranean Sea the political goals are multiple and complex and have different implications such as sustainability of marine resources, conservation of cultural heritage and aims for higher quality of food.

In this framework, the ability to manage a sustainable development implies a strong effort to interpret the contradictory/conflictual demands between actors and to find efficient strategies able to answer them. In this process, consensus is crucial.

In the light of the above, a social perspective to segmentation of SSF would help us to explain the phenomena and to find a more functional and useful interpretation of fishery system in line with the need of scientific and political sphere of European Union fishery sector.

Chapter III

Epistemology and Method development

Soltanpour, Y., Peri, I. & Temri, L., 2019, Area of protection in S-LCA: human well-being or societal quality, *Int J Life Cycle Assess*, Online first

Area of Protection in S-LCA: Human Well-being or Societal Quality

Abstract:

Purpose:

The set of stakeholders included in the Social Life Cycle Assessment (S-LCA) guideline (UNEP/SETAC 2009) could create confusion as to the target of the assessment: individuals or society. This paper attempts to develop the epistemological foundations of S-LCA in social sciences. Its major discussion is who should be addressed in S-LCA: individuals or society as a whole. This article contributes to the definition of a social life cycle based on sociological perspectives.

Methods:

This paper is a critical evaluation of well-being methodologies and sociological perspectives used to analyze the effects of a change in a social system. The two perspectives, individualistic and holistic, have been evaluated based on four criteria: subjectivity, social values, possibility of aggregation of social data and rebound effects. We have examined different points of view in the sociologic discipline to determine which perspective would be more suitable. Insights have been taken from structural-functionalist, symbolic interactionism and conflict theories to answer the troubling debates identified in S-LCA: Can the life cycle defined for LCA be used in S-LCA? More specifically, does S-LCA include the same actors and timeline as LCA? Does aggregation of data of individuals convey the characteristics of a society?

Results and discussion:

Organizational or technical change induce new cost and benefits in the social system. When focusing on the well-being of individuals, little emphasis is directed to the relations between people and thus social costs and benefits are not valorized. The sociological perspectives that deal with social change (structuralism, functionalism and symbolic interaction) seek to explain social phenomena based on the relations that are established and affected by a social phenomenon. The sociologic concept has brought insights to the definition of a social life cycle, the object of S-LCA.

Conclusions:

This paper is an attempt to bring the attention of S-LCA practitioners to the concept of social change defined by sociologists. Whether society is considered as a sum of individuals or as an independent entity determines our approach as individualistic or holistic. This would obviously influence our perspective in the selection of stakeholders of the life cycle, the boundaries of the analysis and the indicators to be assessed. We recognize the central social matter of a product system as its contribution to the overall order in a society.

1. Introduction

Consumers are more and more concerned about social impact relative to the products they buy, leading to the rise of debates such as “fair trade”, “fair use of resources” and “socially responsible consumption.” This pressure from consumers for a higher quality of life on enterprises has prompted them to not only be economically viable and environmentally sustainable but also to magnify their social benefits and avoid unaccepted ethical matters such as child labor, excessive working hours, unhealthy working environment and so on. While the principles of sustainable development are well defined, it is still difficult to achieve a similar consensus on an operational definition that can be used to assess the effectiveness of specific actions (Swarr 2011). The concept of Corporate Social Responsibility (CSR) has emerged in this regard as: “the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life” (Holme & Watts 2000, P.10). However, this approach lacks operative quantitative methods of calculating social effects a business may have on society. S-LCA was introduced in mid-1990s, based on the framework of an environmental assessment developed in 1960s - Life Cycle Assessment (LCA). S-LCA aims to assess the impacts that a product has on the people who interact along the life cycle of that product. There have been several attempts to formulize the social assessment and make it as robust as the environmental part of this assessment, such as Guidelines for S-LCA of products developed by the United Nations Environmental Program and the Society for Environmental Toxicology and Chemistry (UNEP/SETAC 2009) and progressively The Methodological Sheets for Sub-categories in S-LCA developed by the same organizations (2013). These guidelines provide recommendations on how to conduct the first two phases of S-LCA (i.e., goal and scope definition and life cycle

inventory). The research on the third phase (life-cycle impact assessment, LCIA) was, at that time, not considered sufficiently mature to be included (Sureau et al. 2017). Impact assessment methodologies are under development and S-LCA is an open field for future research (UNEP/SETAC 2009). While the Guidelines (UNEP/SETAC 2009) are an important reference for the methodological framework for S-LCA, they currently co-exist with a plethora of other S-LCA methodological frameworks and methods (Wu et al. 2014, as cited in Sureau et al, 2017) which incorporate alternative criteria and indicators into S-LCA framework. “It is foreseen and desirable that the methodological sheets are a living resource in the sense that they continue to evolve and their content is expanded over time” (UNEP/SETAC 2013, p.5).

The S-LCA guideline (UNEP/SETAC 2009) considers social impacts as those that may affect stakeholders along the life cycle of a product and may be linked to company behavior, socioeconomic processes and impacts on social capital (UNEP/SETAC 2009, p.37). Furthermore, it considers these impacts consequences of positive or negative pressures on social endpoints (i.e. well-being of stakeholders) (UNEP/SETAC 2009, p.32). However, in the S-LCAs carried out to date, the term social impact is used in a broad manner encompassing the notions of effects, consequences, social change processes and presence of social attributes (UNEP/SETAC 2009, p.69, footnote 48). Among the six main categories defined in the guidelines (UNEP/SETAC 2009) as human rights; working conditions; health and safety; cultural heritage; governance; and socioeconomic repercussions and the range of five stakeholder categories (worker, consumer, community, society, and value chain actors), the most considered stakeholder category is “workers” (Petti et al. 2014) and consequently the most analyzed indicators are relevant to this category (fair salary, health and safety, child labor, equal opportunities/discriminations) (Wu et al. 2014; Kühnen and Hahn 2017) which shows the dominant thinking of CSR focusing on individuals directly involved in the production system as recipients of the product systems’ effects. “Currently, much of the S-LCA literature reflects a focus on society as a collection of individuals, with impact categories used in the case studies more often focusing on an impact that falls on an individual rather than an impact to a community overall (methodological contributions examining community-level impacts include Feschet et al. (2013) and Bocoum et al. (2015), which both address relationships between economic activity and population health)” (Grubert 2016, p.7&8). “A perspective that considers how the development of a product would affect the social structure in which it will be embedded seems to be lacking” (Zamagni et al. 2011, p.597). The hypothesis that focuses on individuals would have repercussions on S-LCA methodologies (Iofrida et al. 2017) omitting social

relations and cultural context of the target population. The shortage of case studies on holistic perspectives of product systems in S-LCA or/and the dominance of individualistic case studies has encouraged us to conduct a study to examine the features of S-LCA in a holistic perspective. In the S-LCA literature, the holistic perspective is considered as a methodology among many others. It is an epistemological question whether to adapt an individualistic approach or a community (or society) level approach. Most of the S-LCA applications take into account values, stakeholders' perceptions, subjectivities, and participation in an interpretivist way, but often without clarifying their theoretical underpinnings (Iofrida et al. 2017; Iofrida et al. 2018). S-LCA needs further grounding in sustainability science (Sala et al. 2013) and social sciences to improve its rigor (Grubert 2016). Although S-LCA is a management tool which needs to be practical, simple to understand, and relatively fast to perform, eventually we have to decide to what extent rigor should be sacrificed for practicality. Proponents of Life Cycle Management (Fullana i Palmer et al. 2011) have already called for more social science input, mainly to help LCA practitioners better navigate the political, social, and cultural contexts in which they work. An arena where rigor remains challenging is defending the topics of inquiry and more fundamentally, the choice of the area (or areas) of protection (AoP) that S-LCA should address (Grubert 2016). "A reinforcement of the theoretical bases of S-LCA is needed, with more attention given to the epistemological discourse" (Iofrida et al. 2018, p.477). Despite the consensus on considering S-LCA and the other life cycle assessment methodologies to be management tools to work toward more sustainable patterns, it is doubtless that S-LCA addresses social impacts, which are a concern of sociology which entails that the epistemological eclecticism of these disciplines (management and sociology) be reflected in S-LCA literature (Iofrida et al. 2018).

This paper aims to improve the scientific embeddedness of S-LCA in sociological perspectives by contributing to its epistemological discussion of social analysis. Epistemology defines the way to reach knowledge. In this paper, we review the sociological paradigms that have been developed to analyze social change. Throughout sociological thinking we encounter two opposing intellectual convictions, that of individualism which considers the starting point of sociological thinking to be human individuals (a position originating in Max Weber) and that of holism which by contrast claims that the starting point must be the collective entity of society itself (a position attributed to Emile Durkheim) (Šubrt 2017). Meanwhile some theories have emerged viewing both these tendencies as one-sided and limited and attempted to overcome them by bridging or linking them. Among these theories are the symbolic interaction theory

(Blumer 1969), embeddedness (Granovetter 1985/2000) and more recently Social Quality Theory (Walker and Maesen 2002) which considers the individual as the core unit of the society who shapes the social structures by interacting with other individuals.

In the following sections of Part One, we present the definition of terms employed by the well-being methodologies and sociological perspectives that support our discussion in section 3. In section 4 we see how the social life cycle (social system) may be adjusted to be compatible with the sociological perspective.

1.1. Area of Protection

Issues of importance to a target society (Area of Protection) are the core of a social assessment. Area of Protection (AoP), also known as safeguard subjects (B. P. Weidema 2001) or damage categories (UNEP/SETAC 2009), are the entities to be respected in the social assessment. AoP acts as a benchmark defining the ideal situation. The divergence or convergence to this point marks the quality of situation. Joroen (2002 cited in UNEP/SETAC 2009) has defined AoP as a cluster of category endpoints of recognizable value to society. Therefore, the AoP is very much relative to the social context of assessment. However, there is a major discussion between S-LCA researchers on which social impacts should be investigated or which hypotheses should be validated. The social impacts considered in an analysis are mainly on human capital, human well-being, cultural heritage, socio-economy and social behavior (Weidema 2006; UNEP/SETAC 2009). Other authors have listed other goals or have used different wording to present the AoP list in S-LCA: human dignity and well-being (Hauschild et al. 2008); autonomy; well-being (in the sense of freedom); fairness based on a capability approach (Reitinger et al. 2011); and human dignity and health (Dreyer et al. 2006). Papers on S-LCA show a broad consensus that the AoP should be human well-being itself (Weidema 2006; Dreyer et al. 2006; Jørgensen et al. 2008, 2010; UNEP/SETAC 2009, Reitinger et al. 2011). The concept of AoP in LCA—which includes human health, natural environment, natural resources, and man-made environment— was extended to “human well-being” by S-LCA practitioners, allowing extra-engineering values to enter into engineering discourse and practice (Sakellariou 2018).

Most of the S-LCA literature transposed the definitions of social impacts from CSR and Social Impact Assessment (SIA) into this new perspective (Iofrida et al. 2018). SIA’s objective is the sustainable social development of local communities where the projects and the companies operate. SIA relies largely on the preference of local community for the definition of social

development goals identified through a participatory process of planned social change designed to improve the well-being of the community as a whole and especially of the vulnerable, disadvantaged or marginalized groups within a region (Vanclay et al. 2015). CSR is a philosophy that looks at the social interest and the enlightened self-interest of businesses over the long run as compared with the old, narrow, unrestrained short-run self-interest (Steiner, 1971). Thus, social responsibility requires that business people engage in actions and change their attitude 'for reasons at least partially beyond the firm's direct economic or technical interest' (Davis 1960). That is to say, the responsible exercise of both economic and social power requires that business people look at the impact of their decisions on their workers and the communities affected and take those impacts into account in directing the economic activities of the companies in which they hold positions of responsibility (Cragg et al. 2009).

1.2. Human well-being

Well-being is gaining acceptance as an indicator of social and economic progress by many governments and agencies (Parackal 2016). However, its meaning has been discussed since the time of the Greek philosophers. Three theoretical possibilities emerge: (a) 'well-being' is an empty notion; (b) 'well-being' is an important and meaningful term which conveys meaning no other term conveys (and, given further research, will be shown to convey this meaning universally); or (c) 'well-being' is 'essentially contested'—its meaning and content fluctuates depending on who is using it, and why they are using it (Seedhouse 1995). Since the first two definitions lead nowhere, we are persuaded to focus on the third possibility. One solution to define well-being is to leave it to each individual. There are as many quality of life (well-being) definitions as there are people (Liu 1976). To distinguish what the scholars mean by the term well-being, we may refer to the approaches that they employ to discuss the matter. We can perceive two major waves of scientific literature addressing well-being: those which focus on psychological matters of satisfaction, (eudemonic) happiness, self-perception of health which are referred as Subjective Well-Being (SWB) and those economic oriented studies which address the level of material possession through the subjects of poverty, inequality and welfare. Welfare economics has developed this aspect of well-being which relies on the premise that preferences are exogenously given and stable (Friedman 1962). Welfare economics is concerned with the conditions which determine the total welfare of a community which is equal to the sum of the utilities of all constituent individuals (Lange 1942). It develops the discourse around the marginal utility of income and the inequality in the distribution of incomes. While

on the contrary, SWB is founded on the discourse of subjective preferences of individuals. SWB is associated and measured with overall life satisfaction. It is argued that human well-being is at least as much about what people ‘internally’ think and feel about their life (Veenhoven, 1994 in Copestake 2009) as it is about challenges that each person faces in life and their future perspectives and opportunities (Budowski et al. 2016). It’s people’s perception of their current state of being compared to their peers and other groups as well as to their own past (Weeratunge et al. 2014). The closer their actual situation is to their expected situation, the higher an individual’s (subjective) well-being.

Emergent approaches, such as that of researchers at International Well-being Group at University of Bath-UK, have proposed a third dimension of well-being, adding human relations to the subjective and material measures. ‘Relational’ aspects include relations of love and care, networks of support and obligation, social, political and cultural identities, including relations with respect to organs of the state and formal structures, which determine the scope for personal action and influence in the community (White, 2009). This particular model of well-being is also referred to as “social well-being” in order to distinguish it from approaches that emphasize only well-being’s subjective and material aspects (White 2009; Weeratunge et al. 2014; Belton 2016).

1.3. Societal Quality

Societal quality is the term employed in this paper to comprise the elements of society which stabilize its overall conditions and guarantee its maintenance. More particularly, a society equipped with such elements is capable of resolving occasional conflicts raised due to (technological, institutional and natural) changes in their conditions. To discuss such conditions, we refer to sociological perspectives which deal with the issue of social change. In this section a brief introduction to two main sociological perspectives that each look at a society from different points of view are given. The objective of this introduction is to see the characteristics of a socially sustainable society through each of these perspectives. We take insights from these sociological perspectives for the development of the discussion on the goal (AoP) of S-LCA.

Since the seventeenth century the confrontation of social structures and the role of individuals in shaping them was a debate among philosophers. Social contract as a dispositive of

sovereign's control over people is presented by Thomas Hobbes in *Leviathan*, while John Locke sees it as having a protection function over the liberty and property of citizens. Hobbes assumes a sovereign power of social structures over the actors and Locke believes society is founded on an accord of its members. In the first, it is the sovereign who is in charge of defining the good in the society and in the second it is based on the consensus of its citizens. Rousseau has a position between the two and sees society as a submission of an individual's will to the general will. The more recent sociological perspectives that have investigated the interaction between social structures and individuals are: symbolic interactionism (Blumer 1969) and structural functionalism (Parsons 1937/1968). The prominent philosophers and their corresponding theories of structural functionalism⁵ are Niklas Luhmann (social systems theory), Talcott Parson (action theory) and Emile Durkheim (division of labor). According to functionalism, each of the social institutions (family, educational system, politics, economics, etc.) contribute functions to society (reproduction, transmission of knowledge to youth, governance and production of goods and services). In social studies the holistic perspective refers mainly to Durkheim's view on society as an independent social fact *sui generis*. Durkheim (1895, 1982) contended in a passage from *The rules of Sociological Methods*, "the group thinks, feels and acts entirely differently from the way its members would if they were isolated. If therefore we begin by studying these members separately, we will understand nothing about what is taking place in the group."

The Chicago School of Sociology's pragmatism view discusses the role of human interactions in shaping social processes and eventually social organizations. This school of thought -- particularly that started by Goerge Herbert Mead and then echoed in the works of Blumer (1969)- believed that the study of human behavior must begin with human association, a notion that was not common in the viewpoint of early American sociology, which treated the individual and society as discrete entities (Meltzer and Petras 1970). In Blumer's view, social institutions exist only as individuals interact. Society is not a structure but rather a continuing process where agency and indeterminateness of action is emphasized (Collins 1994). Gerson (1976) has stated such relationships between individuals and society generate each other via a continuing process of negotiation. This approach rests on the assumption that both social order and individuals arise in and through a process of ongoing negotiation about who shall be whom and what order shall pertain. The path of a society's creation departs from the interactions and

⁵ Since the boundary between structural-functionalism and functionalism was never rigid (Bernard 2000) we would use the term functionalism through the text which represents the ideas of sociologic discourses pertaining to structuralism, functionalism and structural-functionalism.

leads to structures and not the other way around. This is the main difference between action-structure duality and structuralism which believes that the individuals' actions are determined by structures, leaving them no autonomy (inspired by Boudon and Bourricaud 1982).

Hybrid methodologies emerge by crossing these two methodologies. Giddens (1987) proposes the study of reciprocal relations between actions and institutions. Among those we may refer to Social Quality Theory (2017) that has defined “the social as the outcome of the dialectic between processes of self-realization of people (as social beings) and the formation of collective identities.” Social Quality Theory (SQT) follows a consistency between individual recognition as social beings and societal solidarity, taking social cohesion as a conditional factor and social recognition as a constitutional factor, and sees their interplay as the most crucial issue (Lin and Herrmann 2015).

2. Research Method



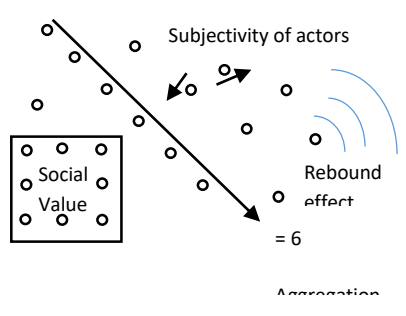
Since the well-being perspectives (SWB and welfare) concentrate on individuals and the sociological perspectives look at the whole society (each based on their own definition), we are considering in this paper the two visions of individualism and holism. The individualism-holism debate is one of the most important yet most misunderstood debates in philosophy of the social sciences (Herfeld 2018). This confrontation is analyzed based on four criteria: subjectivity, social values, possibility of aggregation of social data and rebound effects. Through this debate, we discuss the information that would be acquired through studying human actors (agents) as opposed to learnings from studying their actions (agency). Changing the individualistic perspective to a holistic one in S-LCA would have effects on its methodological features. In this paper, the boundaries of the system would be discussed by reviewing the concepts developed by sociologists.

The methodology of this research is founded on two principle phases (Figure 2). First, the S-LCA literature⁶ were screened to identify the methodological gaps and the challenges of S-LCA application (second column in Figure 2) and then at the second phase a conceptual review of sociological perspectives was realized (first column in Figure 2) and solutions to the S-LCA methodological challenges were presented (third column of Figure 2). The sociologists' points

⁶ It is not an exhaustive literature review by itself

of view on four criteria of subjectivity, social value, possibility of aggregation of social data and rebound effects have been investigated (in section 3.3, 3.4 and 3.5). A discussion on the nature of social change has been added to facilitate the proceeding discussions.

Figure 2. Schematic representation of methodology

Sociological perspectives	S-LCA challenges	Result
Structural-Functionalism  Insights Symbolic Interaction 		Definition of a Social System for S-LCA
Sections 3.2, 3.3, 3.4 & 3.5	Section 3.1	Chapter 4

3. Results

3.1. Epistemological challenges of S-LCA

The S-LCA studies present a wide range of challenges that is coherent with its diversity of ways they have approached the social issues and the methodologies used. Iofrida et al. (2018) have classified S-LCA literature between two main paradigms: post-positivism and interpretivism. Their review, that has been carried out on S-LCA literature from 2003 through 2015, ascribed about 73 % of the studies to the group of interpretivism-oriented paradigms, and only 24 % to the post-positivism. The orientation towards UNEP-SETAC (2009, 2013) approach which emphasizes stakeholders' involvement, social values, actors or companies' behavior and context specificities has been classified as interpretive. Those who followed the causal chains (known as impact pathways) were ascribed to post-positivism. The positivists are characterized as value free, objective, reductionist and affordable and the interpretivists are considered to be rich in meaning and values, relativist, holistic, long and costly.

