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Insurance and microinsurance of agricultural risks : public-private partnerships and innovative business models

Pierre Casal Ribeiro

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Membre de l'université Paris Lumières

Pierre Casal Ribeiro

Insurance and microinsurance of agricultural risks

Public-private partnerships and innovative business models

Assurance et microassurance des risques agricoles

Partenariats public-privé et modèles économiques innovants

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Résumé

L'observation des marchés de l'assurance agricole dans le monde révèle qu'à l'exception des polices d'assurance contre les risques nominaux, l'assurance agricole ne s'est développée à grande échelle qu'en présence d'un appui public, prenant généralement la forme de subventions à la prime. Ce constat est vrai dans les économies développées, émergentes et en développement. Par ailleurs, la situation des petits agriculteurs pose des défis supplémentaires pour étendre la couverture d'assurance à un grand nombre d'agriculteurs. Plusieurs décideurs politiques dans le monde ont décidé de soutenir activement l'assurance agricole afin d'améliorer la protection des agriculteurs. Cette évolution pose la question du modèle économique de l'assurance agricole, et des modalités des partenariats public-privé. Cette thèse passe en revue les motivations et les modalités de l'intervention publique sur les marchés de l'assurance agricole. Les questions autour du modèle économique et des partenariats public-privé de l'assurance agricole sont ensuite analysées autour de deux études de cas et d'une enquête par sondage. Le travail de recherche évalue la possibilité de remplacer un programme public d'assistance en cas de catastrophe par un produit d'assurance commercial, en prenant le cas de l'assurance des prairies en France. Il analyse également les produits d'assurance récolte et bétail proposés par une compagnie de microassurance au Kenya, afin de comprendre comment les produits et les processus sont conçus pour cibler ce segment spécifique d'agriculteurs. Enfin, il étudie l'opportunité pour des institutions de microfinance de proposer de la microassurance à leurs clients, sur la base d'une enquête menée auprès de 36 institutions en Afrique et en Asie. Le travail de recherche démontre qu'une assurance indicielle peut être une alternative viable à un fonds public de réponse aux catastrophes pour protéger les agriculteurs. Il montre également que s'attaquer au segment des petits agriculteurs nécessite un changement d'approche, au-delà de la simple réduction des primes et des sommes assurées. Il invite également les décideurs politiques à envisager d'autres leviers d'action que les seules subventions aux primes. Pour les institutions financières, on constate que le bien-fondé économique de distribuer des polices d'assurance à leurs clients n'est pas évident. Ce travail contribue à la littérature sur les risques agricoles et l'assurance, en analysant les enjeux auxquels sont confrontés les opérateurs privés, tant du côté de l'offre que de la demande. Il ne se limite pas au point de vue des assureurs et des réassureurs, et inclut des acteurs clés tels que les courtiers d'assurance, les institutions financières et les acteurs de la chaîne de valeur agricole. Il offre également des perspectives et des leçons pratiques aux professionnels de l'assurance agricole et aux décideurs politiques.

Mots-clés : assurance agricole, assurance indicielle, partenariats public-privé, microassurance, modèle économique, petits producteurs

Executive summary

A review of agricultural insurance markets around the world reveals that, except for simple name-peril policies, agricultural insurance has developed at a large scale only in the presence of government support, usually taking the form of premium subsidies. This observation holds true in developed, emerging and developing economies. The situation of smallholder farmers though, brings additional challenges to extending insurance coverage to a large number of farmers. Several policy-makers around the world have decided to actively support agricultural insurance in order to improve the protection of farmers. This situation raises the question of the business model of agricultural insurance, and the modalities of public-private partnerships. This thesis review public intervention in agricultural insurance markets' rationale and modalities. The questions around the business model and public-private partnerships of agricultural insurance are then analyzed around two case studies and one survey. The research evaluates the possibility to replace a public disaster assistance program by a commercial insurance product, taking the case of grassland insurance in France. It analyses the crop and livestock insurance products offered by a microinsurance company in Kenya, in order to understand how products and processes are designed to target this specific segment of farmers. Finally, it investigates the business case for microfinance institutions to offer microinsurance to their clients, based on a survey of 36 institutions in Africa and Asia. The research demonstrates that an index-based insurance can be a viable alternative to a public disaster fund to protect farmers. It also shows that addressing the smallholder farmers segment requires a shift in the approach, beyond simply scaling down policies. It also invites policy-makers to consider other levers of action than just premium subsidies. For financial institutions, it is found that the business case of distributing insurance is not straightforward. This work contributes to the literature regarding agricultural risks and insurance by analyzing the challenges faced by private operators, on both supply and demand. It is not limited to the perspective of insurers and reinsurers, and includes key stakeholders such as insurance brokers, financial institutions and agricultural value chain actors. It offers practical insights and lessons for agricultural insurance professionals and policy-makers.