S-LCA practitioners rely mainly on the procedure described within the UNEP/SETAC (2009) guidelines to define the goal and scope of the study and do not question some key aspects that makes the analysis a challenge such as functional unit and system boundary definition (Zanchi

et al. 2018). Also for those who seek to model the social consequences raised by a product system, the central problems seem to be how to relate the social indicators to the functional unit of the product-system and how to restrict the many social indicators proposed to a manageable number (Kloepffer 2008). The inherent value-laden and context specific nature of social aspects remains one of the key challenges for developing a general applicable framework (van Haaster et al. 2017; Freidberg 2018). A coherent discussion about the social values and ethical and ideological positions that underlie the indicators of social impacts is missing (Baumann et al. 2103; Iofrida et al. 2018). More research is needed concerning S-LCA's applicability to the social analysis of systems and services (Sousa-Zomer and Cauchick Miguel 2018).

Finally, the actual S-LCA methodology seems to offer little or no assessment in regards to the actual functional societal benefits of a product during a product uses phase (Shin et al. 2015). The use stage and the relations between value chain actors receive less attention than the production stage (Sureau et al. 2017). The set of indicators and subcategories proposed by the UNEP/SETAC (2009) guidelines for the use phase relate to the company behavior/general behavior like consumer complaints, quality labels, management measures to improve transparency like publication of sustainability reports, and privacy of consumer data (Subramanian and Yung 2018). These indicators target the satisfaction of the consumers from the product and from the interaction they have with the retail seller. However, the use phase may be interpreted in another way: the effects that the consumption (presence) of the product would have on the social interactions. Some aspects of the S-LCA methodological challenges overlap with the on-going discussions between LCA practitioners. LCA methods suffer from uncertainties because of “the (unknown) system behavior” and also because of “the uncertainty in value” (Hofstetter et al. 2000). Practitioners of LCA acknowledge that more input from social scientists can help advance the cause of life cycle management (Freidberg 2015).

3.2. Nature of social change

The inherent nature of the impacts under assessment are different in S-LCA from LCA, as the latter was conceived to analyze environmental impacts (linked to natural sciences) and the former to analyze social impacts (belonging to the realm of social sciences) (Iofrida et al 2016). As discussed earlier, the social change may be studied at the level of social context, at the level of individual behavior change, or in terms of the relation between the two (Trommsdorff, 2000). Other words employed by other sociologists for these two extremes are “social structures” and “economic action” (Granovetter 1985), institutions (or constraints) and actors' interaction (Bernoux, 2004/2010). By studying the case of a car factory of Volvo in Kalmar in 1960s,

Bernoux (2004/2010) announces that it is the reaction of workers to the (institutional and technological) changes that caused social change. Disruptive behavior (conflict) is the change maker (Goffman 1983) in social structures. The conflictual situation creates an environment which leaves no other alternative except opting for new agreements. They are processes, issued by a social or technical change, which induce new costs and benefits (social, economic, politic, etc.) (Leroy 2005). In two other situations, compromise and consensus (Bellenger 1998), the initial situation keeps progressing and its evolution is so slow that it is not noticed as a distinctive change. Contrary to the changes made by conflict, these are minor improvements and adjustments (transitional) that do not change the system's core (transformational) and that occur as the system naturally grows and develops (Levy 1986). In management and organizational transformation discussion, those which are transitional are ascribed as the *first-order change* and those which transformational are ascribed as *second-order change* (Hernes 1976).

Table 4. The characteristics of first and second-order change in organizations (Levy 1986)

First-Order Change	Second-Order Change
Change in one or a few dimensions, components, or aspects.	Multidimensional, multicomponent change and aspects.
Change in one or a few levels (individual and group level).	Multilevel change (individuals, groups, and the whole organization).
Change in one or two behavioral aspects (attitudes, values).	Changes in all the behavioral aspects (attitudes, norms, values, perceptions, beliefs, world view, and behaviors).
Quantitative change.	Qualitative change.
Change in content.	Change in context.
Continuity, improvements, and development in the same direction.	Discontinuity, taking a new direction.
Incremental changes.	Revolutionary jumps.
Reversible changes.	Irreversible change.
Logical and rational change.	Seemingly irrational change based on different logic.
Change that does not alter the world view, the paradigm.	Change that results in a new world view, new paradigm.
Change within the old state of being (thinking and acting).	Change that results in a new state of being (thinking and acting).

Transformational changes are characterized by discontinuity of continuous processes. Any stable system can, on hitting an instability threshold, go through radical changes that culminate in a new structure based on a new ordering principle (Zeeman 1976). If the capacity of the society to adapt to the changes in its environment (i.e. technological, institutional etc.) is not

compatible with the speed of the change, then dysfunctional elements of the society would disrupt the social stability. Thus the social term “stability,” which bears the sense of sustainability in sociological matters, does not carry only the sense of maintenance but also resilience and flexibility reflecting the capacity of the society to adjust itself to changes. Transformation is defined not by any reference to what it really is, nor by reference to any physical cause of the change, but by the giving of a set of operands and a statement of what each is changed to (Ashby 1999). To identify the extent to which a change in the product system is relevant to the social stability, we repeat Strauss’s (1993/2017) question: “how is (the) change related to (social) order or disorder?” or more particularly “what is changing, what aspect of it, in what direction (for worse or for better) and at what rate?” These questions are concerned with what happens, not why it happens.

3.3. Preferences and action

In most views, the objectivity and authority of science is not threatened by epistemic, but by contextual (non-cognitive) values (Reiss and Sprenger 2017). In this section we discuss two matters of subjectivity: that of the researcher and that of the effect of social values on the responses the population provides at the time of data collection. Social aspects can be highly diverse and are weighted very differently by different interest groups and in different countries and regions (Grießhammer et al. 2006). What a given society regards as true or false, scientific or unscientific, right or wrong, lawful or unlawful, beautiful or ugly, is conditioned fundamentally by the nature of the dominant culture. Based on the classification of societies by Sorokin (1959), societies are either “ideational” (based on truth of faith) or “sensate” (truth of senses) or a mixture of the two which is designated as “idealistic” (based on truth of reason). In each culture, the other two are considered to be wrong. Thus, claiming the rightfulness of a society’s (working, living, institutional) conditions based on another society’s values would be invalid. Hofstetter et al. (2000), have proposed considering the cultural perspectives (archetype) in modeling the value sphere in the context of LCA. Social facets are even more influenced by context than environmental or economic facets (Sierra et al. 2017). The matter of identification of cultural context is particularly relevant at the time of choosing indicators for a social analysis. While the individualized indicators offer a robust approach to assessing quality of life at the individual level, they are less useful when community and other social relations are the focus of analysis (Siltaniemi and Kauppinen 2005). Granovetter (1985/2000) who sees individuals’ actions embedded in social structures, affirms that sociologic approaches based on norms, roles and values, like the economic theories of market, are far from the context of action and thus

have the tendency of minimizing its influence. Individuals' behavior can't be explained neither by their interest nor by structural constraints, but we should take into account the concrete reciprocal social relations and the social context where the individuals are involved (Bernoux 2004/2010).

Nonetheless, concerning the 31 sub categories of assessment described by UNEP/SETAC (2009, 2013), for general applicability this method requires large amounts of data which is not always available, and there is a large influence of the subjectivity of the individual researcher (Blom and Solmar 2009; van Haaster et al. 2017). The focus on values and subjectivity in S-LCA is extremely valuable not only for S-LCA but also for other methods, most notably LCA (Grubert 2016). To effectively communicate the criteria for whom and what was included in and excluded from the assessment is a major credibility factor (Swarr 2009). Within the S-LCA framework, stakeholder participation increases the legitimacy (and credibility) of results (von Geibler et al. 2006; Mathe 2014). A participatory approach of data collection is usually based on the principle that there is no one more adequate than the people involved in the sector to determine what is good and what is bad for themselves. Although, (in the majority of cases) the scope is driven by the discipline represented by the monitoring team, rather than by the interests of all affected parties (Berkes 1988). Different mechanisms are applied based on the empowerment and capability of society members. We have to make sure that the categories of indicators that we are considering to evaluate the social impact of the society are valid for that particular society. For instance, in some societies the fact that a child works (and gains his/her living) is appreciated. One might say that the international organizations' agreements are one good indication of social values that have to be respected by all its member countries. These values are, however, normative ideals that are anticipated to become universal. Some societies might be far in terms of attainment of goals of the agreements signed by their countries' representatives. On the other hand, the absence of one quality should not be translated as a weakness since other qualities, not considered in the assessment, may compensate. Therefore, the social (and socio-economic) impacts to be covered in an assessment and the way this should be done needs to be case and context specific (UNEP/SETAC 2009). A literature review carried out by Petti et al. (2014) shows that some S-LCA authors have used, among social indicators, elements which are the characteristic indicators of a given sector to better characterize the context in which a company operates (although not present in the Guidelines), which would have little meaning if considered within a different context. The value laden nature of the social indicators justifies the context based methodology of S-LCA. That does not, however, mean

that the data has to be collected from each actor separately, but the social indicators have to be sought in the society where the assessment is being carried out. On a global scale one could avoid confronting the stakeholders with “Western-imposed social benchmarks” (Pelupessy cited by Griefßhammer et al. 2006).

The matter of subjectivity is relevant to both perspectives. The weight of subjectivity in the well-being perspective is on the social values of the research population and in the societal quality perspective on the researcher’s personal values. Weber (1904/1949) rejects the point of view on which both positivists and subjectivists agree: the absence of presuppositions. He found it “necessary” that the social scientists formulate presuppositions in order to give order to the chaos of infinite multiplicity, enabling the social scientist to choose a part of concrete reality which is interesting and significant to us (Hekman 1983). We have to figure out to what extent the economic action is embedded in structures of social relations. Neither should the embeddedness be considered over-socialized nor under-socialized. In order to reduce the involvement of the researcher in the selection of social impact indicators, one should discover the preference of the research population by examining the actions they conduct. Based on “strategic actors’ theory” (Crozier and Friedberg 1980), peoples’ preference is reflected in their actions. They are rational agents who, despite their cognitive limitations, would decide the optimal choice available in the structures of their environment. Therefore, by studying the trends of actions of the target society, we would realize the main issues that are important to the society. By such, we include social values such as equality, fairness and freedom or even deeper concepts such as justice and dignity in the structures of the environment. We presume that actions are based on rational decisions considering all elements of the context which are known to the decision maker. Nevertheless, declared preferences, such as “what would you do if ...”, are idealistic in that they are not necessarily in line with the structure of the society. The common criticism of life satisfaction, as well as related indicators such as happiness or malaise as measures of well-being, is that they measure only individual states of mind based upon psychological theories, which is not necessarily helpful for measuring the quality of society as a whole (Abbott and Wallace 2012). Etzioni (2018) in his book *Happiness is the Wrong Metric* has addressed the influence of social norms on the dynamics of society:

“The societal structure and culture considerably influence the lifelong struggle between the pursuit of happiness and the quest for affirmation. These collective forces, rather than individuals’ preferences and actions, greatly affect whether the quest for affirmation or the pursuit of satisfaction, or a carefully-crafted balance between the

two, guides individuals' conduct and societal dynamics. That is, individuals have much less agency than several influential social scientific theories, major ideologies and the general public assume. It follows that those who seek to understand the components of, and attempt to form a good life and a good society should grant greater importance to social action, in which individuals act in unison and draw on shared norms and institutions, than to individual agency".

Individuals' preferences reveal the distance of the desire of each individual from the normative ideal that he/she has in mind. Though the preferences are social products that can be collectively modified (Etzioni 2018), though it does not tell whether the society itself has or does not have the characteristics. Nevertheless, it is essential to track citizens' subjective sense of happiness and life satisfaction to improve societal conditions and maximize the fulfilment of human potential (Diener et al. 2018). The pragmatist paradigm of sociology has defined preferences in another perspective: that of the meaning that people give to each action. In this regard, social impact is based on three 'premises' that define its scope and mark out its distinctive analytical stance: (1) people act toward things based on their meanings; (2) these meanings arise in social interaction; and (3) conveying and changing meanings demands that people define and interpret situations (Blumer 1969). The security of the system implies that the actors coordinate their actions and each personally try to adapt him/herself to the system with coherent actions (Crozier and Friedberg 1977).

To conclude, what is expressed in questionnaires or interviews is not what one really believes, but actions reveal the veritable desire of people. Sociological methodologies mainly rely on the action (and interaction) of people while well-being studies pertain to psychological analysis which measures the satisfaction and preference of the people.

3.4. The rebound effect

The uncertainty of human behavior arises from the fact that the consequences of each individual's action may affect the behavior of other actors. Paraphrasing the LCA terminology, the adoption of a societal perspective implies that a *ceteris paribus* assumption does not hold: interrelations exist that need to be evaluated (Zamagni et al. 2011). Even in the environmental impact assessment, where the future is assumed to be predictable, some authors have challenged this mechanistic and equilibrium-centered view, arguing that there will always be surprises (Berkes 1988).

Each change in the production system may have its particular effect on the society and each effect, in turn, may create its own consequences (e.g. change in socio-cultural relations). This stems from the fact that every product is accompanied by a particular production-consumption culture. The social domain (compared to natural sciences) is complex due to the existence of strong interactions between factors leading to multiplier effects (Rey and Cunningham 2003). Sierra et al. (2017) outlined that social sustainability assessment has two aspects: 1) the social contribution in terms of how interventions interact with their context and 2) the potential benefit distribution effects on a long-term basis balanced with its short-term contributions. The impact of a single technology at the macro level is generally small, but could potentially be large (van Haaster et al. 2017). In the case of a major innovation, as Shumpeter has held up, it is always accompanied by other issues, which leads to modification not only of the economic relations, but also social, political and cultural relations which contributes to a larger change (Bouchard 2006).

Weidema and Thrane (2007) define rebound effects for production and consumption changes as derived changes in production and consumption when the implementation of an improvement option liberates or binds a scarce production or consumption factor (money, time, space and technology). They distinguish three types of rebound effects; that of 1) the production-consumption of the product under assessment, 2) overall production-consumption, 3) behavioral and organizational changes (socio-cultural rebound effects). Each rebound effect will in turn create another series of changes resulting in an endless rippling effect. Smetanin and Stiff (2016) have included “induced” and “systemic” impacts in addition to direct and indirect impacts of investments. For instance, in the case of a new investment, the intended (direct) impact is to increase the profit of the company, of which its byproduct (indirect impact) is creation of new employment. This increase in real wages, employment and productivity would induce impacts on the local economy as those newly employed spend their income buying product and services offered by local enterprises, which leads to new investments and also additional taxation revenues for the government. Systemic impacts, however, endure footprint generated by investments (or its absence) on the shape of the environment where the individuals interact, addressing more particularly the connections among agents and industries.

3.5. Aggregation of social data

After the categories of analysis have been decided on, the researcher must decide whether or not to bring the disparate categories into one aggregate indicator. According to the UNEP/SETAC (2009) guidelines “the action of summing or bringing together information (e.g.

data, indicator results, *etc.*) from smaller units into a larger unit (e.g. from inventory indicator to subcategory) in S-LCA -aggregation of data- may be done at the life cycle inventory or impact assessment phase of the study and should not be done in a way that leads to loss of information about the location of the unit processes.” Weidema (2006) has proposed modeling or aggregating the results of the subcategories in order to present one overall indicator of well-being. Nevertheless, the pathways connecting the inventory data to the impact categories are not yet fully identified to aggregate them as a single result. Kruse et al. (2018) have classified socio-economic indicators between two main categories of additive and descriptive indicators. The additive indicators are aggregated with a scoring system in type I (S-LCA methodologies with no causal relationship) characterization model (Wu et al. 2014). Weighting, as described in ISO 14040 (2006), is converting and possibly aggregating indicator results across impact categories using numerical factors based on value-choices. The fact that the data prior to weighting should be available is also emphasized in the ISO 14040 (2006). Presenting the initial data would bring transparency and may reduce the confirmation bias, but the main problem still remains, which is the meaning that the accumulated data convey. Nevertheless, weighting requires comparisons with benchmarks and the act of mental comparison and selection of benchmark are both arbitrary. do Carmo et al. (2017) proposed an approach based on customized value function to overcome the linearity problem of weighting social indicators. However, this approach is also based on the S-LCA expert’s judgment, which may solve the linearity problem but amplifies the subjectivity associated with the expert’s value judgment.

While thinking about aggregating indicators, we have to consider the fundamental principle that objective and subjective dimensions are separate entities that normally bear little or no relationship to one another, and so must be separately measured (International Wellbeing Group 2013). It is very common to confound this rule even though the researcher admits it in advance. The subcategories to be covered in S-LCA inspired by ISO 26000 (2010) are not of one single nature (subjective and objective). The assessment of social impacts involves several hundred specific indicators. Therefore, aggregation is, if not impossible, at least heavily value-laden and, therefore, not recommended (Hunkeler 2006).

Unlike the natural scientist, the social scientist is not interested in the common or average aspects of the facts under consideration; rather the social scientist is interested in their characteristic traits, their cultural significance, and their meaningful interrelationships as defined by the problem at hand (Hekman 1983). The statistical feature of social indicators of sustainable development is to reflect the detail of distributions under different arrangements

and not average or modal situations (Antoine 1999 in Rey-Valette and Cunningham 2003). An increase or decrease in the level of social indicators should neither be considered negative nor positive. The value of the change is relative to the future plans of the region, and whether that change complies with that plan or not. Nevertheless, the evaluation of social experiments need not be in terms of the degree to which they have fulfilled our *a priori* expectations, rather we can examine what they did in terms of what we now believe to be important (March 2006).

It seems clear at this time that indices which use an additive functional form and arbitrarily weighted variables are of little value (Wish 1986). Studying each single indicator separately can be a solution to avoid the aggregation problem. Either this comparison is carried out between two alternatives or the situations of the case study before and after the change in the product system. Another solution can be simply limiting the assessment to a single end point indicator. Endpoint indicators have the advantage that they can reflect the potential damage or benefit to the AoP, having the advantage, in theory, that no subjective weighting is needed (Jørgensen et al. 2008).

4. Discussion

Whether the aim of S-LCA is to pinpoint the effects of a change in the activities of a value chain on the wellbeing of individuals or that of the society in which they live (Macombe 2013) makes a great difference in the approach we adopt to analyze the effects. The disproportion of S-LCA studies regarding the two perspectives of individualistic and holistic encouraged us to examine the features of S-LCA, particularly that of the boundaries of product system, based on the holistic perspective. The richness of S-LCA literature in individualistic perspective allows us to compare them with that of the prospective holistic features of S-LCA.

When O'Brien et al. (1996) first introduced the integration of social analysis into LCA, they were aware of the particular characteristics of a social cycle as being an “unstable process with complex and shifting boundaries”. Nevertheless, they contend that combining engineering and social science data and, to a lesser extent, perspectives makes the process of assessment more transparent and more complete. Two conceptual views of the system exists, and often coexist, in S-LCA literature; one technical approach, defining life cycle stages in terms of technical processes related by material or energy flows, and one description of the system in socio-economic terms, selecting organization as system units (Dubois-Iorgulescu et al. 2018). As

described by Lagarde and Macombe (2013) in addition to product, material or energy flows of LCA, the system links organizations by a flow of services that create interdependence.

The precedence of the environmental assessment to the social one influences the S-LCA system boundaries. For those studies that realize both environmental and social LCA, the system created for the LCA is used as a starting point for S-LCA's system (Dubois-Iorgulescu et al. 2018). A second layer (Parent et al. 2010) referring to organizational context is proposed to be added to the initial environmental system to include the social stressors. Employing an identical or an equivalent system boundary (van Haaster et al. 2017) to that of LCA for S-LCA is valuable in the sense that it gives more objectivity to the boundaries, the life span of the product and the stakeholders involved. In life cycle sustainability assessment, the common principle is the life cycle thinking. The UNEP/SETAC (2009) guidelines indicates that the calculation basis shall be as consistent as possible. However, consistent does not mean identical and system definition and cut-offs made in LCA are based on environmental relevance, which can differ from social relevance (Kruse et al. 2009). LCA and S-LCA studies of the same real system will be coherent, even if the descriptions of the system and the rules of fixing the boundaries differ, provided they reflect the same scenario (Lagarde and Macombe 2013). Emphasis on adjusting social analysis to an engineering perspective would limit the sphere of the study to the changes that the process of production would cause for individuals directly engaged in the production. As “the whole is other than the sum of the parts” (Reynaud 1997), even if we include all the stakeholders engaged in the process of production (organization, foreground and background processes) into the boundaries of the product system, the objective of a social assessment from the holistic point of view would not be satisfied. In the following sections we develop the concept of the social system based on the sociological perspectives.