Keywords: agricultural insurance, index insurance, public-private partnerships, microinsurance, business model, smallholder farmers

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LIST OF ACRONYMS

ACRE	Agricultural Climate Risk Enterprise Ltd (Kenya)
ANRT	Association Nationale de la Recherche et de la Technologie
AoA	Agreement on Agriculture
BIP	Base Insurance Product (Mongolia)
BoP	Base of the Pyramid
CAP	Common Agricultural Policy (European Union)
CAT bond	Catastrophe-linked bonds
CERISE	Comité d'Echanges, de Réflexion et d'Information sur les Systèmes d'Epargne-crédit
CGAP	Consultative Group to Assist the Poor
CIFRE	Conventions Industrielles de Formations par la Recherche
CRM	Corporate Risk Management
DRP	Disaster Response Product (Mongolia)
ECA	Europe and Central Asia
EU	European Union
FNGRA	Fonds National de Gestion des Risques Agricoles (France)
FPI	Forage Production Index (France)
GCAF	Grameen Crédit Agricole Foundation
IBLI	Index-Based Livestock Insurance (Mongolia)
LIIP	Livestock Insurance Indemnity Pool (Mongolia)
MENA	Middle East and North Africa
MFI	Microfinance Institution
MPCI	Multi-Peril Crop Insurance
NAIS	National Agricultural Insurance Scheme (India)
PAR	Portfolio at Risk
RCT	Randomized Control Trial
RPG	Replanting Guarantee (Kenya)
SSA	Sub Saharan Africa
SSEA	South and South East Asia
TCIP	Turkish Catastrophe Insurance Pool
WTO	World Trade Organization

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INTRODUCTION

Introduction

Agriculture represents 28% of the world's total employment (International Labour Organization, 2018), and remains a source of livelihood for an even larger part of the humanity. Millions of people's income and livelihoods are vulnerable to natural hazards like droughts, floods or pests. Agricultural insurance can play a role in helping farmers, herders and their communities to mitigate the negative financial impact of such adverse events.

Farmers are exposed to several types of risks. Agricultural risks are traditionally classified into four categories (Antón, 2009): production risks, market risks, financial risks and legal and institutional risks. Insurance can only address production risks. Those risks have an impact on the quantity or the quality of the farm output. Typically, an insurance policy protects farmers against weather hazards, natural catastrophes, pests or diseases affecting yields or livestock. In an insurance contract, an insurer shall pay specific pre-defined compensation when financial damages are caused by predefined cost-generating events, in exchange for upfront payments of a premium by the policyholder (Dror & Piesse, 2014). Microinsurance is not different from traditional insurance, and it relies on the same insurance principles. The term however emphasizes its specific target, low-income households. It is commonly accepted in the literature and by insurance practitioners, that providing insurance to low-income people is not simply the provision of insurance at a "micro" scale (Churchill & Matul, 2012). Microinsurance requires a more fundamental reengineering of products and processes, in order to address properly the needs and constraints of poor clients. This research on agricultural insurance will address microinsurance specific challenges, as 90% of the 570 million farms in the world are run by an individual or a family (FAO, 2014). The vast majority of world farms are small or very small: farms of less than one hectare account for 72% of all farms, and farms between 1 and 2 hectares account for 12% of all farms.

Governments and development organizations' interest in agricultural insurance has grown steadily over the last two decades. Indeed, agricultural insurance stands at the crossroads of several of current global issues: food security, climate change adaptation, rural development, economic, social and financial inclusion. However, most of the world's farmers are not covered by an agricultural insurance policy. Those who are usually live in countries where the government is actively supporting access to agricultural insurance. Indeed, under standard market conditions, there is often no market for comprehensive agricultural insurance policies. Agricultural risks are often spatially correlated, meaning that insurers are not able to mutualize

those risks efficiently within their portfolios (Miranda & Glauber, 1997). Reinsurance only offers a partial solution and remains expensive. Therefore, public intervention appears essential to support the development of agricultural insurance markets and extend protection against natural risks to a large number of farmers and herders.