4.1. Social life cycle and its actors

There are similar concepts to life cycle with almost the same meaning, and one has to be careful to find the nuances: product system and value chain. They all describe the articulation of flows during the making of a good (Macombe 2016). The concepts of value chain defined by economists imply the idea that, in case one actor falls out, another actor would substitute, ignoring the actor who has been eliminated. For example, a supplier of raw materials negotiates with several customers to define the optimum price and eventually chooses the best option to maximizes benefits. However, the idea of a (social) system, covers all those who are inside the system, no matter whether they are a supplier, a consumer or neither, they would be influenced by the overall functioning of the system, comprising those who are excluded due to a change.

Actors may not explicitly announce their non-interest in contributing to the system, but neither do they refuse to be part of it. They may be considered neutral members of the product system. Nevertheless, they should not be omitted simply because they have (apparently) no contribution to the system. They would be affected by the social context that is shaped by active members. All of them, together, shape the society. The presence of each actor determines the characteristics of the society all together. In economic terms, “free riders” and those affected by “externalities” (either positive or negative) should be included beside the actors of the value chain.

By accepting the well-being perspective, the social analyst, besides measuring the well-being of the actors (or stakeholders), has to include others who, due to the change, have dropped out or those who have been included in the game in the new arrangement. In the societal quality perspective, however, both the actors (before and after the change) and those involved in the material life cycle are included by simply considering the change in the context in which the interactions take place. This requires looking at the relationships between the individuals rather than the individuals themselves. An individual is an actor (as a labor, manager, consumer, ...) and at the same time he/she is a part of a structure (such as cooperatives, factories, consumers, ...). Individuals may even assume several roles at the same time in an individual or collective capacity (being a worker, consumer, member of workers' union and participant in public debate).

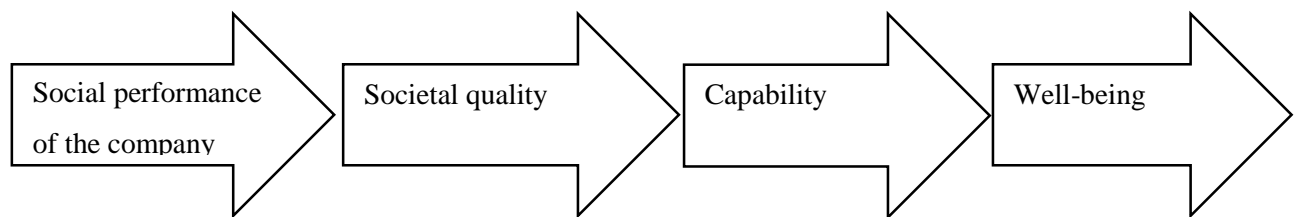
The action of exchange between actors within the system determines the system's social sustainability. There are implicit motivations that are not expressed by actors (at the time of survey) and which go beyond the economic drivers of exchange. No matter whether or not the services and goods received are compatible with what has been provided (economic cost/benefit analysis), if actors continue to conserve the interaction the exchange is socially viable. Thus, engaging in a social interaction is an indicator of social acceptance. Or in other words, the fact that the interaction takes place justifies it socially.

Finally, we can go further and consider actions as institutions as said by Reynaud (1997): “what the actors produce are not choices but rules, they are not decisions adapted to what the equilibrium of system requires, they are the system itself⁷”. The actions shape the social organization and develop by interaction. The regular interactions will augment the individuals'

⁷ Translated from French : « Ce que produisent les acteurs, ce ne sont pas des choix mais des règles, ce ne sont pas des décisions conformes à ce que demande l'équilibre d'un système, c'est le système lui-même ».

capacity to act and employ its capabilities to reach a state of well-being. According to the discussion of this paper, we position societal quality (Figure 3) as a direct effect of company's performance and one of the factors which leads to a state of individual well-being. In other words, a stable society where organizations act in accordance to the contextual conditions creates an environment of personal development which increases capabilities (in sense of Greek *Arete* meaning great effectiveness) and leads to human well-being (in its eudaimonic sense as human flourishing).

Figure 3. The position of societal quality perspective among other S-LCA AoPs



4.2. Time, space and society

Introducing a cut-off criterion has the objective of limiting the study to a feasible scope. The percentage of studies in S-LCA that do not clearly state their cut-off criteria (15 out of 31) and those who explicitly indicate the data availability (7 cases out of 31) (Dubois et al. 2018) can be an indicator that S-LCA practitioners continue evaluating the social effect up to the point that the time and research budget allows. The social significance that has been suggested by Griebhammer et al. (2006) as the S-LCA cut-off criteria follows the ISO 14044 (2006) recommendations to set the boundaries of LCA based on environmental significance of production processes. In 9 out of 31 cases that have been reviewed by Dubois et al. (2018), the concept of social significance has been used, however, employing different methods to identify it (quantitative, qualitative and semi-quantitative). It should be acknowledged and understood that LCA will never be able to faithfully model reality, because it will always be affected by inevitable (and somewhat arbitrary) assumptions and cutoff rules (Fullana i Palmer et al. 2011).

The term social system is commensurate with environmental life cycle of the product in the sense that both may be created and abolished (the idea of cradle to grave). Although society is not created and abolished the same way as a material, the socio-economic culture that is shaped around a product can be transformed to another socio-economic arrangement. As with environmental LCA, the ripple effects in the social life cycle of the product are difficult to determine. It is hard to see where the effects of social interaction finally diminish. Since the

scope of the studies is quite large, it is impossible to truly assess the entire life cycle (UNEP/SETAC 2009, p. 9). Without declaring boundaries and defining where the effects become negligible, the studies would be almost unfeasible. Therefore, the matter of where to draw the line or the boundaries of social life cycle is crucial. It is hard to justify empirically or even logically which interactions should be included in the S-LCA case studies. The guidelines (UNEP/SETAC 2009) suggest using the “social significance” as the cut-off criterion. A method used to evaluate social significance among those who have employed a cut-off criterion for their S-LCA is through social hotspot assessment (Dubois-Iorgulescu et al. 2018). The measurement of Social Hotspot Index (SHI) is based on the best practice observed in different countries. The average of the indicator in the target country is compared to that of the best (or worst) practice allowing the practitioner to measure the situation of the target region regarding that particular indicator. The cut-off criterion of significant dependency has been used by Lagarde and Macombe (2013) to define the system in S-LCA in systematic competitive models employing the logic of including organizations in the boundaries of S-LCA study which their behavior is significantly affected by the changes. Jorgensen et al. (2008) adds the researcher’s judgment to the cut-off criteria of the social system. It is to acknowledge, also, that one’s perspective as a researcher is incomplete and thus in need of other perspectives, expert and otherwise (Freidberg 2018). It should also be stressed that the way in which an instrument is implemented will lead to different results in terms of social impact (Rey-Valette and Cunningham 2003).

The “art of cutting” (Roy 1985) is a cycle which is based on the necessity of understanding a matter to be able to cut and to cut well to understand (Mermet 1992). It indicates that the S-LCA practitioner, like a painter, like a cinema director, like a novelist also has to have the art to keep as much necessary material to tell the story of the social effects of a particular product system while not making it too complex to be incomprehensible. Simplifying the image of social arena to the extent which can clarify enough evidence to prove the hypothesis is the social scientist’s goal. However, one has to take caution not to mix actors in different time slots. If a picture is going to be presented, we should be careful not to include effects that pertain to another period than that of the time of the exposure. So the relevance between three items of time, people and space are to be checked. If we are willing to show the pathway of the effects, our study has to function as a video picturing time, space and appropriate people. If we are searching the final impact, we would present two pictures of before and after the change of the relative space and people.

The importance of defining the time and space boundaries of the assessment originates from the unstable picture of a society with constant changes. From there rises the significance of identifying loops where the interactions occur repeatedly and a rhythm which can be observed and registered. Treating society as structured, patterned, or stable is a reification because society, like individual actors' interactions and experiences with one another, is constantly in flux (Carter and Fuller 2015). Lefebvre (1974/1991) discusses that space is a product of society which exceeds the definition of private property (conceived space) and enters the domain of "lived spaces". He considers space as a cultural being and thereby has a history of change. The geographies in which we live can have both positive and negative effects on our lives. They are not just a dead background or a neutral physical stage (Soja 2010). The boundaries of the study need to include those loops of interaction that define social processes that have been modified by the change in the product system. By identifying loops of interaction between actors that are repeated continuously in a specific place, we may define a social system that can be the object of the S-LCA.

5. Conclusions

The objective of reaching social acceptance of a product has directed research toward the identification of methodologies suitable for measuring and evaluating the impacts of product systems. The LCA practitioners' attempts to incorporate a social dimension is facing challenges. The variety of S-LCA methodologies implies that the term *society* and its derivatives (social and societal) have been interpreted differently. The sociological perspectives reviewed in this paper can bring insights into S-LCA methodology. Everybody agrees that the goal of S-LCA is to assess the social impacts of products along their life cycle, but what should be included as social impact and the definition of social life cycle is to be decided. It is the definition of the term "social" that specifies the employment of individual based or community based indicators. Whether the society is considered as a "sum of individuals" or as "an independent entity" determines our approach as individualistic or holistic. We agree with Kühnen and Hahn (2018) on that the S-LCA needs to reach a normative consensus on what definitional characteristics constitute social performance along product life cycles, before designing technically measureable indicators. Addressing issues of health, human rights and working conditions as impact categories of the assessment and taking human well-being as the

AoP shows the individualistic approach of S-LCA. Nevertheless, the sociologists' approach to investigate social phenomena target the relations between individuals.

In human well-being methodologies (subjective well-being and welfare analysis) individuals are the subject of the assessment while in methodologies classified in this paper in the category of societal quality methods, which are discussed mainly by sociologists, each addressing the subject from a specific angle; the social structures (structuralism), the functions attributed to each social group (functionalism) and the meaning that people give to their relationships (interactionism), the subject is the relations between individuals. What is common in these sociological perspectives is the primordial role given to human action. In opposition, the well-being methodologies reside on the psychological preferences of individuals. This paper holds that the subject of S-LCA should not be the actors themselves, but the relations between them. The power that keeps them together (relations) in a format of society/ organization/ value chain, can be weakened or strengthened through the new coordination as actors adapt to a change in the product system. These adaptations are reflected in turn in physical environment, institutions, social order (opposite to disorder). The examination of sociological perspectives brought insights to answer the challenging debates repeated in S-LCA. The hope of developing a quantitative tool standardized by ISO (Kloepffer 2008) may not be reached through the marriage of sociological perspectives with S-LCA but "it's better to have a rough approximation but right, rather than a very detailed prevision but wrong" (De Jouvenel 1993).

S-LCA is not simply a matter of checking company's compliance with human rights. Any violation of human right needs to be recognized by legislative authorities which have the power to sanction the lawbreaker for not respecting the minimum standards: issues such as minimum wages, safety of working environment and child labor. The topics covered in S-LCA should go beyond human rights and target the conditions of human society. It should advocate the rights of all humans like that of LCA which deals with the environmental conditions such as climate change, emission of greenhouse gases *etc.* which effects not just some individuals but entire generations. The social costs of a product system confronting product system change, from this point of view, would be those institutions, organizations, norms and culture which they have accumulated over the years and have to give up to free up space for the new institutions to be replaced.

In the well-being approach, analysis of actors is limited to those who are along the defined life cycle of the product. Conversely, in the sociological perspectives everybody residing in the

society/community where the change in the product system has been introduced are considered involved, and thus counted as potential actors and/or receivers of social impacts. When analyzing the well-being of individuals, little emphasis is put on inter-relations between people.

We suggest that S-LCA covers the social interactions that have been changed due to a change in the product system and discuss to what degree the change would create social disorder (or order). It is clear that in the process of change, those who are more prepared (empowered in that regard or flexible or resilient) undertake less social cost and benefit relatively more. The matter of empowerment and capability are more fundamental issues that require further discussion which goes beyond a social assessment. Another issue that requires further discussion is the indicators employed for the social assessment of the product life cycle change. In the social context, issues such as inequality, democracy, social exclusion, and many others are implicitly engaged. There is none among them that is less important and can be excluded from the social assessment. The changes in their states due to a change in the product system needs to be emphasized in the social assessment. The characteristics of S-LCA's AoP which have been discussed in this paper suggest retreating a step in our assessment to observe a larger picture of the society and the effects that the change in the product system would have on the organization of society. We should initially seek the social AoP's among basic factors that their absence would put into question the existence of society. The social AoP needs to emphasize facts that keep the society together. We may search among those factors that made individuals gather and shape a society in the first place such as protection (security) and division of labor. These factors, however, change appearance in different contexts, through time and space.

Chapter IV

Fishers – Environment Interactions

Chapter IV: Soltanpour, Y., Peri, I. & Temri, L. Conceptual framework of social-ecological system of fishery at port of Sète, submitted to *Système Alimentaire-Food Systems*

Conceptual model for the analysis of fishery social-ecological system: case of port of Sète

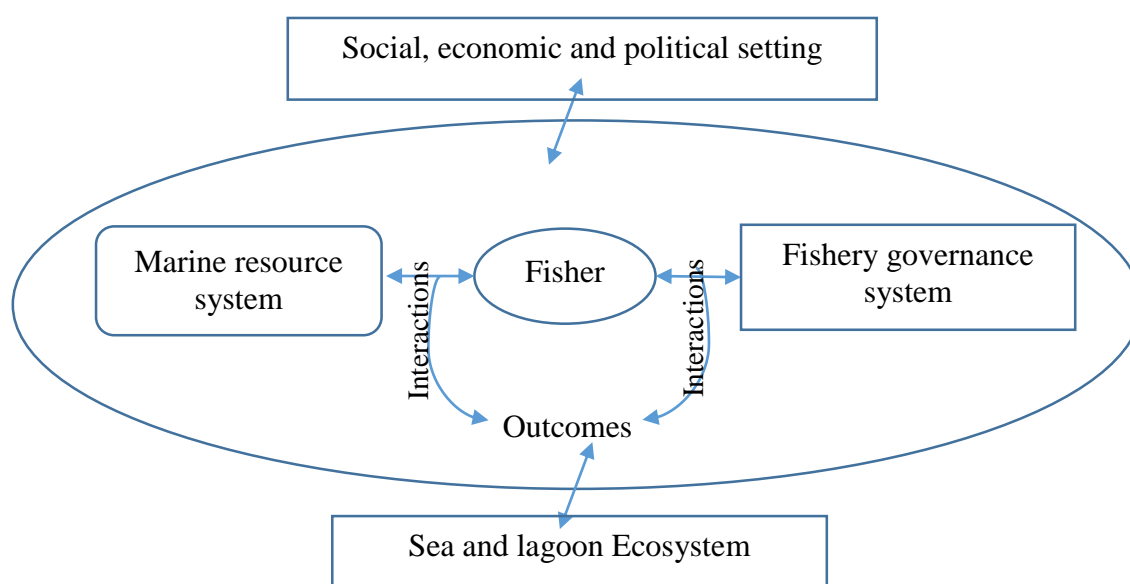
Abstract

A conceptual model represents the interactions between a system's components. This article aims to present a conceptual model for the social-ecological analysis of Sète's fishery system. Following Mohan et al. (2008) and Berkes and Nayak's (2018) proposition to analyze fishery social-ecological systems as complex adaptive system, we have designed a relative agent-based modelling framework. An agent-based computational model is able to reveal the interactions between fishers and their marine environment in a changing economic and political context. The interactions between 450 active fishers from three categories of fishers I) small-scale lagoon fishers, II) small-scale coastal fishers and III) trawlers and their marine environment (lagoons, coastal area and offshore) are identified. These interactions are to be inserted in a model simulating fishers' population in different levels of fish stock. The simulation would allow us to understand the consequences of a change fish resources have on the entry/exit dynamics of fishers.

1. Introduction

The small-scale fisheries (SSF) is an interesting interdisciplinary case of study in social science and natural resource management (Ommer 2018), in an environment of dominant high modern narratives of change (Derek Stephen Johnson 2006). It is becoming widespread that harmony with our natural environment will require a holism approach that goes beyond simple technical models (e.g. effect of fishing effort on fish stock) to include more components of human knowledge and perception (Jentoft 2006; Mahon et al. 2008). The human capacity of learning and adapting to conditions have been absent in such models. Benefiting from Ostrom's (2009) framework of analyzing the sustainability of social-ecological Systems (SES) (Figure 4), in this article we discuss the learning capacity of fishing communities in south of France and their adaptability to external drivers, particularly fluctuations in the fish stock.

Figure 4. Interactions between the sub-systems of a fishery social-ecological system



Source: Interpreted from Ostrom (2009) framework for analyzing social-ecological systems

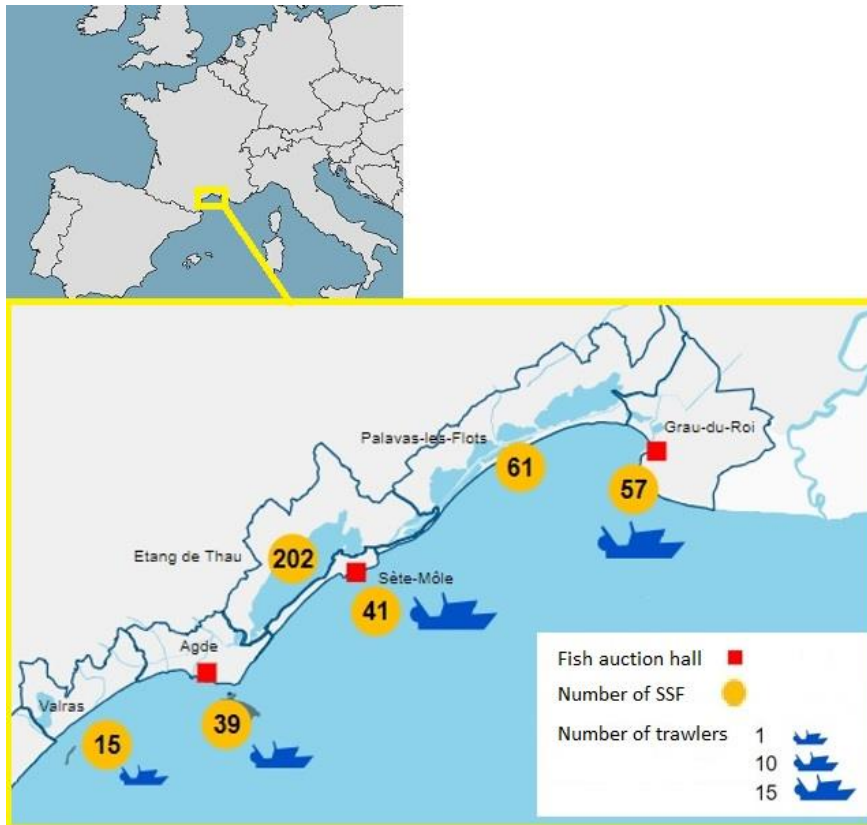
The objective of this work is to provide a better understanding of the dynamics between the different components of the system (i.e. fishers and fish stocks) which would eventually serve to explore the effect of different change scenarios. For this purpose, the attributes of marine ecosystem and also the fishers are to be taken into account in one single study. Berkes and Nayak (2018) have proposed a complex adaptive system (CAS) approach for the analysis of fishery social-ecological systems which is characterized by linkages, feedback, and attention to uncertainty and scale. This supports earlier calls for addressing the social complexity in fisheries (Fulton et al. 2011; van Putten et al. 2012). The dominant characteristic of CAS is the capacity of components to absorb information from their surrounding environment and accumulate knowledge which leads to adaptive actions. Fisheries as CAS self-organize in response to a wide variety of stimuli: internal feedback from within the chain (resource, markets, etc.), external effects, as well as to the governing system itself (Bavinck et al. 2013; Wilson 2017). The combination of feedbacks between agents and the fishery system and the role of social factors therein warrants a CAS view (Libre et al. 2015).

1.1. Case study

The west side of the French Mediterranean littoral is characterized as shallow and double shore, with an area of 47 thousand hectares of lagoons behind the coast of the sea (Giovannini 1995) of which 28 thousand hectares (Cepralmar 2013) of it consists of lagoons located in the case study (Figure 5). We may distinguish differences in the context of inshore, coastal and offshore fishing. For instance, the authorized length of fishing boats of lagoons is limited to 6.5 meters

and its engine power to 60 CV (Interview: regional committee of fishery and aquaculture 2010). The coastal fishery (till 3 nautical miles) are characterized by the relatively larger boats and higher engine power, while trawlers who sale over the 12 nautical miles may reach up to 24 meters.

Figure 5. Case study area, port of Sète and its surrounding



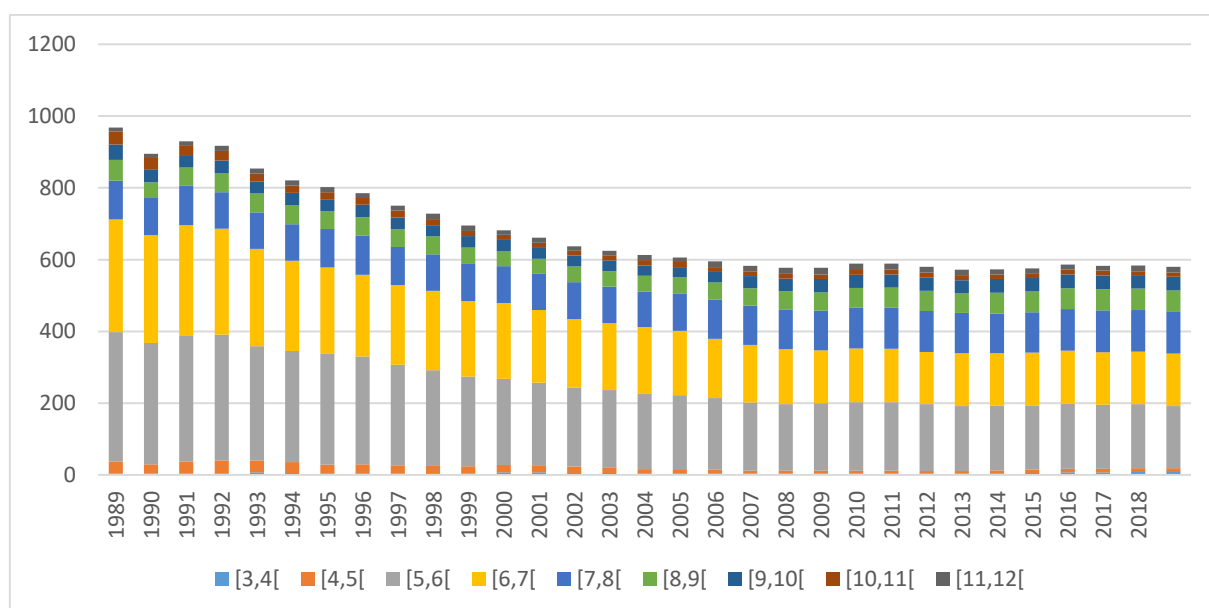
Source: Cépralmar 2016

All boats active in the department of Hérault and Gard are matriculated under the delegation of port of Sète (*Délégation à la Mer et au Littoral de l'Hérault et du Gard*). Their historical data are documented by European Commission Fisheries and Maritime Affairs, and are accessible through the portal of Fleet Register (EC 2019). Since the global census of 1989, historical data of 1841 fishing boats registered at the port of Sète are available concerning their modifications (name, port of activity, engine power and fishing gears) and their movements (exit/entry). One of the general trends that can be observed through analyzing statistically those data, is a decline of number of boats from the first census till 2003 (figure 6) which is mainly due to the exit of vessels between 4 and 7 meters. Based on the European fishing entry-exit regime, the total capacity of each member state's fleets expressed in terms of tonnage and engine power cannot exceed the reference level of year 2003 (Article 11, 12 & 13 of Council Regulation 2371/2002). New fishing vessels may enter the fleet only after the same fleet capacity (in kW and gt) is

removed from the fleet. Through this ‘entry-exit’ system, Europe’s fleet can no longer increase (EC 2014). In 2018 the number of vessels registered at port of Sète was 475 boats with the average length of 8 meters and the engine power of 100 HP (EC 2019).

Although all ports figured in the above map (Figure 5) pertain administratively to the delegation located at Sète, but their fishing activity are mainly concentrated towards the fish auction halls (*criée* in French) at the most proximity. There are three fish auction halls active in the case study area (Figure 5). Compared to two neighboring auction halls, at Agde and Grau-du-Roi, who have experienced more and less stable status in the last ten years, Sète has experienced a 60% of decrease in the quantity of fish sold (from 5895 T to 2367 T) and 40% decline in the value of the products (from 17589 k€ to 10711 k€) in the last 10 years (FranceAgriMer 2009-2019). Commercializing through the auction halls remains as the principal channel for all fishers. More than 60% of fishers considered it as their principal channel of sale (Chaboud et al. 2015).

Figure 6. Evolution of Fleet at Port of Sète (number of boats)



Source: European commission, fisheries and maritime affairs (EC 2019)

The halieutic resources of lagoons consists of fishes which immigrate between sea and lagoon (bar, gilt-head bream, muge, ...), shellfishes (clam, urchin, mussels, snails) and fishes of lagoon (European eel). The share of each specie has changed through time. While in the 80s, the landing of clam was estimated around 1000 tons, at the end of 90s it fell to less than 400 tons (Mazouni et al. 2000) and in 2013 it decreased to 88,4 tons (Lavaud 2014; Cevalmar 2016). Consequently, the number of fishers have decreased. All those who harvested only shellfishes

have been forced to stop with the sudden disappearance of clams in 2007. Today, those fishers who are active in the lagoon are mainly targeting the migrating species and European eel plus sea snails. The European eel's catch is thus increasing despite the controlling plans that has been put in action by the European Union for reconstitution of its stock (EC 2017-1). This is the only species targeted by SSF that requires a license. There are 65 license holder in the lagoons of the case study who catch in total around 1.2 tons per year (Cepralmar 2013). Concerning coastal and offshore fishing, landings registered by fish auction halls (table 7) reveal dramatic decrease in the population of certain pelagic species (sardine and anchovies).

2. Method

In order to capture the dynamics of the fishing system an agent-based modelling (ABM) is proposed. ABM is a computational model which explores systems of multiple interacting agents who are spatially situated and evolve over time (Sabzian et al. 2018). It's built upon complexity theory (CT) which is characterized by bounded rationality, information asymmetry, network interaction, emergence and inductive reasoning (Moss 2008; Sabzian et al. 2018). ABM provides a mechanism for modeling CASs (North et al. 2013). The philosophy of ABM comes directly from the idea that a CAS can be effectively modeled and explained by creating agents and environment, characterizing behavioral rules of agents, and specifying interactions among them (Wilensky and Rand 2015). With ABM, the researcher explicitly describes the decision processes of simulated actors at the micro level and then structures emerge at the macro level as a result of the actions of the agents and their interactions with other agents (Janssen and Ostrom 2006).

To design the fishing system simulation in ABM, the probability of interaction between components are required. The line between the mathematical modelling and the ABM is the production functions which constitute the essential link between biophysical and bio-economic models (Flichman and Allen 2013). So far, there are several economic studies dedicated to the analysis of the factors which effect the entry/exit/stay decision of fishers (refer to section ... boat behavior). Systemic impacts arise from the relationship between every economic agent and the environment in which they operate, as they influence one another's states and behaviors (Smetanin and Stiff 2016). Thus, the output of ABM is the structural change issued from the agents' interactions.

The conceptual framework of the model is designed in two phases. In the first phase, behavioral traits of actors are identified through literature review and interviews. The scientific studies, in

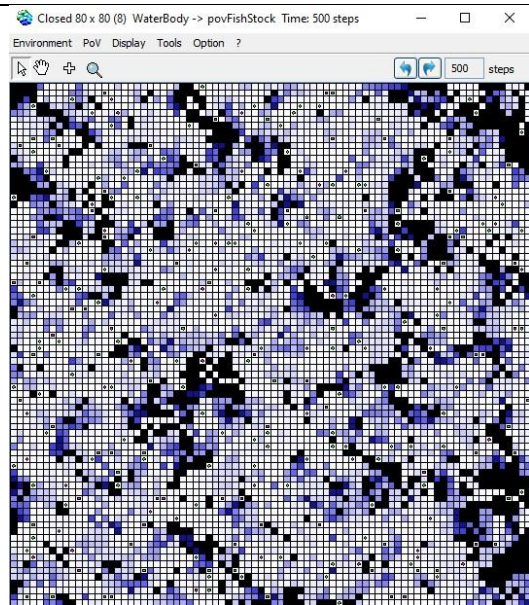
the field of economics and marine biology define the micro level rules which apply to each component of the fishery system. In the case of this article the components are limited to fishing boats and fish stock. For instance, if the population of fish stock changes from level X1 to level X2, then the number of probability of fishers with attribute “A” will change relatively. These changing, complex, and usually nonlinear causal relationships (Wilson 2004) are introduced using static mathematical relations between two variables. The most simplest relation is: $A \rightarrow B$ (if A, then B). Otherwise, A can be one of the variables of a function which leads to B ($f(A) \rightarrow B$), or A can transform to B through a function $A-f(x) \rightarrow B$.

Figure 7. The two main phases of methodology

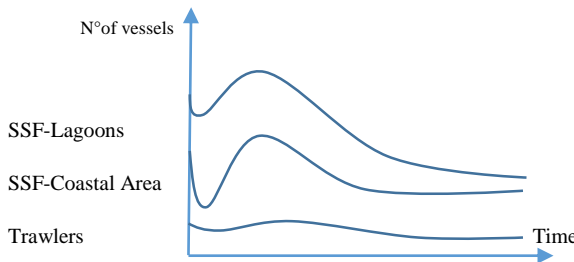
Phase I: Identification of micro-level relations and emergence of macro-level relations

e.g. the effect of speed of fishing on share of each category of fishers in the fishing fleet

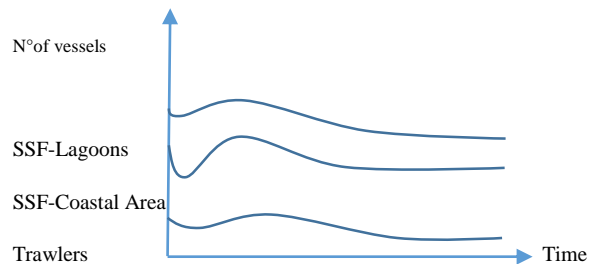
The spatial grid in Cormas demonstrating the interactions of fishers and fish stock →



Phase II : Validation of the model



The trend in “real life” \approx or \neq the trend in “Simulation”



In the second phase, empirical data of the case study are presented to verify and validate the model (refer to section verification and validation). At this level, the trend of changes observed in the field data are to be contrasted to the results of the model. The coherence between the two would validate the model. That means that the micro functions that represent the probability of each action (phase one) and their combination (the ABM) are well defined to represent altogether a macro-fishing-system-model.

3. Results

3.1. Conceptual Framework

“In between the literal description of a model and its implementation in a computer using a specific programming language, a formal representation of the conceptual model is vital” (Le Page and Bommel 2005 p.328). The model consists of a biophysical component (equation 1) and attributes agents (table 6). The conceptual framework has been conceived based on Ostrom (2009) conceptual framework. Two weaknesses of Ostrom’s (1990) “eight principles for the analysis of common management” which were “lack of attention to social learning” and the “exclusion of external drivers” (Trimble and Berkes 2015) were resolved in her 2009 framework for analyzing sustainability of SESs (Figure 4). This new framework offers exhaustive and detailed indicators which covers the interactions between the resource users and the dynamics of SES. The attributes of the components of the fishery system of the case study are presented in table 5. Components number 2 to 6 are inserted in the model either as an attribute or a formula. Outcomes (component number 7) is emerged from running the model. Component number 1 and 8 are the context in which the interactions are carried out. They are not inserted in the model nor the model attempts to describe them after being ran. They describe the setting in which the interactions take place. The importance of including them in the conceptual framework is due to their influence in defining the attributes of other components.

Table 5. Conceptual framework of the case study

	Class	Attributes	Variable (sources)
1	Social, economic and political setting	EU and national budgets, The perception (appreciation) of population on fishery	€ of EMFF (588 Mil, France 2014-2020) ⁸ Field data
2	Resource system	Productivity of sea and lagoon	Value of fish accessible (total landed fish*average price)
3	Resource units	Fish (sole, eel, gilt head, bar, muge) and shellfish species (clam, murex urchin and baby mussels) Growth Economic value (price of fish per kg) Spatial and temporal distributions	Fish caught from lagoon (table 7) Fish from sea (table 8) (Equation 1.) (FranceAgriMer/ofimer 2001-2019)

⁸ European Maritime and Fishery Fund of which it consists of European Union’s support: 58 134 197,00
National support: 42 835 724,00 adding up to a total financment:100 969 921,00 (Programme régional 2014; EC 2017-2)

			Equally distributed (no difference between lagoon, coast & offshore)
4	Governance system	Harvesting restrictions (quota and licenses) Exit/entry scheme (quota of GT and HP)	Fishing effort fixed for trawlers on licenses, Fixing the fleet size from 2003
5	Users	Number of users Age of vessel, engine power, tonnage Place of activity Catching capacity	Number and attributes of fishing vessels (EC 2019) Lagoon, coast, offshore (table 9) Estimation from FranceAgriMer (2019) and AMOP (2017)
6	Interactions	Catching fish Exit and entry of boats	Landings, FranceAgriMer (2019) Probability of decommissioning, change to other marine activities and (re)entering from other marine activities and ports to Sète fishery (table 10)
7	Outcomes	Evolution of engine power and tonnage per group of fishers Ecological performance measures	Equity Health of fish stocks
8	Related ecosystems	Pollution patterns	report of Syndicat Mixte du Bassin de Thau (SMBT)

Source: Research conceptual framework based on Ostrom (2009) framework, source of variables indicated in the parenthesis

3.2. Model Specification

Modelling is identified as a tool that scientists can bring into the deliberative process to facilitate dialogue and evidence-based decision-making within a stakeholder forum (Parrott 2017). The modeling question is “How would the number of SSFs of Sète change in the context of more scarce fish stock?” A modelling procedure proposed by Roughgarden (2012) regarding the steps of increasing the complexity and detail of the model has been applied. First an “idea model” which consists of a general simulation is modelled and then progressively detailed information are added to represent the specificity of the case study. In the following, we present the idea model that explains the exit/entry behavior of fishers and the basic fish stock compartment. The purpose of this model is to explain the reason behind the decreasing share of SSF in a

competitive setting where fishers act as pure economic agents and the fish stock follows a logistic function.

3.2.1. Fish stock's behavior

The fish stock is considered as one single species. The fish stock's only behavior is to reproduce and to be caught. The interaction of fish stock depicts the structure of a standard "von Neumann" cellular automata network (equation. 1). ABMs dealing with renewable resources management are frequently using such a structure to represent the environment" (Le Page and Bommel 2005). Thus the fish stock follows the logistic equation with a growth rate of r and the carrying capacity of K . X_0 is Sigmund mid-point. Assuming 4 years for growth of the fish to an adult size, the growth rate in the model has been inserted 0.25 and with the full capacity of 1.

$$\text{Equation 1. Fish stock} = \frac{K}{1 + e^{-r(x-x_0)}} \rightarrow x(t+1) = x(t) + rx(t) \left(1 - \frac{x(t)}{K}\right)$$

3.2.2. Boats' behavior

The economic analysis assumes that a typical commercial fisher expects a return rate of investment at least equal to the market rate of return. The models consist of explanatory variables which affect significantly the decision making of fishers to stay, enter or exit. The models employed varies from, proportional hazard model (Cordón Lagares et al. 2016) multinomial (unordered) logit models (Pradhan and Leung 2004; Mardle et al. 2006), and discrete choice model (Tidd et al. 2011). Furthermore, in the case of SSF, Cinner et al. (2009) used a binary logistic-regression model, and Muallil et al. (2014) used the "Fishing Industries' Support in Handling Decisions Application" model developed by Philippine Environmental Governance (2007) to determine the influence of different socio-economic factors in the exit-behavior of SSF. A variety of variables have been covered in these studies of which we may distinguish those in table 6. The relation between the attributes and the fishing activity are presented by the coefficient of variables (attributes) that determine the exit/stay/entry decision of fishers.

Table 6. Attributes of the fishery sub-system

Attributes of social-political conditions and ecosystem	Attributes of vessel	Fishing activity
Fleet size	Length	Revenue
Decommissioning premium	Tonnage	Target species (eventual revenue)

Spawning stock biomass	Engine power	Fuel price
	Gears	
	Age	

Source : Cordon Lagares et al. (2016) ; Tidd et al. (2011); Pradhan and Leung (2004); Mardle et al. (2006)

3.3. Dataset

The quantitative data has been mainly drawn from EU fleet register platform (EC 2019) and Cépralmar (2006, 2013) reports. The history of each boat, which consists of its entry date (census date, or year of construction, imported from other ports), modifications (in the gears used and the engine power) and exit (decommission date, change to non-fishing activity or date of being exported to other port) are available from census date (1989) till June 2018. This data platform also includes attributes of fishing vessels of the case study such as, date of construction (age of vessel), engine power, length and main and secondary gear type.

Concerning the marine resources, the fish sold at the auction halls are assumed to be representative of accessible resources in the sea and lagoon. Sources of landing data for the lagoons are declarations registered by research institutes (Cépralmar 2006; Ifremer 2011, 2016), and for the sea are from annual data registered in Sète fish auction hall (Ofimer 2001-2008; FranceAgriMer, 2009-2019). Amount of species (in tons) have been converted into monetary scale by the price of sale of each kilo to have one indicator representing the accessible resources common between species. Landings of 2008 have been taken as an average of fishing.

Table 7. Landings of fish at port of Sète

Fish Species (French names)	Quantity (tons)	Price (€/kg)	Value (€)	Comments
Anchovy (anchois)	1924	2.24	4309760	
Sea bass (bar)	51	13.69	698190	
Anglerfish/grouper (baudroie)	55	8.55	470250	
Squid (calmar)	38	10.19	387220	
Capelin (capelan)	206	2.19	451140	
Gilt-head bream (dorade)	78	8.07	629460	
Gurnard (grondins)	117	1.28	149760	an average of years
Mackerel (maquereau)	688	1.12	770560	data of 2007 replaced due to absence of data in 2008
Hake (merlu)	764	3.48	2658720	
Octopus (poulpes)	272	3.39	922080	
Red mullet (rouget barbet)	75	7.37	552750	data of 2010 replaced, due to absence of data in 2008
Sardine	2171	1.1	2388100	
sole (sole)	26	18.78	488280	
Others	1052	3.16	3324320	

Source: (FranceAgriMer/ofimer 2001-2019)

Table 8. Landings of fish and shellfish at lagoons of Thau and Ingril

Species	Thau			Ingril	
	Quantity (tons)	Price (€/kg)	Value (€)	Quantity (tons)	Value (€)
Palourdes	250	12	3000000	200	2400000
Murex	250	3	750000	5	15000
oursins	150	1.2	180000		0
naissain de moules	2000	0.31	620000	1200	372000
anguilles	70	5	350000		0
sole	0.4	15	6000	112	560000
daurades	150	8	1200000	20	160000
loups	100	10	1000000	16.5	165000
muges	100	0.5	50000	10	5000

Source : Cepralmar 2006

3.4. Verification and validation

The second phase of ABM consists of validation of the model. Evaluating a model by means of sensitivity analysis is the other half of the modeling process (Le Page and Bommel 2005). The two steps of simulation and experiment consists of first building an agent-based network that can reproduce some of the key properties of fishers' network and then to validate the model

by comparing the results of simulation with empirical data. This is to check if the outcome of the simulation model corresponds to the statistical data of the previous years. The iterations executed by the software results in different spatial and graphical outcomes. This is due to random probabilities which are attributed to the movement of vessels and the fish reproductions. Thus different outcomes are given every time the model is run. However, a representative trend can be drawn to verify its validity.

We check in this section if the probabilities of interactions that we inserted in the model corresponds to the overall reality of the system. Input-output relations are not clearly predefined in ABMs because of the nonlinear feedbacks driven by agent behavior and decision making (ten Broeke et al. 2016). In order to obtain clear input-output relations we ignore interaction effects and analyze the model response to the change of one parameter at a time (Libre et al. 2015).