However, innovative approaches of agricultural insurance are being tested and sometimes scaled-up. The extension of mobile network coverage and a range of technological innovations in satellite imagery, automated weather stations, drones or big data allow the development of new insurance policies and extend the limits of insurability. Innovation also happens at the organizational level, resulting in new distribution, enrolment, claim management or payment processes.

This research aims at analyzing these disruptions, and how such changes affect both the business model and the public policies of agricultural insurance. The concept of “business model” has been used extensively in the academic literature, especially since the mid-1990s, but scholars do not agree on a single definition (Zott et al., 2011). However, patterns emerge among the various definitions used in academic work. In general, the concept of business model is used to analyze how firms do business, adopting a systemic level, holistic approach. Therefore, a business model analysis goes beyond the firm, and encompasses its partners and networks. In this work, we will also mobilize the concept of business model to study revenues generated and costs borne by a firm, with an emphasis on the long-term viability of agricultural insurance. As agricultural insurance schemes are often struggling to attain financial viability under regular market conditions, public actors play a key role in most agricultural insurance programs around the world. Therefore, analyzing the business model leads logically to study public-private partnerships. Following Linder (1999), we adopt a very broad definition of the public-private partnerships, to include all “cooperative ventures between the state and private business”. All those partnerships are built with the aim to foster the development of agricultural insurance markets, but vary in nature, governance, risk-sharing and cost-sharing agreements. The thesis reviews the instruments available to policy makers to support the development of the agricultural insurance sector, taking into account that insurance is one among a range of risk management tools. It also examines the potential to renew the business model of agricultural insurance in order to make it affordable and accessible to a larger number of farmers.

The research is based on two case studies and a survey in both developed and developing economies. Though farmers may experience different kind of challenges, innovation is happening in both types of economies with lots of potential for cross learning and exchanges

of best practices. The thesis investigates the case of grassland insurance in France and an agricultural insurance scheme aimed at smallholder farmers in Kenya. It also includes a survey of potential distributors of agricultural insurance in Africa and Asia. The research makes use of different methodologies: financial modelling, interview-based qualitative study and quantitative survey. This variety in both case studies and methods makes possible to take-out different natures of results.

An important methodological feature of this work lies in the fact that the research took place within the framework of a CIFRE contract (CIFRE standing for Conventions Industrielles de Formation par la Recherche, or Industrial Research Training Agreements in French). A CIFRE contract is an agreement signed between a company, a research laboratory and a PhD student. The company hires the PhD student for a period of 3 years to conduct a research work under the supervision of an external laboratory, this work leading to the preparation of a PhD dissertation. During those 3 years, the hosting company receives a yearly grant from the Association Nationale de la Recherche et de la Technologie (ANRT), a public agency under the supervision of the French Ministry of Higher Education and Research. The ANRT gathers public and private actors involved in research and development. The agency is responsible to administer CIFRE agreements on behalf of the Ministry and validates the doctoral projects before the signature of the CIFRE agreement. The existence of the CIFRE scheme can be considered a success of public and private collaboration, producing research that is valuable for both academics and companies (Canet & Grassy, 2006). Indeed, CIFRE researchers often play the role of « mediators » between these two worlds (Levy, 2005), allowing knowledge to flow from the company to the laboratory, and vice versa.

In our case, the researcher worked with the Crédit Agricole group. The Crédit Agricole is a French cooperative financial institution, composed by a network of local banks, 39 regional banks and a holding company named Crédit Agricole SA. Crédit Agricole SA itself holds many subsidiaries in the finance and insurance sectors, and has activities in France and abroad. As the name suggests, the Crédit Agricole was founded at the end of the 19th century to fund the agricultural sector. It later diversified its activities during the 20th century but remains the main lender to the French agricultural sector. The researcher was hired by Pacifica, the non-life insurance company of the Crédit Agricole group. He collaborated with the Agricultural market team. This team develops and manages insurance products designed for the farming sector, to protect farmers' productions and assets: hail and crop insurance, truck/tractor insurance, livestock insurance, professional liability insurance. These products are then distributed

through the Credit Agricole banking network. The researcher also worked with the Grameen Crédit Agricole Foundation (GCAF). Created in 2008, at the joint initiative of Crédit Agricole's Directors and Professor Yunus, founder of the Grameen Bank in Bangladesh, GCAF's mission is to fund and support microfinance institutions, businesses and projects that promote inclusive finance and the development of rural economies around the world. It offers debt, equity, guarantees and technical assistance services, and is active in developing economies. The setting of the CIFRE agreement has been extremely beneficial for the research, as the PhD student had the possibility to work with very different contexts (French agriculture vs developing countries' agriculture). Both Pacifica and GCAF provided access to their data and contacts with their partners, and gave the practitioners' perspective on the research conducted through regular feedback.