The history of exit/entry of boats is to be studied in face of the exit/entry scheme and the fish stock changes. The 30 years' behavior of 1 563 vessels which have been active in the fishing fleet of Hérault in the period of years between 1989 and 2018 (until June) (EC 2019) can be analyzed as for the validation of the model. The probability that has been extracted from other studies to predict the fishers interplay with the fluctuations in the marine ecological environment concerning exit, enter and stay are to be checked if they correspond to the reality. Exiting (decommissioning or change to non-fishing activity), entering (construction or changing the status from non-fishing to fishing) and staying (no change or modifying the fishing equipment) have been modeled for several regions and type of fishing. The import and export (replacement of a boat from one port to another) has been excluded due to their small number in the region. The incidence of these (inter)actions in intervals of 5 years are presented in table 10. The three size categories of fleet [0-6[, [6-12[and [12-24[represent the SSF-Lagoon, SSF-Coastal and Trawlers. The reducing number of vessels under 6 meters (table 10) is representative of the less resources to be exploited in lagoons. Those between 6 and 12 meters are still resisting. Probably those who left the lagoons have joined the crew who exploited the coastal line (area till less than 3 nautical miles). The restrictions imposed to the trawlers, concerning fishing effort, made their activity lose its economic viability and left fishing.

To consider the human point of view, taking into account the number of fishers engaged directly in the fishing activity, size of fleet is the most representative attribute of the vessels. We may consider a trawler of 24 meters to be occupied with in average 4,3 persons on board (AMOP

2017; DG MARE 2016), a boat of 12 meter by 1,7 and a boat of 6 meters by 1,2 persons (field data, case of *Prud'homies* of Palavas, Sète-étang and Sète-Môle).

Table 9. Share of fishing area frequented by each user &

Attributes of resource users

Users	N° of users	area (km ²)	Capacity (k€/km ²)	Spatial entity	Tonnage (ton)	Power (kw)	Age vessel (year)
SSF_Lagoon	200	28*	110	Lagoon	0.96115646	36.5714286	32.3571429
SSF_Coastal	200	125	26.5	3 nautical miles (coastal)	3.68026846	117.134228	24.0536913
Trawlers	50	450	26.5	12 nautical miles and offshore	53.09125	266.895833	36.7291667

*comprising Camargue Gardoise, lagoon of Or, Lagoon of Palavas, Grec, Prévost, Arnel, Pierre-Blanche, Vic, Ingril and lagoon of Thau

Source : Authors' calculations and assumptions based on several data sources such as Réseau de Suivi Lagunaire et Pôle relais Lagunes, Communication Direction Départementale des Territoires et de la Mer de l'Hérault (DDTM 34), 2019 & Fleet Register (EC 2019)

Table 10. Changes incidence with-in the fleet (1989-2018)

Action	Size of Fleet			Entry to fleet						Exit from fleet					
				Change of activity			New construction			Change of activity			Break-up, shipwreck		
				CHA (+)			CST (+)			RET (-)			DES (-)		
Year	[0,6[	[6,12[	[12,24[	[0,6[	[6,12[	[12,24[	[0,6[	[6,12[	[12,24[	[0,6[	[6,12[	[12,24[	[0,6[	[6,12[	[12,24[
1989-1994	597	224	78	209	28	59	15	19	3	340	132	14	43	7	9
1994-1999	485	210	65	112	18	34	10	15	4	213	53	10	21	10	11
1999-2004	412	201	66	134	23	53	7	5	17	199	72	29	15	9	4
2004-2009	347	230	50	55	10	25	5	19	5	113	35	13	12	1	13
2009-2014	339	234	43	27	10	13	4	40	2	29	14	2	10	4	9
2014-2018	338	242	45	37	6	21	2	9	3	37	14	4	3	3	0

Source: Calculations from Community Fleet Register (EU)

3.5. Model development

There are so many factors that determine the dynamics of marine ecology. The numerous studies carried out by marine biologist and research institutes are an asset in modeling the trends of interactions between different components of marine ecosystem. These interactions are still to a great part unknown to us. In this article the outcomes of marine ecosystem are represented by the biological model of Von Neumann cellular automaton. However, there are dynamics which are more complicated than linear relations. For instance, the population of anchovies and sardines, which consisted the largest catch in the region till 2009, declined with such speed that today they are considered as the least caught fishes presented to the fish auction halls. According to scientists (interview-ifremer) this phenomenon is due to the pollution which decreases the number of planktons. While a tuna fisher in Sète, who his vessel has reached its annual quota of 2000 tons earlier than what have been planned (in 15 days instead of three weeks) when explaining about the catches of their recent years, which are comparably bigger and heavier fishes (200 and 250 kg vs. 60 to 90 kg in the past), has theorized that the decline of sardine population is due to the increase of its predators' population. This view is shared by 25 other fishers (Chaboud et al. 2015). In the same study, other fishers (54 out of 162 interviewees) have declared an increase in the presence of Gilt-head bream (Daurade Royale) though there is a stability seen in the landings sold at Sète's fish auction hall (an average of 110 tons per year with a standard deviation of 25 tons for the years 2001-2018). Apparently, this perception is due to ease of catch of these species compared to the past (before the application of quota for blue fin thon and restrictions of effort of fishing for the trawlers in 2007). According to Didier Daynac (Prud'homme of *Prud'homie* of Palavas) the gilt-head was captured during the nights of full-moon. While nowadays, this pattern has changed to the absence of moon. These are all to say that there is a need for further studies to identify the biological interactions between the different components of marine ecosystem. Although literature in marine science is rich but due to the interventions of human activities in the marine ecosystem (i.e. pollution and fishing) the biological compositions are varied and thus the marine nature adapts new equilibriums.

The same argument is true in the case of social attributes of the model. Due to the changes that the cultural values and social norms undergo the attributes of fishers are to be updated. For instance, concerning the harvest rate attribute of fishers, though the data from the fish auction houses are available, but that is not the case for other channels of marketing such as sale on the dock and direct sales to wholesalers and restaurants (Cepalmar 2013). Estimates of quantity of sale by alternative marketing channels needs to be inserted into the model.

Though one positive characteristic of ABM is to randomly create such dynamics and to insert them in the interactions between the system components. However, the more precise and closer to reality the initial attributes (either that of marine ecosystem or that of the fishers) the outputs of the model would be more reliable and describes better the reality.

4. Conclusions

The model serves as a virtual laboratory to investigate the interplay between the individuals, the institutions, the fishing community, and the fish stock they exploit (Lindkvist et al. 2017). Their objective is usually to determine how fishing effort maximizes profits while considering renewable capacities. While marine environmental studies are concerned with identifying maximum sustainable yields (MSY), economic literature in fisheries, produce models of fishery that measures the economic viability of fishing.

The conceptual framework of social-ecological system presented in this article supports the implementation of an agent-based modelling to identify the problem of declining number of SSF in south of France. A more detailed framework and modelling would be needed to translate the discussed framework into a full-scale model for studying the behavior of fishers to the economic and political changes in the fishery system. An ABM, at its early stages of development, is more about development of ideas (i.e. how could it evolve vs. how it did) rather than having a precise model simulating the interactions and their outcomes. Descriptive models are more comprehensive as they discuss verbally the relation between the inputs, interactions and outputs in the system. Nevertheless, a model with mathematically defined pathways creates a field for prospective development. The probabilities of agents' interactions are different based on the social and ecological conditions where they are realized. Identifying these probabilities through mathematical models and verifying them in the overall picture of SES would create an instrument that allows us to measure the effects of policies and market fluctuations of fishery activity.

The intersection between natural and social sciences may be observed through the dynamics which are played between the agents of the two systems (ecological and social). Nevertheless, the most obscure part of these models are the decision making protocols of human agents. Their learning capacity allows them to opt for new strategies, innovating their interactions with their surroundings. Contrary to the natural sciences, universal models do not determine the response of humans in face of drivers or stimuli. Specific models are required for each social context,

comprising the capacity of its human actors to learn and adapt. Depending on the decision-making capacity of its actors, the fishery system reacts distinctively in response to different drivers. Therefore, consequences of new pathways are to be inserted into such model to update the outcomes that it results.

Chapter V

Fishers - Governance System Interaction

Co-management of fishery from negotiation lens: Case of Prud'homies

Abstract

While European Union's fishing policy is mainly based on maximum sustainable yield, at the fishing local community level, fishers' main incentive to sustain fish stocks appears to be maintenance of social relationships. Divergence of stakeholders' objectives in the management of marine resources create conflicts of interests that can be overcome through a process of negotiation. The formulation of the solution is embedded in the perspective of the stakeholders. Reaching an optimal solution to fishery management, where the stakeholders are better off, seems to be depending on their negotiating capacity. In this paper we analyze the negotiation mechanisms between the French Mediterranean local fishing communities and the European Union common fishery policy. Inspired by interactive governance theory, the performance of *Prud'homies*, as a local governance entity in the French Mediterranean, has been analyzed through their capacity to cooperate and represent the fishers' voice in the formal institutes. Their potential to sustain in the co-management of marine fishery has been discussed.

1. Introduction

Attentions are directed towards re-engagement of traditional tools in the management of marine resources as the issue of sustainability gets more critical. The Green Paper (EU 2009) suggested regionalization as a strategy to overcome failures within the common fishery policy's (CFP) decision-making system (Salomon et al. 2014). Incorporating wider range of stakeholders in the decision making intends to increase the legitimacy of the regulations beside guaranteeing their implementation. Co-management in this context is defined as the sharing of power and responsibility between the government and local resource users (Berkes 2009). However, governance problems in fisheries are often 'wicked' (Rittel and Webber 1973) where there is no optimal solution, and no right or wrong solution which the formulation and existence of the problem is deeply embedded in the perspectives of the stakeholders (Rittel and Webber 1973; Whyte and Thompson 2012). The dynamics of human-in-nature systems (or social-ecological systems) raises issues of resilience, adaptation and transformation and requires changing the focus from seeking optimal states and maximum sustainable yield paradigm to co-management (Jentoft and Chuenpagdee 2009), capacity of self-organization (Folke et al. 2002) and resilience analysis (Holling 1973; Walker et al 2004).

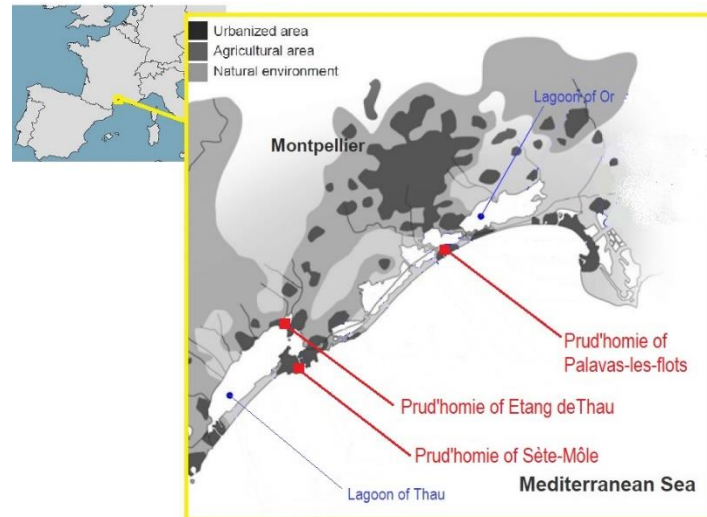
Accepting fisheries as social-ecological systems (SES) reinforces the notion that fisheries need to be managed by addressing problems related not only to the resources themselves but to the people targeting them (Hilborn 2007; Gutiérrez et al. 2011). The community level is important as the starting point for the solution of the tragedy of the commons (Berkes 2006). Viable fish stocks require “viable fishing communities”(Jentoft 2000). “Before one can hope to rebuild fish stocks, one must start to rebuild communities; one cannot succeed without the other” (Jentoft 2000: 53). Viable fishing communities are able to cope with challenges (Hechter and Horne 2008) either in the political sphere or in the natural environment. The survival of the fishery and community viability have always been, and still remain, a consequence of an adequate level of flexibility (Broch 2013). The resource collapse is highly probable in open-access sources where the resource users are diverse, do not communicate, and fail to develop rules and norms for managing the resource (Ostrom 2009). Governability here can be rephrased as the capacity of fisheries as a whole to self-organize and maintain themselves with due consideration of the inherent and constructed qualities embedded in nature and society (Song and Chuenpadgee 2015; Berkes and Nayak 2018). While in the top-down pyramid-like fishery governance system the fishers are passive recipients of regulations, in the alternative community based management system, fishers serve simultaneously as subject and object of governance (Jentoft 2006; Berkes and Nayak 2018). Governors - whether of the state or of the fishing population - need to balance between different policy objectives and between the imperatives of inclusion and exclusion to improve governability (Bavinck et al. 2015).

1.1. Case study

The west side of the French Mediterranean littoral is characterized as shallow and double shore, with an area of 65 thousand hectares (Cepalmar 2013) of lagoons behind the coast of the sea of which 10 thousand hectares of it consists of Lagoons located in the case study (figure 8). Golf of Lion, on the south-western Mediterranean coast of France, is among one of the rich fishing areas of Mediterranean Sea, which at the same time is treated by pollution (Meyer 2000). The biological cycles of lagoons, through their interaction with the sea regulates fishing activities and also social organization of the fishing communities of lagoons (Giovannoni 1995). Lagoons are enclosed common-pool resources which rise the importance of governance much more than that of the open sea. Its resources are managed by an institution particular to French Mediterranean coast, the *Prud'homie* of fishers. Their attachment to the territory had made them overcome the changes through centuries. They take into account the evolution of available short- and medium-term resources and set rules that are accepted by fishers (Decugis

2015). However, the changes in the fish stocks and the European policies, which have left progressively less space for local management, have put their future into question. In this paper, we discuss the interactions of stakeholders active in the management of lagoons of Thau and Or in south of France (figure 8).

Figure 8. Location of area of study, south of France



The sovereignty of state over French maritime area has been officially registered by “Ordonnance de la marine du mois d’août 1681⁹” in which authorized maritime activities have been specifically determined. The French Constitution of 1852, despite several modifications, is the general framework of coastal fishery exercised today. The Law N° 85-542 (22 May 1985)¹⁰ asked for harmony with the European regulations especially in the issue of management and conservation of natural resources, at the same time, allowing state council to take decisions when necessary.

The evolution of small-scale fisheries’ organization is considered as a crucial topic in assessing the industrial versus small-scale division (Johnson et al. 2005). Though, the target of this study is specifically small-scale fisheries (SSF) as large-scale fisheries (LSF) are rarely tied to a community (Berkes and Nayak 2018). In small-scale fisheries, community is affirmed by notions of fairness, share systems, kinship connections, locally adapted legal systems and shared attachment to place and profession (Derek S. Johnson 2018). Although, community values are constantly being eroded and communities are often at risk of losing their identity (Jentoft and Eide 2011; Jentoft and Chuenpagdee 2015) but still due to their differences in the

⁹ P. Osmont, Paris

¹⁰ Modifying the decree of 9 January 1852 on the exercise of marine fishery.

role of community in governance there is a distinction between the management of LSF and the organization of SSF in scientific literature and also political texts.

1.2. Prud'homies

The Prud'homies are democratic institutions of boat owners in the French Mediterranean coast. There are 33 fishing Prud'homies on the French Mediterranean coast. According to Chaboud et al. (2015), their birth can be explained by the presence of a big number of lagoons on this coastline and the necessity to manage the activity of different gears within lagoon's territory. The complexity of managing Mediterranean fishery was such that in 19 November 1859, a part of coastal authority has been officially assigned to Prud'homies. By this decree, decision making on “all organizational matters and precautions that, due to their variety and their diversity, were not foreseen in general and specific texts on the authority of fishing,” has been given to Prud'homies (Article 17 of Decree of 19th November 1859¹¹). Based on ethnological studies (cf. Berthelot 1868 and Giovannoni 1995) their juridical autonomy goes back to ancient Greek. Similar organizations can be found in Mediterranean coast of Spain (Cofradias) and Venice (Fraglie) (Raicevich et al. 2018). The Prud'homies are to manage the fishing community as a mutual society. It comprises the boat owners that are registered as a fisher. In order to be eligible to fish in the lagoon, in addition to be registered at the delegation of sea and coastal affaires (Délégation à la mer et au littoral, the official organization of maritime affaires), one has to be a member of Prud'homie.

In this study we address 3 Prud'homies have been selected as a sample. Though the three of them are registered officially under the administration of port of Sète but their attributes are distinctive. One is only active in the management of lagoon of Thau (Etang de Thau), the second Prud'homie (Sète-Mole) is located at the port of Sète and includes not only SSF but also trawlers and tuna fishing boats operating exclusively in the sea. The third Prud'homie (Palavas-Les-Flots) operates in both areas of lagoon and sea. The other 30 Prud'homies are similar to the third case. We have included intentionally the two extreme cases (the first and second case) which helps us develop the discussion. The three Prud'homies are from the regulative point of view similar, but have gradually adopted managerial strategies due to differences in social-ecological environment.

Table 11. Three cases of Prud'homies

¹¹ Regulations on maritime coastal fishery in the 5th maritime area (arrondissement de Toulon).

Name of Prud'homie	Place of activity	Number of active vessels			
		SSF – Lagoon	SSF – Sea	Trawlers	Tuna fishing
Etang de Thau	Lagoon	170	-	-	-
Sète-Mole	Sea- Coastal and offshore	-	30	16	15
Palavas-Les-Flots	Lagoon and coastal	19*	19	-	-

*Among the 38 fishers of Prud'homie Palavas-les-flots there are 10 fishers who fish in both areas of lagoon and sea

Source: Interviews (2019)

Every three years, fishers choose three to eight representatives (Prud'homes) to lead the fishing community. The idea of having Prud'homes (the leaders who manage the Prud'homie) is to benefit from the orientations of the wisest among them. Leadership is not only about resolving conflicts and distributing the fishing area but to guide the fishing community toward a sustainable extraction of resources, where all those families in need can carry out an honorable living (Giovannoni 1995). Prud'homies represent a strong identification between a community and its fishing territory (Cazalet et al. 2013).

2. Methodology

Interactive governance theory provides the conceptual thinking of this analysis. In the “interactive governance theory” it is argued that fisheries and coastal governance is basically a relationship between two systems, which could be termed a “governing system” and a “system-to-be-governed” (Bavinck et al. 2013). The former system is social: it is made up of institutions and steering mechanisms (Kooiham and Chuenpagdee 2005). However, although few studies have applied already the application of interactive governance theory to fisheries, but its lack of conceptual reasoning and tools in discussing matters such as power and marginality has been criticized¹² (Scholtens 2016 In Song et al. 2018). Thus, in this study, not only did we address 1) the dichotomy between the European and community based regulations but also based on negotiation theory we have discussed the 2) the capacity of Prud'homies in negotiating for power in decision making in the actual European context.

¹² For a complete discussion on tools for assessing the changes in the governing system and the system to be governed refer to Chuenpagdee and Mahon (2013).

Understanding how micro-level behaviors of heterogeneous actors, their interactions with other actors and their biophysical environments, give rise to different forms of self-governance, requires a disaggregated approach (Lindkvist et al. 2017). Dividing the fishing governance system into two levels; regulative level and community level has allowed us to specify the interactions occurred in each level separately, and between the two levels. Nevertheless, this paper is specifically interested in the interactions that happen between the two levels of governance between local fishing communities (the Prud'homies) and the EU regulative entities.

To understand some of the essential challenges that confront any collective action we need a “thick description” of the context (Geertz 1973). In order to discuss the potential of co-management in the Mediterranean fisheries, one should answer the question of: “who loses and who benefits from the social-political changes (going further towards centralization of decision-making or regionalizing) in the fishing system?” This full and detailed picture of what happened in the past is most probably to explain how organizations evolve and what shape they would assume. Oral history, field observation, interviews and focus groups are used to obtain detailed and specific information about individuals, households and communities (Chuenpagdee and Mahon 2013). For this purpose, a timeline is drawn with the participation of a group of fishers in each Prud'homie to track the historical trend of social change. Timeline is a participatory data collection tool for gathering longitudinal data in the history of a community. The topic of the research is analyzed in the sequence of key events. Small group discussions are preferable to individual –one to one- data collection, because they encourage discussion and are a better representation of collective community experience and knowledge. Since the Prud'homies are elected by fishers to represent them in the management of the fishing community we have considered them as the most knowledgeable fishers who are able to describe the important events of the community in the studied matter since the date they recall to present. The timeline provides a different form of presentation of the topic, altering the interaction from oral to visual mode (Sword-Daniels et al. 2015). A0 size (841-1189 mm) sheets of paper with a line marked with points in equal interval, each representing a year were placed on the center of a table with participants having control over it leaving one to take charge of taking notes on the sheet. The discussions were conducted in French by the lead author. Some interviews were audio-recorded and some were recorded by handwritten notes apart from the main large sheet.

We may figure out the negotiation that has been realized between the state and the local community by analyzing the role of interest groups and their influence on the final policy

outcome (Markussen and Svendsen 2005). The question would be: how does the design of the common fishery policy be affected by the interactions between SSF, regional and national delegations, and the EU legislation framework? In the following section of results, we present the actual and previous position of the Prud'homies regarding the rest of fishery governance system. Historical evolution declared by the active and older members of fishing community are presented. The section after, discusses the strategies that governing system adopts in order to survive in the degrading marine ecological system.