This thesis contributes to the scientific literature and the debate around agricultural insurance in different ways. One characteristic of this work is that it relies heavily on real cases. The case studies in chapters 3 and 4 for example describe and review specific features of agricultural insurance products available in the market. As noted by Sandmark et al. (2013), many publications on agricultural insurance schemes lack details on the financial aspects or the product design. This thesis aims at taking into account this remark by providing a comprehensive information on agricultural insurance contracts, such as premiums, deductibles, sums insured, risks covered and exclusions. Chapter 3 also proposes calculations on the financial viability of an insurance scheme, even if it relies on assumptions and modelizations rather than on an actual insurer's financial data.

This research's contribution also comes from the confrontation of scientific literature with field reality. Chapter 4 digs into the line of work initiated by C.K. Prahalad in 2002 around marketing for the low-income households and the concept of the "bottom of the pyramid" (Prahalad, Hammond, et al., 2002), as well as the research on demand for microinsurance products. The literature's analytical framework is then mobilized together with an existing industry's management tool to review three crop insurance policies and one livestock insurance policy commercialized in Kenya. Chapter 5 examines the existing research to list possible motivations of financial institutions to distribute insurance for their clients, before surveying a panel of 36 microfinance institutions. This back and forth movement between theory and practice allows to enrich analytical frameworks and ground the research into operational realities.

Finally, the thesis offers practical insights and lessons for agricultural insurance professionals and policy-makers. Though it is not comprehensive of all agricultural insurance public-private

partnerships around the world, it offers a broad overview of agricultural insurance public policies and public intervention mechanisms to support the development of agricultural insurance markets. The thesis also analyzes the challenges faced by private operators, on both supply and demand. It is not limited to the perspective of insurers and reinsurers, and includes key stakeholders such as insurance brokers, financial institutions and agricultural value chain actors. Indeed, the author is utterly convinced that agricultural insurance is not a topic that can be addressed only by the insurance industry, or the farming sector, but rather requires the involvement of a broader range of stakeholders.

The thesis adopts the following structure. Chapter 1 describes the agricultural insurance context and the challenges it faces. It also introduces the research hypotheses forming the base of this work. Chapter 2 examines the literature to question the rationale for public intervention in favor of agricultural insurance. It then reviews the instruments available and questions their respective advantages and shortcomings, as well as complementarities between them. Chapter 3 evaluates the possibility to replace a public disaster assistance program by a commercial insurance product, taking the case of grassland insurance in France. Chapter 4 analyzes the crop and livestock insurance products offered by a microinsurance company in Kenya, in order to understand how products and processes are designed to target this specific segment of farmers. Finally, Chapter 5 investigates the business case for microfinance institutions to offer microinsurance to their clients, based on a survey of 36 institutions in Africa and Asia.

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CHAPTER 1

THE BUSINESS MODEL OF AGRICULTURAL INSURANCE: CONTEXT AND PROBLEM STATEMENT

The business model of agricultural insurance: context and problem statement

Risk is inherent to the agricultural activity. Farmers face a variety of risks, related to production, market trends or other events. Unforeseen events affect any business, but agriculture's strong dependence on nature puts farm businesses in a situation of constant instability. These risks affect farmers' income, which is uncertain and unpredictable. The existence of risk has a strong influence on farming practices and investments. In particular, agricultural risk can hinder economic development, limit growth opportunities and exacerbate poverty and vulnerability in rural areas. Many of these risks can be managed though, and farmers implement different risk management strategies. Farmers' risk management decisions will depend on the financial, social and human capital available, as well as on individual farmers' risk-aversion. Agricultural insurance is one instrument within a portfolio of risk management tools available to farmers. Therefore, agricultural insurance should not be analyzed in isolation, but rather be replaced within the broader framework of agricultural risk management.

This chapter is organized as follows. Section 1 sets the context, describing risk management strategies and agricultural insurance markets. Section 2 presents the challenges faced by agricultural insurance, and questions the viability of its business model. Section 3 introduces index insurance, and how it is disrupting agricultural insurance. Section 4 focuses on the role of reinsurance in agricultural insurance. Finally, Section 5 exposes the three research hypotheses and the case studies that make the backbone of this thesis.