3. Results

After years of practicing top-down approach of fishery management in the European Mediterranean coast, in 2002 the common fishery policy (CFP) reform, has proposed the establishment of Regional Advisory Councils (RACs) to 'advise the Commission on matters of fisheries management in respect of certain sea areas or fishing zones' (Commission for Environmental Cooperation 2002, Article 32:27). In this regard the Mediterranean Advisory Council (MEDAC), headquartered in Rome, transfers the new sub-regional fisheries' management plans in the Mediterranean coast to the European Commission so that the contextual differences would be included in the commissions' decision making. In this arrangement, the RACs are only advisory bodies, not management bodies with the authority to make decisions (Gray and Hatchard 2003).

The desire of interchange can be clearly seen in the two sides. First, on the EU side, facilitating the creation of Fisheries Local Action Groups (FLAG) is an attempt to create the conversation with the local communities. This role has been played partially in the past by earlier organizations such as Cofradías (in Spain), Prud'homies (in France), and Fraglie (in Italy). However, the composition of FLAGs is broader (i.e. not only fishers, but also representatives of the public, private and civil society sectors), and their objectives are more focused on increasing employment and territorial cohesion rather than on local based management of fishery resources (Raicevich et al. 2018). On the other hand, in sight of globalization and the need of support, the Prud'homies have tendency to negotiate the functional specifications.

“It would be desirable that the system progresses towards the modern concept of co-management” (a fisher of Thau lagoon 2019).

“Coupling the fishery of European eel (*Anguilla*) with the same restricting regulations of other fisheries, such as threshold of motor power and the vessel tonnage, is not pertinent, as it’s not the boat which fishes, it’s the fisher” (a fisher of lagoon of Thau).

The SSFs are aware of the importance of the continuance of their activity from the eyes of their adversary. Their resistance would be beneficial to the official institutes that govern them. However, reaching a consensus that creates a win-win situation seems to be a challenge, as the regulative system and the community are not necessarily complementary aspects of the same rationality of governance, but pertain to different governance problems potentially in competition (Crawford 2001).

“The decline of the number of fishers puts in risk the existence (loss of credibility) of all the organizational structure around the fishery (Prod’homie, regional committee, fish auction hall, cooperative). It’s the tax which pays for these organizations and the connection between the fishers maintains these” (a member of regional committee of fishery).

“Our challenge is an act of resistance in the face of changing regulations and market forces” (Prud’homme of Palavas 2018).

There are few challenges for the survival of SSF identified in the context of our case study. The rarity of marine resources in the previous decades is associated with the pollution of water of the lagoon. Technology has not been an unsolved issue in the case of Prud’homies as “the pace of technological change tends to be relatively slow in the Mediterranean, the effect being to cushion the level of social disruption in terms of organization of labour and eventual loss of employment resulting from innovations” (Bonzon 2000). However, the rarity of fish, either due to pollution or to overfishing, is an issue that fishers are willing to cooperate with other entities in order to be resolved. These topics are the negotiating subjects between the Prud’homies’ representatives and the regional authorities. There have been agreements developed around the lagoon of Thau in this regard (refer to “Contrat de gestion intégrée 2012-2017”, Syndicat mixte du bassin de Thau), in which the voice of Prud’homies among representatives of official entities (city council, regional committee of fishery, water agency, ...) seems to be low.

3.1. Types of interactions

Gutiérrez et al. (2011) have categorized co-management in three types : consultative (consultation mechanisms and dialogue); Cooperative (cooperation in decision making); Delegated (delegated responsibility to users). Based on the questions posed regarding the

structure of decision-making and the significance of the Prud'homies' role in taking decisions and their application, we identified which type of co-management is applied in the Mediterranean context. The nature of regulations in different levels of social life requires a distinct category of co-management. We observed all the three types present in the context of French Mediterranean context. However, each type had a different weight in different levels of decision-making. For instance, the cooperative co-management can be observed in the general assembly and the thematic sessions organized by each Prud'homie to resolve the problems of the marine territory under their governance. However, they delegate the power of interference to the port authority (*capitainerie*) in case of tensions between the member of Prud'homie and the other boats (recreational and illegal fishing boats). Eventually, representatives of fishers, the Prud'hommes, attend different committees of the regional organization of marine fishery to transfer the ideas and the problems to national entities and the European Parliament.

3.2. Prud'homie – EU interactions

Among the 162 fishers of Prud'homies interviewed by Chaboud et al. (2015) 82 of them considered the quality of actions of the European Commission concerning the SSF poor. This is while the same amount of people perceives a high quality of performance from local and regional institutes. The majority of small-scale fishers of south France have announced also that the quota and access restrictions have no effect or if any they have negative effects on management of fishery (Chaboud et al. 2015). These statements seem to be a part of the game. They benefit from any tribune to renounce the conservation policies and gain more profit. By asking their perception verbally, they have the tendency to show a dramatic situation and ask for more support. When discussing co-management, it is crucial to distinguish between exercising a right at the operational level and the right at a collective-choice level (Schlager and Ostrom 1992).

The emergence of other official institutes (producers' organizations, cooperatives, Regional Fisheries Committees and National Committees) reduce Prud'homies' rights. The institutional changes of 1992, 1998 and 2010 has accorded to the Regional Committees the power of managing the area within 12 nautical miles. The influence of cooperatives and producers' organizations which their members are mainly the trawlers and the tuna fishing boats, restricts the voice of SSFs. The field of action of Prud'homies has been reduced to local level and the management of resources in lagoons. They have no official recognition in French fisheries management framework (Gutiérrez 2013). These institutional changes discourage the development of Prud'homial managerial concepts. While, during a time Prud'homies have been

viewed as a model to be generalized to the Atlantic and the North Sea façade (Teran Perez 2000). SSFs are facing a paradox of wanting to conserve their perpetual agreements while they are aware of the on-going change in the political structure and the decision making processes.

“We need to follow the changes, at the same time respecting the laws that were valid in the past” (a Prud’homme in the case study).

To what concerns the lagoons, Prud’homies devise their operational level rules which makes the entire organization to be considered as a single agent while trawlers and tuna fishing boats active offshore act individually in the large context of fishery. This fact is more tangible in the case of second Prud’homie (Sète-Mole) as the trawlers and tuna fishers consist the majority of the members and even the SSF act independently as there is very little to be coordinated. While the fishers of the lagoon need to organize the place of their gill nets, which is specified in an annual meeting in June by random draw. It seems that the evolution of European policy is leading SSFs of the lagoons to the direction of having the same attitude as those fishers in sea. Applying equal legislation to all categories of fishing vessels creates a competition that in order to survive from it you have to beat others. This is in contrast with the cooperative philosophy of community based management practiced by Prud’homies. Transferring certain charges to the port official entities (e.g. gendarme of the sea, port authority (*capitanerie*) departmental directorate of the sea (*affaire maritime*)) reduced gradually the responsibilities and the collective choice power of the lagoon Prud’homies. The general assembly and thematic meetings are narrowed to certain operational rules that usually concern the place of posing the nets. Entering the lagoon as a fisher is no more confined solely to the decision of Prud’homies, but to the quotas defined at the national and regional level by the EU. Concerning the fishing quota, it is only applied to the tuna fish and the fishing effort of trawlers. These restrictions have been applied after a phase of three years of data collection by the port authorities. Registering the landings are seen by the SSF as an attempt by the EU to apply restrictions also on their activities.

4. Discussion

In the following section, different types of interactions between the local and social level entities are discussed. The fundamental contrasts between the sovereignty of state and people is taken as a base of negotiation. The capacity of negotiation and its outcome (inclusion and exclusion). The order of discussing the elements which influence the negotiation power of the fishing community is based on its priority and its generality. First we have discussed the

capacity of learning and adaptation, and then the cooperative behavior between the members of the system, the said synergy, social capital or social cohesion. Finally, the voice and the influence of the community on the control regulations has been discussed.

4.1. Society - community dichotomy

The community/society dichotomy (*Gemeinschaft/Gesellschaft*) has been first introduced by Tönnies (1887). He introduced two levels of order that are not mutually exclusive. In the case of SES, we may add an ecological system that determines the environment of interaction between the two classes of actors (the society and the community). This consideration can be seen also in the study of other behavioral and social sciences dividing the analysis into three levels: (I) the individual human agents constituting (II) a society as a part of a (III) (supra) regional social-ecological system (Solich and Bradtmöller 2017). According to Reynaud (1997) there are two organizational systems that coexist. The first one is a control system which is based on logic of efficiency and cost-benefit management and the second one is based on affection relations and feelings. The first one leans on regulation and the second one covers the practical reality. The incompleteness of control regulations leaves the way to local norms to develop. In other words, the flexibility of local norms allows the control regulations to work properly. The two reach a consensus to enable them to interact. Another point of view addresses the relation between community and the global regulations as “roots-and wings” suggesting a balance between inward and outward looking: “We obviously need the roots that community provides, but we also need the wings that globalization both grants and requires. We need robust communities that install in people a solid identity. We need communities for the permanence and stability they provide. Communities help us stay sane” (Jentoft 2011 p.20).

4.2. The two main parties in fishery management

In the case of fishery, the two parties are 1) the local community and 2) the control regulation system. The goal of the fishery governing system is to influence the interaction between the social and the natural sub-systems that are to be governed in order to halt ecological degradation (Jentoft 2006), while the fishers’ behavior (individually or collectively) are determined by social relations in fishing communities including a diversity of relationships such as dependency, obligation, support, reciprocity, exploitation, and collective action (Pollnac, 1988; Jentoft et al. 1998; Coulthard 2012). In a democratic society, as rules have to be in accordance with the willingness of the majority, the former group attempts to attract more fellows and thus represent itself as the majority’s will. Politicians ask for advice only to support and legitimize their pre-formed political decisions (Hoppe 2005). In this process, one party in order to

convince the members of the other group, or to attract their support has to assure that their activity does not have any harms or would compensate in case of any. They would need the popular consent for actions they take. In this context, the actions that are fulfilled are a result of negotiations between agents of the community and the society's regulative system and not driven from a participatory decision making process as it is advertised by many defenders of co-management. Fisheries management, till date, is mainly oriented to satisfy the needs and aims of large-scale vessels targeting both demersal and small/large pelagic fish, and not SSF that is more rooted in fisheries communities (Raicevich 2018). Though, the fishers will engage when invited, but they do not seek out engagement as a strategic partner who must be included as part of the solution, as they report that they often feel that they are targeted as the “cause of the problem” or the “bad guy” by conservation and environmental advocacy groups (Pomeroy et al. 2016). If the imposed regulations by state are not adequate to the local context, the fishers' disobedience is a response in the framework of negotiation. The continuous negotiation between control regulations (state rules) and social autonomous agreements (civil society) limits one to take control over the other, reducing the probability of falling into autarchy. Although, a strong central governance system may provide a structure of regulation formation, and thus enhance co-management, but local community attributes are also necessary for success (Gutiérrez et al. 2011). As a universal European policy does not correspond to the characteristics of Mediterranean fishery (Teran Perez 2000), the local fishing communities attempt to modify it to conform to their reality. One of the main arguments by the Prud'homies for fisheries sustainability was the need for local governance and the realization that EU policies' “one-size-fits-all approach” does not match the scales between the policy and the local social-ecological characteristics of the fishery (Gutiérrez 2013).

4.3. The role of negotiation in co-management

Negotiation between the actors is the heart of co-management (Borrini-Feyerabend 2000). Social-ecological systems don't have a single, optimal or clear solution. They are considered as “wicked problems” (Rittel and Webber 1973). They have innumerable possible solutions (Norton 2012; Whyte and Thompson 2012), there are no right or wrong solutions because there is no end point and no stopping rule (Jentoft and Chuenpagdee 2009). Therefore, there is a non-ceasing negotiation between the agents (institutes, social norms and others) in seek of improving the previous agreement. We have employed the definition of negotiation proposed by Stephenson (1984), that has been employed mainly by researchers in the domain of management, conflict resolution and organizations; a process putting two or more actors face

to face who are confronted with divergences and recognize their interdependence, choose to search for an arrangement to come up with a new equilibrium, although temporary. Members of a local production organization may not be a specialized negotiator. However, they make daily deals without considering them as negotiations (Fisher and Ury 1982). Human relation is full of mutual and collective agreements. The majority are not written down and signed by the concerning parties, but there are verbal consents indicating simply, if you do this I'll do that. Even some agreements may be carried out by a simple eye-contact or a nod of a head. In all cases, the agreements will govern the interactions between the involved parties.

Numerous participative projects consider valuable the principle that it's enough to identify the stakeholders and gather them around a table to obtain a fair consensus. While this principle is not valid unless we assume that the concerned actors have the same power of negotiation (Nelson and Wright 1995). State authorities and managers can deal only with entities and their representatives that in fundamental ways embody a mutual understanding of what is important, employ a common worldview and language to express it, and make decisions in a manner consistent with neoliberal administrative practices and objectives (Ralston Saul 1992 In Davis and Ruddle 2012). On the other hand, when co-management is initiated by the government and the main partners are lobby groups or other non-community actors there is a risk of ignoring community values and perspectives (Berkes and Nayak 2018). In fisheries governance, the state thus often has a role to play in making sure that the process and outcomes are inclusive. Otherwise, the most powerful of stakeholders are likely to pull up the ladder while they climb it (Bavinck et al. 2015). When the governance system is considered to be the sovereign, individuals are limited in exploiting the resources to the acceptable extent. Here, the question which is raised is: "who is more legitimate to govern the fishery system?", "to whom should we transfer the sovereignty of managing the marine resources?" Singleton and Taylor (1992) theorize that the types of solutions that result will depend on the degree of community: at one extreme are fully decentralized, endogenous solutions, which depend on high degrees of community; at the other, solutions heavily dependent on the state, because of low degrees of community, and hybrids such as co-management.

Negotiation is remarkably an important issue in the management of CPR. Its importance is more comprehensible when there rises a problem, which if not resolved usually leads to the tragedy of commons (Hardin 1968). Almost from its inception, the literature on co-management, observed that stakeholder self-organization rises often in the context of crisis, conflict, and competition (Pinkerton 1989; Mahon et al. 2008). Early social theorists such as Cooley (1918),

Simmel (1955) and Coser (1956) saw conflict and cooperation as two sides of the same coin that combined to give structure, meaning and direction to social life (Eggins 1999). Both the degree to which a community is capable of self-organization and their capacity to learn and to adapt to an ever changing environment strongly depend on trust and social capital as well as on the degree to which the community is authorized to change its own rules (Ostrom, 1990; Baland and Platteau, 1996; Agrawal 2002; Vollan 2008).

Synergy is a concept that has been used to explain sociological interactions, both as an outcome and as a mean through which more constructive relationships are fostered (Pascual-Fernández et al. 2018). In the context of interactive governance (Kooiman et al. 2005), synergy is a possible outcome of interactions that occur between the governing system and the system that it aims to govern, as well as internally to both systems. In this case the synergy attained helps create resilience in times of crisis and has proven to be a basis for community sustainability (Pascual-Fernández et al. 2018).

“We were 150 fishers and we didn’t have problems between us, now they are 5 and they dispute” (an ex-fisher of lagoon of Thau at age of 82).

Ecological or political changes evolve the human environment continuously. As long as things continue as before, or at least as they were expected to, there arise no new problems requiring a decision, no need to form a new plan (Hayek 1980). But as the human society is dynamic, the position of individuals keeps on changing. Win-win situations however rare, are achievable in well-coordinated situations where the actors can anticipate the actions of their counterparts. If the change is coordinated and well-organized the benefit would be distributed fairly among the actors, otherwise, either the desired change would not take place or one would gain more in the expense of others losing. Thus, for social order to arise and be maintained, two separate problems must be overcome: people must be able to coordinate their actions and they must cooperate to attain common goals (Hechter and Horne 2008). The prud’hommes are the elected fishers who take the responsibility of solving the conflicts among the fishers in the fishing area. Concerning the surveillance and justice, there is almost no action required to be carried out by the prud’homieal institute due to the self-controlling manner of fishers (Giovannoni 1995).

“The connections made that they regulated the matters between themselves, there was no need to the presence of an authority” (a marine gendarme in the case study area).

In the absence of conflicts between the fishers, the main role of prud’hommes is to lead the community to a safe shore. The sustainability of fishing activity depends on the organization of

fishers and their neighboring activities (shellfish farms, urban area workshops and etc.). The prud'hommes are assigned as the wisest men of their community to represent the community in the regional organizational entities and to negotiate for their wellbeing. Once the matters are coordinated and agreements are reached, the boundaries of the agents' actions would be restrained accordingly. When the culture is highly resistant to change and culturally tight, then those who have the least in common with the mainstream are the most likely to be marginalized (Lassiter et al. 2018). Although scholars using the co-management theory are clearly and deeply concerned with the marginalization of small-scale fishers, we are still lacking a conceptual reasoning and proper tools to analyze the (re)production of marginality" (Scholtens 2016 In Song 2018).

4.4. Exclusion/inclusion in governance

"If you bring on board everyone in need of rescue, the boat will sink" (Hardin, 1974).

Principles of good governance emphasize openness and stakeholder participation through inclusion (Jentoft and Chuenpagdee, 2015). Social inclusion represents more than the mere physical presence, but the participation and engagement in the mainstream society (Cobigo et al. 2012). Inclusion is usually defined by its opposite, exclusion, which is then often regarded as a synonym of poverty. However, social exclusion is a relational and multidimensional notion contrary to poverty which largely refers to a lack of material resources (Picker 2017). From developmental perspective, social inclusion can be defined by one's opportunities to interact with others and his/her participation in activities, including sense of belonging and well-being (Hall 2010).

The good will of Prud'homies in leaving access to the resources of lagoons to families in need can no longer be held as the boundaries of the fishing society has to be set somewhere. This fact has been realized by the fishers of lagoon of Thau, consequently limiting even the divers harvesting urchins to those registered in the Prud'homie. Therefore, the Prud'homies are still practicing partially their "right to exclusion" (Schlager and Ostrom 1992) but not exclusively they do not determine any more how many fishers or boats may be active in the lagoon. This right has been transferred to the EU by the application of "entry-exit regimes" (EC 2002). Based on this policy, the total capacity of each member states fleets expressed in terms of tonnage and engine power cannot exceed the reference level of year 2003 (Article 11, 12 & 13 of Council Regulation 2371/2002). At the port level, it's the departmental delegation of fishery who takes in charge the allocation of available quota allowing the applicant to enter the fishing area under

administration of the port of registration. However, another permission is required afterwards in order to fish in the lagoon which would be issued by the Prud’homies. Inclusion and exclusion need to be balanced and for this governors need meta-governance principles that stakeholders find legitimate and can agree on (Kooiman and Jentoft, 2009 In Bavinck et al. 2015). In line with UN’s SDG, and based on Rawls (1971) “principle of difference”, which advocates the access to scarce resources and space, work to the advantage of those who are worst off. However sometimes, the machinations of inclusion and exclusion can be devious and dirty, with the wrong people sometimes being included and the right people being left aside (Bavinck et al. 2015). The criteria of entrance in the case of port of Sète is precedence. Whoever had applied beforehand would be admitted to enter as soon as the required quota is released. Based on the categories of users upon rights that they exercise, the Prud’homies have declined from the position of proprietor to claimant (table 12) losing part of their rights after the application of exit-entry regime (EC 2002).

Table 12. Bundles of rights associated with positions

	Owner	Proprietor	Claimant	Authorized User
Access and withdrawal	X	X	X	X
Management	X	X	X	
Exclusion	X	X		
Alienation	X			

Source: Schlager and Ostrom 1992

A system which cannot generate from within itself the conditions for its own change; it cannot produce the rules for the change of its own rules (Watzlawick et al. 2011). Communication and interaction between different levels of systems of governance is required to stimulate the change.

4.5. Power and voice

It is inevitable to discuss “voice” while treating negotiation and interactions of local and state level authorities. Having voice, as an indicator of being included in collective identity, is discussed in political science as democracy and in social psychology as social cohesion. However broadly speaking, voice remains under-theorized as there is very little consensus on how to measure it or even its feasibility (Lawy 2017). Critics have argued that actually voice offers “only superficial forms of inclusion”, thereby “essentializing group identities” and failing

to address “the problem of power in the selective bestowing of voice” (McLeod, 2011: 179). Theory of voice is not only about speaking, participating or making yourself heard, but also must consider the implications of using a voice that relies upon dominant structures to legitimize it (Lawy 2017). While Prud’homies are attached to a port and originally to a village, they have a weak representation at the local level (Bertrand Cazalet, secretary and legal adviser of SSF syndicate of Languedoc Roussillon). To have a voice is not only about maintaining or claiming a political agenda as a group but is also a “key representational trope for identity, power, conflict, social position and agency” (Weidman, 2014: 39). Depending on how much responsibility (or right) is assigned to Prud’homies their position (table 12) in fishery governance would be determined. The knowledge of how marine ecological system function is acquired by local fishers through succession and years of close observation. This expertise puts them in a position where SSFs are able to decide spontaneously on how to react in order to sustain the resources and their own activity. Formal management, compatible with the scientific findings, cannot function as efficient as the local agreements in the field (Jentoft 2006).

5. Conclusions

Key attributes of co-management can be found in local based management (Gutierrez 2011). Pre-modern fishers’ organization could contribute to management with their local knowledge, create social order, solve conflicts and assist in regulating fishing effort (Bavinck et al. 2015; Raicevich 2018). However, adaptation to the day’s economic and political context is necessary to be compatible with the changes in the social-ecological system. In the neoliberal management system, in order to stay in the game, they have no other choice but to adapt to get involved in the management. Otherwise, their exclusion from managerial sphere not only creates a governance system hostile to them but also threatens the marine ecological system. They are as much guardians of the sea as the farmers are of the land. Organizing SSF to participate in the management of marine resources is an attempt to include the knowledge of this stakeholder in the decision-making. New capacities are required to be attained by representatives of local fishing communities (the prud’homies in the case of our study) in order to be able to negotiate the terms of agreements for the management of marine resources under their exploitations.

Conversely to what is declared as a EU policies’ goal in the field of regionality, the Prud’homies, as local entities of management, are losing their position. Other regional organizations are created and are regularly substituting the traditional role played by the

Prud'homies in the decision making and operating the rules. If the solutions to the tragedy of commons does not raise from direct users of resources, then it would not be surprising that a higher level authority takes over and implements protection strategies in order to conserve the resources for future generations. Local fishers, as the direct receivers of ecological health of marine area, need to assume their responsibility as if they own the sea and lagoons and it's to the dominant structure to credit them with legitimacy.

The intrinsic goal of the Common Fishery Policies seems to be to decrease the impacts of transition on less adaptive components of fishery system. This can be achieved by slowing down the speed of transition for those dragging behind to allow them to catch up with the rest providing an appropriate environment to adapt to the new conditions. "A key component of the transition is to minimize risk by developing the capacity for the system to learn as it goes" (Mahon et al. 2008 p.110).

An obstacle to this study was the fishers concern about the use of the results of the research which prevented them to participate in the meetings. This has been overcome through a year of correspondence to convince the independency and neutrality of the research group towards the topic. The lack of trust between the fishers and the official system of management already is an indication of the rivalry of the two in the subject of management of marine resources.

Chapter VI

Conclusions

1. Introduction

The objective that has been followed by the chapters of this thesis was to offer a better understanding of the effects that a change in the fish product system has on the fishing community. While the overall purpose of the thesis, as expressed in the title, is to identify the sustainability strategies of the SSFs. Nevertheless, strategies of survival cannot be proposed without having a clear idea of the social situation of the actors. The information provided by the social analysis of the case study constitute the input for the discussion regarding the strategies to sustain the SSF. Social analysis, in this thesis, consists of studying the interactions of social agents among themselves and collectively with other external actors (i.e. political system).

Previous to this thesis, researchers have targeted almost the same question of that of this thesis by treating issues such as vulnerability of fishers. Vulnerability as a wicked problem has no right or wrong solutions that can be determined scientifically because there is no end point and no stopping rule (Jentoft and Chuenpagdee 2009). Nayak and Berkes (2018) and Chuenpagdee and Jentoft (2019) suggest strategies to overcome vulnerability and build on the strengths of fishing communities, affirming that that is not an exhaustive list, as it can be expanded depending on the context.

(1) Combining coastal habitat conservation and mobilization of physical resources for community economic development (i.e., gain in primary income, income diversification, value added products, decreased reliance on informal credit, direct access to market);

(2) Combining social cohesion, economic independence, and enhancing political voice (i.e., strengthening existing community support systems, with focus on empowering community members especially women; building inter-village collaboration and cooperation through networks; and raising political consciousness);

(3) Honing individual and community awareness and internal strengths (i.e., raising levels of education, improving health, using traditional knowledge, providing entrepreneurial and innovation opportunities, building a stronger connection with the resource, sharing in the protection, and management of resources).

These studies are kept argumentative and no models have been developed to support their discussions. The simulation model executed in this thesis based on the principles of socio-ecological systems aims to complete their arguments. This explanatory model searches to define the interactions between the fishers and the fish stock. The fundamental assumption of the model is that the attachment of SSF to their territory makes them unfeasible to move to another

fishing ground. This willingness to leave may be due to several external and internal stimuli such as depletion of the fish stock (as an example to external driver) and discontent with the job (as an example to internal stimuli). However, the mechanism of fishers decision-making has been considered are unknown to us, as fishers as an agent are considered as black boxes. The only behavior which has been inserted in the model was that “the fishers leave (exit) fishing as soon as their accumulated profit from fishing reaches zero” for other economic activity which provides their livelihood. Further hypothesis can be examined by adding further details to the behavioral traits of the fishers and the fish stock or even modifying the economic and political setting to explain the effects that the proposed strategies would have on the fishery system.

In this transition, the European policies (Social Cohesion, EMFF, ...) seem to follow the objective of decreasing the impacts of transition on less adaptive components of the fishery system. This can be achieved by slowing down the speed of transition for those dragging behind to allow them to catch up with the rest providing an appropriate environment to adapt to the new conditions. “A key component of the transition is to minimize risk by developing the capacity for the system to learn as it goes” (Mahon 2008). In this context, the traditional local governance institute, the Prud’homies, which supported the marginalized members of the community to achieve a livelihood from the lagoon and sea resources are now struggling to survive itself.

After the discussions developed in the previous chapters, in this chapter the key messages of the thesis are presented. Integrating the findings of the papers, the overall conclusion targets to answer the main question of the thesis “what strategies would maintain the SSF in the Mediterranean Sea?”. However, there have been issues that constrained the research (section 3) which are translated into some research lines to continue this trend of research (presented in section 4).

2. Contributions of this thesis

This is an interdisciplinary work that can be attributed to several scientific and practical fields. It has taken insights and meanwhile has contributed to the progress of those fields. Economics and management of natural resources, fisheries management, marine resources management, monitoring and evaluation of value chains, social impacts assessment of technological changes, social-ecological systems, cybernetics, action theory, system dynamics, agent-based modelling, complex adaptive systems, social assessment of production systems, well-being studies, Social Life Cycle Assessment, governance of common-pool resources and negotiation. If we have to

choose one of the above mentioned fields among others it would be “management of marine resources”. Meanwhile it focuses specifically on the human actors rather than the biological aspects of management of this common resource. This work has implications concerning the adaptation of fishers to their changing ecological and political environment. It is in line with the title of its sponsoring doctoral program “Agricultural Transformation by Innovation” (AgTraIn) that searches to identify what are the changes that the social actors involved (fishers) go through to maintain their livelihood despite the evolutions of their environment (marine and political). It is also highly consistent with the scope of the research group where the thesis has been developed, *Marché, Organisations, Institutions et Stratégies d’Acteurs (MOISA-Montpellier)*.

2.1. SSFs’ position in the fishery system

The changes in the fish stock available in sea and lagoons has forced the governance system to adopt certain measures in order to stop the degradation or slow down its pace. This governance system comprises also local small-scale fishers of lagoons and coastal areas. In fact, a great part of the beneficent are this category of stakeholders. They are the guardians who are effected in the front line before anybody else. The interest of studying this group of economic actors of the society has been augmented due to the critical situation of marine resources. Many researchers, mainly with descriptive arguments, have tried to prove the importance of protecting this activity rationalizing that its practice has little effect on the marine environment. This work does not advocate the protection of SSF. Neither does it agree that they have a less negative impact on the marine environment.

The agent-based models’ simulation formally demonstrates that the size of the fishing fleet, measured by the tonnage of the boats and the engine power, should be in harmony with the natural resource they exploit otherwise one would cause the deterioration of the other. Meanwhile, it is the responsibility of control regulations along with the local agreements to avoid the wearing down of one in the cost of the other. However, the control regulations (in this case the EU policies), with their more holistic view, aim at conserving the resources and thus not allowing the local users to go too far in exploiting the resources till the point that they would no more be renewed. The scarcer the resource becomes; more people have to leave the sector. The question then would be: “Which category of users has to withdraw first, the SSF or the LSF?” From the economic point of view, they are simply the free market functions that determine those with the highest efficiency to remain. Environmentalists on the other hand, argue that the weight of the SSF’s activity on the environment is much less than that of LSF’s,

thus the state support is required for the continuity of SSFs' activity. The political economists likewise discuss the lobbying power and voice of LSF. From the organizational and management point of view, the LSF may confine themselves to the regulations in a shorter time due to their organizational attributes.

The thesis case study has been the SSF and the analysis and its discussion are limited to this category of fishers. The LSF have been considered as an element in the context in which the SSF act. In the first article, it has been discussed that it's not because "small is beautiful" that we are interested in maintaining SSF active, neither it's because their practice is more in line with sustainable production than that of their competitors (LSF), but it's the social structure that has been shaped around this type of production that makes SSF valuable. Losing it would create a social disorder that has a burden on society and the environment. Thus, the boats smaller than 12 meters are not directly at the center of the interest of this thesis, but the social structure that has been shaped around the marine resource is the focus of the study. Though, the agents involved in the extraction of marine resources are mainly equipped with vessels smaller than 12 meters, the size of the boat is only one objective attribute among many others. That is due to a natural selection that boats of 3 to 6.5 meters long are the most appropriate and efficient to fish in the lagoons and the size of 6 to 12 meters in the 3 miles' distance from the shore (the coast). Larger boats simply would not fish in these areas due to their characteristics of boats and gears they employ. Thus, the exploitation of the lagoons and coastal area is explicitly devoted to SSF and that of the off-shore is mainly conserved to LSF.

Concerning the share of SSFs in the management of marine resources, as discussed in details in paper 4, the voice of SSFs community is decreasing in the decision making processes as the number of this group of fishers is reducing. The Prud'homie, that once played a major role in the local decision making is no more formally included in the policy making, being substituted by other institutes to create harmony at the European level.

2.2. Epistemological precision for a social impact analysis

Fundamentals of a social analysis to be respected in a social assessment of a production and consumption system have been proposed in paper 2. These epistemological aspects have been extracted from sociological perspectives. They can be pointed out in three main points:

I) to focus on the actions of actors rather than their preferences (declarations). This proposes the use of pragmatist philosophy rather than idealism. Actions should be counted as the element of research and not preferences of agents (what is orally announced, statements). This is to

avoid the subjectivity of the researcher and that of the object of research in case they are humans. This objectivity is reflected in the actions (or interactions) of agents in the models and allows replicability at the same time including social (norms) differences of the contexts of analysis. It includes systematically the different reactions that the objects of the system reveal by simply including their historical (time-series) actions.

II) social-ecological systems are dynamic, thus we need an interactive model which represents the interactions between the agents and their social-political environment and ecosystem. Including dynamism is to consider the interactions of actors towards the strategical changes of other actors and the environment. Contrary to static mathematical models, this work suggests analyzing the social-ecological systems as complex adaptive systems.

III) social effects are more than a mere sum of individuals' actions. Thus to examine the social effects of a change, we are obliged to examine the global image of the society (and not the individuals and the aggregation of their actions).

While evaluation tools, such as Life Cycle Assessment, are struggling to homogenize social assessment with the environmental assessment of a product system, an ABM simulation applied to a SES can explain simultaneously the social and ecological impacts of a change on social and ecological performance measures. This is a fundamental reason an ABM application may be developed as S-LCA tool.

Concerning the choice of orientation towards one of the two main perspectives of S-LCA, the attributional or the consequential, the methodology that this work advocates has fractions of the two. These two approaches differ from their point of departure and assumptions. The attributional approach assumes that agents with same attributes will behave similarly and thus create same kind of effects. This approach ignores the social context where the agents are located and the norms that limits their behavior. On the other hand, the consequential approach to S-LCA searches the consequences of the product on issues such as health of agents and their personal well-being in general. This work takes into account the attributes of the agents and eventually looks at the consequences that behaviors applicable to those owning the attributes have on the society. In addition, due to the dynamics of social agents, the behavior of each agent tends to change in the course of interactions with other agents in a social-ecological system.

Eventually, this paper, published in *Int J of LCA*, shapes the framework for its two following papers (paper 3 and 4). Paper 3 addresses the “system to be governed” is a social-ecological system: it consists of the ecosystem and the users of the resources. Paper 4 treats the “governing system”, which is man-made or “group selection” (Berkes, 1989). It is made up of institutions

and steering instruments and mechanisms (Jentoft 2006). The movement of members of a fishing community has been the case of study in the third and the fourth paper to examine and validate the propositions made in paper 2 concerning the social assessment of a product system.

2.3. One single social impact indicator

The matter of specification of the area of protection had been discussed before this thesis by Macombe (2014) by posing the question: “what is worth in the social world?” She proposed “permanent social peace” as the AoP in S-LCA. Her definition of social peace in a value chain consists of Pareto efficiency where all actors would draw some value from the change in the value chain. It guarantees a fair distribution of improved wages, better working conditions, access to resources, and improvement in recycling rate of the goods which are provoked by a change in the production-consumption system of a product. The matter of justice and equality are often discussed in socio-economic projects to make sure if the costs and benefits of setting up a project are shared fairly among all those involved. Although, reaching a win-win equilibrium point for all actors seems idealistic but it fits well the concept of AoP. In this context, the S-LCA’s AoP, such as the sustainable development goals (UN 2015) (e.g. zero hunger, no poverty, ...) is an objective direction to move towards and not necessarily a goal to be fully attained. The presupposition of inability of reaching the AoP frontier stems from the fact that the resources are limited and thus the use of them by one would avoid the others to benefit from them. Therefore, agreeing on the next equilibrium point, with the constraint of keeping the social peace, would oblige a part of the actors to give up the privileges they benefited from so that it can be transferred to other actors.

A holistic approach towards the social axis of sustainable development has been opted rather than individualist approach in order to be in harmony with the two other axes, the environmental and the economic, which are measured by indicators with a holistic nature such as climate change, and the gross domestic product. There are other indicators that accompany these main measures, but which more specifically target the sub-issues of economy and environment. For instance, rate of greenhouse gas emission or rate of unemployment are factors which determine partly the overall measure of these axes. For the social axis, which is much less discussed in the sustainable development discourse, and often represented by economic and political sub-categories such as employment, health, livelihood, participation and so on, this work has opted for the “size of the society” as the main indicator. This selection may be justified by what it has been nominated as the “societal quality”, explained in paper 2, as a sum of characteristics which stabilize the society’s conditions and guarantees its development. An argument has been

presented in paper 2 that the more a society is stable, the higher the tendency of population to settle there. This will thus attract further actors to choose that society as their immigration destination. This trend has already been observed in big societies, such as capital cities, where they offer higher chances of community resilience towards changes occurred in the social system. These communities (cities) have relatively higher capacity and better access to instruments to learn and adapt facing challenges that are imposed by the interactions with other societies. Therefore, the social indicator that presents the societal quality is proposed to be the “the inclusion and exclusion of its members”. This indicator is the marginal subcategory that shows the changes in size of a community. In the case of fishery, the mobility nature of vessels, allows them to select a port of activity and register their boat to pursue their activity in the area. The issue is no more how to harvest, but who has the right to harvest first. Considering the depleting resources, contaminations, and all kind of side effects that human activity has on natural resources, we may consider negotiation as the only way out. There is no other choice left, either we give up some of our conventional rights in the favor of the others or we’ll all loose what we have.

2.4. Governance system

The size of the community is one attribute that we may rely on to compare its quality with other communities. The changes in the demographic data, such as migration, reveal the changes in the quality of society’s structure that determines the quality of life of its habitants. The welfare conditions, under the capitalist framework, are the main attraction or reason to stay. This welfare rising conditions require a well-structured governance system. Social impacts are understood in S-LCA as a wider sense of welfare economics (Weidema 2018). We may assume that a high quality society (such as big society) has resolved its structural problems that prevents its growth by negotiation tools available to its agents (habitants), while in the society which loses its population, through migration or other forms such as low life expectancy, governance problems are present. In low quality societies there is often a conflict present between the governance system and the social norms. We assume that the attributes that avoid (or encourage) the right interactions between its agents are those of a good society. Nevertheless, the outcome would be observable by the inclusion or exclusion of agents. Thus, monitoring the inclusion/exclusion of actors was proposed implicitly in paper 2 and employed to analyze the case study in papers 3 and 4. The simulation that has been designed in paper 3 to represent the fishery SES, however simple, shows clearly how the size of the fishing community reduces in face of overexploitation of the marine area.

The traces of social synergy between the fishers active in the lagoons had made them to cooperatively adopt measures so that the fishing would survive even though with fewer fishers. This issue can be further seen in the fourth paper by studying in more detail the position of Prud'homies in the governance of marine resources. The role of regional management of resources has been highlighted in the actual European context to overcome the shortcomings of the previous decencies' policy. The negotiation of decision-making actors has been described in paper 4 and the slow but progressive exclusion of Prud'homies from the marine governance has been distinguished. It has been discussed that either the energy which keeps the members of the community together has interpersonal nature (advocated by network theory) or that of trust (advocated by "social capital" researchers) can be threatened by the expanding power of structural top-down governance. In other words, the sovereignty of the state over the society reduces the importance of local governance. The society may increase its capacity in self-governance and keep the sovereignty to its population. That is the transformation of relations from mechanic solidarity (e.g. the power that unifies the members of a society) to organic solidarity (i.e. the agreements at the level of society based on the division of labor) (Durkheim 1893/2007).

3. Constrains and prospective studies

This conceptual framework of modeling the fishery system contributes to the on-going progress in the assessment tools of social and environmental effects of a change in a product system. The output would be more accurate as more details are inserted in the model. There is a difficult trade-off in fitting the data and in keeping it simple. The more complicated the model, the more parameters, equations, etc., to describe the model, the better the model fits the data compared with a simpler model, but it might be too specific for a particular data set (Janssen and Ostrom 2006). The ecological interactions and the fishers' decision making specification requires further research. ABM appears to be a promising framework that determines the prospective research themes. It asks for information in undeveloped fields to be developed, unspecified casual relations to be specified, unclear consequences of pathways to be elaborated and so on. For a developing methodology such as S-LCA, it can be beneficial to adopt such a framework as it clarifies the path of information seeking and structure of interaction between the ecological and social systems.

The applicability of the proposed tool for evaluating the social effects of a change in a production-consumption system is constrained in the case of products for which the entrance

of actors is limited by regulations. In the European context, this is the case of the fishery (with the application of exit/entry scheme), dairy products (quota), and wine (ownership rights) among others. Although, in the case of these products, where the exit and entry of actors (especially producers) are limited, this methodology still serves as a tool for monitoring the evolution of the social-ecological system. The total number of people who are deprived from the resources they had access to may not be counted anymore, but the social category, and the specificities of those social classes would be still the case. The improvement of the social assessment of a change in the product system may be extended, with some modifications, to studies of policy effects and project implementations on society.

The replicability problem of social experience prevents the prediction of social effects in the same manner as it is done in natural sciences. As it has been discussed in detail in paper 2, this is due to the dynamics of the social context, where the society learns and adapts regarding the signals it receives from its interactions with other societies and limiting factors such as the scarcity of resources. The society innovates new procedures (adapts new strategies) that are more efficient facing scarcity of resources and the action of other societies. As it is argued in consequential S-LCA, clear equations representing the pathways are required for the design of the product systems. For instance, “how is the relation between the availability of marine resources and the effort of fishers (hours spent at sea)?” We need to define precisely each of these functions using mathematical methodologies (e.g. econometrics) to determine the probabilities of occurrence of each behavior in the system. Although due to the dynamic of a social system, the result would be limited to a specific time and space. The human capacity to learn and adapt have been intended to be incorporated into the agent-based modelling as attributes of the agents in order to overcome this temporal issue. Nevertheless, in face of these ever changing position of other societies (including the governance system) and the environment, fishers foster collective and harmonious actions. These cooperative actions define the strategy of the fishing community to maintain the activity. SSF shaped, from long ago, an institute called *Prud’homie* that surveys and manages its members’ activity to guarantee a sustainable interaction between nature and the fishers. Population growth, increasing demand for fish products, and technological innovations have disturbed the equilibrium that has been shaped during centuries. The social justice of the marine governance system relies on the fact that who is included and who would be excluded by the change. What are the domains to be protected in order to keep (or increase) the quality of the society?

The prospective system's structure is, for now, unperceivable to us in details. There are blur lines that are shaping and becoming more obvious due to their contrast with the previous system. Concepts such as "responsibility", "social effects", "co-management" are taking forms unknown to us previously. The "social impact analysis" is still young and cases of natural resource exploitation very few. The transfer of impacts is an argument raised by globalization. The borders of impacts are expanded enormously. Users conceive responsibly towards a large range of products. As long as the inputs employed in the process of production are from elsewhere they feel responsible to guarantee the well-being of their producers. A democratic approach to policy-making guarantees a good distribution of responsibility for (negative or/and positive) social effects. Integrating all users¹³ in the decision-making will increase the learning and adaptation capacity of the users to adapt better to the environmental and social conditions. The question "to whom do we contribute the responsibility of each process" is fundamental. For instance, based on the British regulations, in case there is a fraud in the details presented for a product, the last link in the value chain -the distributor- would be counted responsible and is to attend the court, while in the French regulations it is the first link that is counted responsible -the producer or the importer (in case the product is produced outside the French territory). Contracts are important in this perspective. The role of contracts (legislations or institutions in a larger term) is to clarify the responsibility of predicted outcomes, those which are desired and of those which are not sought.

¹³ Stakeholders is the term more commonly employed in co-management studies

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Annexes

A selection of communications to conferences

Social Life Cycle Assessment - its consistency with fisheries' sustainability analysis

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1. Introduction

Fishers' actions are not based on purely economic motivations, although fishermen often "talk as if the only thing that really matters to them is money ... fishermen are clearly influenced by many other social and cultural factors as well" (Acheson, 1975 cited by Palmer, 1993). Ethnographic research in fisheries has long illustrated the importance of the social relations, recognizing that a diversity of relationships such as dependency, obligation, support, reciprocity, exploitation, and collective action in fishing communities can determine both a persons' wellbeing outcomes and fisher behavior (Pollnac, 1988; Jentoft et al. 1998; Coulthard, 2012). However, measuring the impacts of such realities on the sustainability of fisheries is rarely carried out due to the subjectivity of such concepts. Social life cycle assessment (SLCA), for the broad covering characteristic that it holds, seems to be a promising approach to measure the social and economic sustainability of fisheries activities. In this work we'll discuss the advantages and shortcomings of SLCA in analyzing the effect of social relations and subjective motivations of fisheries to maintain their business (or to leave).

2. Consensus and disagreements on SLCA

SLCA is (an approach¹) close to the philosophy of Life Cycle Assessment². Its objective is to anticipate the potential changes of a certain product's life cycle on the society (Razés, 2015). However, to what it may concern the assessment method, SLCA is in an early stage of development where consensus still has to be built (Jorgensen et al., 2008). The items on which there is consensus are (i) to cover a whole product cycle, (ii) to consider the transfer of impacts. The impact transfers, as identified by Macombe & Loeillet (2013), may happen 1) between the stages of a life cycle, 2) by a change in the nature/cycle of impact, 3) among different actors. On the other hand, there is no consensus on:

- 1) The choice between assessing the social performance of the contributing activities (Attributional SLCA) or estimating the social consequences (Consequential SLCA),
- 2) Which impact categories to be included, which is to a high extent related to the availability of data. Although, till now, the majority of impact assessments which have been carried out used generic macro level data, but that does not imply that all researchers agree on this fact,
- 3) The use of qualitative or quantitative data. This is linked to the definition of the functional unit which can cover socio-economic aspects, and that comes from the difficulty to express subjective concepts.

3. Making SLCA consistent with fish product system

A large part of above mentioned disagreements may vanish if we specify the product and the location that the SLCA is supposed to be applied. Contrary to LCA which deals with static-objective realities, SLCA targets dynamic-diverse societies. In the following, we will classify the characteristics of the fish sector, and consequently specify the SLCA methodology that best suits the case. We may classify the characteristics in three main categories consistent with the three dimensions of wellbeing theory as proposed by Coulthard³ (2012): material, relational and subjective.

Materialistic: facilities of vessels, processing factories, financial benefits,

Relational: independency (autonomy) of fisheries, level of cooperation, dominance of traditional or market economy, future employment opportunities

¹ It seems better to say Social Life Cycle Approach (like territorial approach) rather than Social Life Cycle Assessment or Analysis due to the reasons provided in this study.

² LCA is an instrument to assess the ecological burdens and impacts throughout the consecutive and interlinked stages of a product system.

³ This 3 dimension framework has been developed at Economic and Social Research Council- Wellbeing in Developing Countries Research group based at University of Bath, UK.

Subjective: fishermen's satisfaction, sense of belonging and self-actualization, fresh consumption or frozen products (which remarks the preference of consumers), willingness to preserve the traditions,

By taking into account the above mentioned context, we propose to settle the issues of disagreements as following:

3.1. Consequential SLCA

An evaluation should be able to show the cause-effects relations. Due to the dynamism of a human behavior we believe that attributional SLCA could not fully capture the social effects of a production process. The consequences of each action may lead to a diverse behavior of other actors. Therefore a consequential SLCA is proposed that integrates indicators of wellbeing aspects of the social performance of the sector.

3.2. Impact categories

If we consider sustainability⁴ of fisheries as an overall goal, then, apart from the financial viability of the fisheries, the wellbeing aspects (mentioned above-materialistic, relational and subjective) should also be measured. To what concerns the level of data treated in the assessment, there should be a consistency with the level of activity. Since the fisheries activities are community based therefore, their effects should be searched at the community level. Macro data reflect a whole set of impacts which a large part of them can be attributed to other effects above the responsibility of engaged enterprises of the value chain, therefore their use carries bias in the research's results.

3.2. Data collection

Norris (2006) suggests benefiting from field participatory data collection. Use of ranking tools (comparing a situation with a benchmark which might be either an imaginary ideal situation or a real tangible case) would provide us with a numerical functional unit. It would be possible to carry out such analysis for fisheries as single entities or groups (fisheries may be classified based on their characteristics into fishery type 1, 2 & 3 or as a binary 0-1). The classification may be based on a composition of technical/operational numerical descriptors (i.e. vessel length, gears, no. of fishermen per boat, time spent at sea, and fishing capacity) and personal characteristics (i.e. age, education, years of experience and ownership).

4. Conclusion

In order to carry out a holistic social analysis of a fish products system we propose benefiting from a SLCA. Categories to be covered, data collection and analysis methodology depends to the case of study. For case studies, similar to the European countries' fisheries in the Mediterranean the proposed path may be useful.

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⁴ By sustainability we refer to the maintenance of fisheries activity in the market.



Tropentag, September 18-21, 2016, Vienna, Austria

“Solidarity in a competing world —
fair use of resources”

Local Practices vs. Formal Regulations in the Management of Marine Resources

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Abstract

Attentions are directed towards re-engagement of traditional tools in the management of natural resources as the issue of sustainability gets more critical. However, caution has to be taken in this regard due to the complexity of the traditional tools' motivation. We reviewed respective literature in the field of fisheries in order to analyse the motivation of informal regulations and their relative effect in marine resource management. Eventually, incentives which determine the application and effectiveness of local regulations are not conservation of marine resources nor purely economic motivations, but hovers around the maintenance of social relationships. Formal and informal regulations of 12 cases of fisheries management worldwide were reviewed. Also studies from other sectors of common-pool resource management (forestry and pasturing) has been covered (7 cases) to reinforce the findings. The motivation of indigenous practices of each case was analysed from anthropological point of view and the socio-economic drivers of change in the regulation system has been classified. The socio-economic drivers consist of: food consumption change, environmental awareness of stakeholders, competition level of fisheries (considering number and characteristics of fisheries and scarcity of resources).

Benefiting from Ostrom's framework towards common-pool resource management, we will discuss in this study the problems that each, the local practices and formal regulations, address. Local practices mainly seek personal socio-economic stability, while formal regulations impose restrictions in order to stabilise the national economy. We conclude that, although in some cases the outcomes of one party's decision may interest the other party but they are not necessarily, vertically or horizontally, connected. Therefore, one should bear in mind that participatory or bottom-up approaches to policy making in natural resources management is not a simple engagement of natural resources' beneficiaries into the decision making process but it's a negotiation between all stakeholders.

Keywords: Social relationships, sustainability of marine resources, traditional regulations

Discussing Features of Social Measures Important in SLCA Impact Indicators' Selection

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Introduction

There have been several attempts to formalize Social Life Cycle Assessment (SLCA) methodology and make it as robust as the environmental part of Life Cycle Assessment (LCA). "Guidelines for SLCA of products" (UNEP/SETAC, 2009) and progressively "The Methodological Sheets for Sub-categories in SLCA" (UNEP/SETAC, 2013) have provided recommendations on how to conduct the first two phases of SLCA (i.e., goal and scope definition and life cycle inventory). The research on the third phase (life-cycle impact assessment) was, at that time, not considered sufficiently mature to be included (Sureau et al. 2017). With S-LCA conceived by the same practitioners who created LCA, it is not surprising that they attempted to model social impacts in the same way it was done for environment alone (Iofrida et al. 2017). Most of the applications take into account values, stakeholders' perceptions, subjectivities, and participation in an interpretivist way, but often without clarifying the theoretical underpinnings (Iofrida et al. 2017). In the following we attempt to clarify the role of these features of societal measures in the selection of the end-point social impact indicators in SLCA.

Subjectivity

The construction of the subcategories and the related characterization models will inevitably include value judgments and assumptions (UNEP, 2009). It should be stressed that the way in which an instrument is implemented will lead to different results in terms of social impact (Rey-Valette & Cunningham, 2003). The SLCA guidelines (UNEP, 2009) recommend to cover at least the subcategories mentioned to prevent using S-LCA results on a few limited topics for social marketing aims while not addressing core issues. Nonetheless, concerning UNEP/SETAC (2009, 2013) 31 sub categories of assessment, for general applicability, require large amounts of data which are not always available, and there is a large influence of the subjectivity of the individual researcher (Blom and Solmar 2009; van Haaster et al. 2017).

Environmental LCA uses quantitative and comparable indicators to provide a simple representation of the environmental impacts from the product life cycle. This poses a challenge to the social LCA framework because due to their complexity, many social impacts are difficult to capture in a meaningful way using traditional quantitative

single-criterion indicators (Dreyer et al. 2010). Consensus on a single end-point SLCA measure would not be finalized unless its goal is well defined. Researchers agree on the goal of SLCA on that to assess the social impacts of products along their life cycle. However, the variables that are to be considered as social is yet to be agreed upon.

Diversity of Social Values

Contextual values are moral, personal, social, political and cultural values such as pleasure, justice and equality, conservation of the natural environment and diversity. In most views, the objectivity and authority of science is not threatened by epistemic, but only by contextual (non-cognitive) values (Reiss and Sprenger 2017). Social facets are more influenced by context than environmental or economic ones (Sierra et al. 2017). Social aspects can be highly diverse and are weighted very differently by different interest groups and in different countries and regions (Grießhammer et al. 2006). Therefore, the social (and socio-economic) impacts to be covered in an assessment and the way this should be done should be case and context specific (UNEP, 2009).

Ethical issues such as justice, equity and dignity are subject to the society where they are discussed, i.e. what is considered right in a certain society might not be the case in another. Therefore, claiming the rightfulness of a society's (working, living, institutional) conditions based on other societal values would be invalid. One might say that the international organizations' agreements are one good indication of social values that have to be respected by all the member countries. These values are however, normative ideals that are projected to become universal. Some societies might be far from the agreements signed by their countries' representatives. On the other hand, the absence of one quality should not be translated as a weakness since other qualities, not considered in the assessment (i.e. family ties, traditional mechanisms of social support, ...), may compensate them. The social indicators should have a universal character, no matter where it's used, they would have the same sense.

Aggregation of data

It is mentioned in the guidelines (UNEP, 2009) that "the action of summing or bringing together information (e.g. data, indicator results, etc.) from smaller units into a larger unit (e.g., from inventory indicator to subcategory) in S-LCA may be done at the life cycle inventory or impact assessment phase of the study and should not be done in a way that leads to loss of information about the location of the unit processes". Modeling or aggregating the results of the subcategories in order to present one result in terms of well-being has been proposed by Dreyer (2005) and Weidema (2006). While thinking about aggregating indicators we have to consider the fundamental principle that objective and subjective dimensions are separate entities that normally bear little or no relationship to one another, and so must be separately measured (International Wellbeing Group, 2013). The SLCA subcategories, which have been mainly inspired by ISO 26000 (2010), are not of one single nature.

The change in the social indicators should neither be considered negative nor positive. The value of the change is relative to the future plans of the region, and whether the change complies with that plan or not makes it positive or negative. If we don't know the sense of the effect, adding the data together would give a result without any sense. Unlike the natural scientist, the social scientist is not interested in the common or average aspects of the facts under consideration; rather the social scientist is interested in their characteristic traits, their cultural significance, and their meaningful interrelationships as defined by the problem in hand (Hekman, 1983). Furthermore, the statistical feature of social indicators of sustainable development is to reflect the detail of distributions under different arrangements and not average or modal situations (Antoine, 1999 in Rey-Valette & Cunningham, 2003).

Analyzing each single indicator independently can be a solution to avoid the aggregation problem. Either a comparison of the indicator is carried out between two alternatives or the situation, the case study is studied before and after the change. Another solution can be simply limiting the assessment to a single end point indicator. Endpoint indicators have the advantage that they can reflect the potential damage or benefit to the Area of Protection, having the advantage, in theory, that no subjective weighting is needed (Jorgensen et al., 2008).

Rebound effect

The social domain is complex due to the existence of strong interactions between factors leading to multiplier effects (Rey-Valette & Cunningham, 2003). Sierra et al. (2017) outlined that social sustainability assessment has two aspects: 1) the social contribution in terms of how interventions interact with its context and 2) the potential benefit distribution effects on a long-term basis balanced with its short-term contributions. The impact of a single technology at the macro level is generally small, but could potentially be large (Hasster et al., 2017). Each change in the production cycle may have its particular effect on the society and each effect, in turn, may create its own consequences (e.g. change in socio-cultural relations). This stems from the fact that every product is accompanied by particular production-consumption culture. Therefore, apart from the main cycle of the product which is analyzed, their rebound effects have to be considered as well. Weidema (2008) defined rebound effects for production and consumption changes, as derived changes in production and consumption when the implementation of an improvement option liberates or binds a scarce production or consumption factor (money, time, space and technology).

The amplitude of a single change's rebound effects may vary in different time periods for the same society as they may become resistant to certain conditions, adopting strategies which allow them to receive the change more pacifically. Resilience, the ability to absorb the external changes, depends on the capacity of the society to undergo or adapt to change. Therefore, the results of assessment can be expected to be different according to the time of its realization. The assessment carried out after the adaptation process would result in a more stable situation. End-point (or even

midpoint) indicators may be able to capture a great deal of the effects created by the change in the system.

Conclusions and future developments:

The search for universal objective social impact indicators continues in SLCA. Diversity of societal norms in different countries and researchers' point of view (from different disciplines) have prolonged the consensus. The end-point social impact indicator should be able to capture the social effects created in long-term, covering the rebound effects and the range of affecting factors. In this process we should not forget the difference between the natural sciences and social sciences in the sense that social issues are influenced much more by the subjectivity of researchers and the social context of the impacted population.

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Récapitulatif de participation aux Formations
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Doctorat : Sciences Économiques

Ecole Doctorale : EDEG - Economie Gestion

Etablissement : Montpellier SupAgro

Date de la 1ere inscription en thèse : 21 septembre 2016 (3 A en 2018)

Directeur de thèse : Leila TEMRI

Sujet de thèse : Stratégies de durabilité des pêcheurs artisanaux en Méditerranée

Formations suivies

Catégorie : Cours Ecole Doctorale

▣ Economies institutionnelle et évolutionniste : théories et applications (11 avril 2018)

Faculté d'Economie -Salle 416 - Site Richter

20 heures Crédit : 2 enregistrées par : EDEG - Economie Gestion.

Total du nombre d'heures pour la catégorie Cours Ecole Doctorale : 20 h

Total du nombre de crédits pour la catégorie Cours Ecole Doctorale : 2

Catégorie : Formations scientifiques

▣ Analyse de discours (22 mai 2019) Sites Richter et Triolet

20 heures Crédit : 2 enregistrées par : EDEG - Economie Gestion.

▣ Cadres théoriques et éclairages sociologiques pour la recherche sur les organisations (26 mars 2019) Faculté d'Economie - Site Richter

20 heures Crédit : 2 enregistrées par : EDEG - Economie Gestion.

Total du nombre d'heures pour la catégorie Formations scientifiques : 40 h

Total du nombre de crédits pour la catégorie Formations scientifiques : 4

Catégorie : Formations scientifiques interdisciplinaires

▣ Négociation et gestion des ressources naturelles (07 janvier 2019) AgroParisTech - 648 Rue Jean-François Breton, Agropolis, Montpellier

24 heures enregistrées par : GAIA - Biodiversité, Agriculture, Alimentation, Environnement, Terre, Eau.

Total du nombre d'heures pour la catégorie Formations scientifiques interdisciplinaires : 24 h

Catégorie : Langues vivantes

■ FLE - Français Langue Étrangère (session janvier 2018) (29 janvier 2018) Université de Montpellier, Département des Langues Bâtiment 5

26 heures Note : B2

■ FLE - Français Langue Étrangère (session septembre 2017) (25 septembre 2017) Université de Montpellier, Département des Langues Bâtiment 5

30 heures Note : B2-

Total du nombre d'heures pour la catégorie Langues vivantes : 56 h

Catégorie : Outils et méthodes

■ Cérémonie solennelle de rentrée des doctorants du Collège Doctoral de l'Université de Montpellier (25 janvier 2018) Université de Montpellier Site Nord Triolet Amphi Dumontet
6 heures

■ Effective and speed reading (16 octobre 2017) Université de Montpellier

21 heures

Total du nombre d'heures pour la catégorie Outils et méthodes : 27 h

Catégorie : Ouverture pluridisciplinaire

■ Séminaire ED 60 « Sociologie des risques » (06 décembre 2018) Université Montpellier 3 - Site Saint-Charles, salle des Colloques 1 - 71 rue Henri Serres (station de tramway Albert 1er - Ligne 1 ou 4)

2.3 heures enregistrées par : Territoires, Temps, Sociétés et Développement.

■ Séminaire ED 60 « Le cerveau humain et les grandeurs : comment se représente-t-on cognitivement l'espace, le nombre et le temps ? » (14 décembre 2017) Université Montpellier 3 - Site Saint-Charles, salle des Colloques 1 - 71 rue Henri Serres (station de tramway Albert 1er - Ligne 1 ou 4)

2.3 heures enregistrées par : Territoires, Temps, Sociétés et Développement.

■ Séminaire ED 60 « Savoir prendre du recul, savoir remettre en question : apports de la sociologie critique et de l'anthropologie du développement » (01 février 2018) Université Montpellier 3 - Site Saint-Charles, salle des Colloques 1 - 71 rue Henri Serres (station de tramway Albert 1er - Ligne 1 ou 4)

2.3 heures enregistrées par : Territoires, Temps, Sociétés et Développement.

Total du nombre d'heures pour la catégorie: 6.9 h

Total participation : 173.9 heures / 11 modules

About the author

Yazdan Soltanpour was born at Tehran, Iran, on 31 August 1985. He studied agricultural economics at Sari University of Agricultural Sciences and Natural Resources where he obtained his Bachelor of Science Diploma in 2007. Afterwards, he completed an International Master in Rural Development (IMRD-Erasmus Mundus Program) jointly at universities of Cordoba, Ghent and Agrocampus-Ouest (Rennes). He has defended his master thesis with the title of “Assessment of factors influencing the decision making of a farmer to join an agricultural cooperative: the case of olive marketing in Andalusia” in 2010 at University of Cordoba.

From 2011 to 2016 he has worked in Iran as a facilitator and consultant in agricultural development projects. These projects consist of irrigation and drainage projects, formation of local farmer initiatives, participatory management of natural resources, monitoring and evaluation of the effects of extension activities.

He has started his PhD project in February 2016 at Department of Agriculture, Food and Environment (Di3A), University of Catania and Montpellier SupAgro (International Centre for Higher Education in Agricultural Sciences) within the European Joint Doctorate Program AgTraIn (Agricultural Transformation by Innovation).

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