1. Agricultural insurance markets and environment

1.1. Risk management in agriculture

1.1.1. Risks in agriculture

The term risk can be used with different meanings: it can be the chance of a bad outcome, the variability of outcomes or the uncertainty of outcomes (Hardaker, 2000). We will adopt the third interpretation, and define risk as the "exposure to uncertain unfavorable economic consequences" (Hardaker, Huirne, Anderson, & Lien, 2004).

Risks originate from different sources. Antón (2009) identifies four types of risks:

- (i) Production risk: weather hazards, natural catastrophes, pests and diseases affect the quantity and the quality of the farm output
- (ii) Market risk: Price volatility of farm inputs, outputs and assets affect the farmers' disposable income
- (iii) Financial risk: Changes in interest rates, access to credit, farm assets' value or non-farm income affect the household's wealth and income
- (iv) Legal/institutional risk: Changes in the regulation modify the business environment for farmers

Another categorization of risks can be made according to the degree of covariance of losses, between idiosyncratic and systemic risk. Idiosyncratic risk affects a limited number of farms. It has a narrow scale, and it is strongly related with farming practices. Idiosyncratic risk events are usually frequent events that will affect a predictable number of farmers each year. Hail or frost damaging crops, or a non-contagious disease affecting livestock fall into this category. On the other hand, systemic risk affects an entire region or country. Losses among farmers in the affected area are strongly correlated. Systemic risk events are infrequent, but they can destabilize the region's economy. Natural disasters like severe droughts, floods and hurricanes, or epizootic diseases are systemic risk events. Financial risks are also typically systemic risks.

Though our analysis is centered on farming households, agricultural risks do not affect only farmers. Rural communities, local and national governments, financial institutions, private insurers and humanitarian organizations also implement risk management strategies to deal with risk.

1.1.2. Risk management instruments

Farmers can use and combine several instruments to manage risk. These instruments can follow three different strategies (Holzmann & Jørgensen, 2001):

- (i) Prevention strategies, to reduce the probability of an adverse event occurring
- (ii) Mitigation strategies, to reduce the potential consequence of an adverse event
- (iii) Coping strategies, to relieve the impact of the adverse event once it has occurred

Prevention and mitigation strategies focus on income smoothing, while coping strategies focus on consumption smoothing (Antón, 2009). In other words, prevention and mitigation strategies address the risk ex-ante, risk coping strategies address the risk ex-post.

Prevention instruments relate to farming practices and technological choices: vaccination, drought-resistant seeds, pesticides intend to reduce the volatility of the farm output. Some of these technological choices, like irrigation, can reduce the risk exposure while increasing the average production. In other cases, there is a trade-off between risk and profitability. Farmers can choose to plant crops that are less volatile, but also less profitable. Some studies estimate that average agricultural incomes could be 10 to 20 percent higher in the absence of risk (P. Hazell et al., 2010b). Mitigation instruments include both on-farm technical tools and market mechanisms: production diversification, crop sharing agreements, futures and options, contract farming, off-farm work. Agricultural insurance also falls into this category. It mitigates the impact of production loss (in quantity and/or quality) through a claim payment. Finally, farming households mobilize coping instruments to recover after the occurrence of an adverse event: savings, loans (from a formal or informal lender), sale of assets, off-farm income, family and community solidarity, humanitarian and government relief. Risk-coping mechanisms can be difficult to access. For example, a bank might be unwilling to disburse a loan to a farmer in difficulty. Some risk-coping mechanisms are also less efficient for covariant risks than for idiosyncratic risks. When a drought affects an entire region, neighbors and family are unable to provide relief as they are coping themselves with the consequence of this event. Selling livestock is also a very common risk-coping instrument in developing economies, but poorly efficient in the case of a widespread crisis as every household tries to sell at the same time, pushing prices down. Finally, some risk-coping strategies can have long-lasting effects on farmers' livelihoods. If farmers sell productive assets to maintain a minimal level of consumption, it threatens their capacity to generate income in the future.

1.2. The agricultural insurance landscape

Agricultural insurance is a market-based risk mitigation instrument, which reduces farmers' risk exposure to production risk. An insurance contract protects the policyholder against one or several pre-defined risks, against the payment of a premium. It may not be available in all countries, for all types of production risks, for all crops and livestock.

1.2.1. Products

At a global level, crop insurance represents an estimated 90 percent of premiums collected, and livestock insurance represents the 10 percent remaining (Mahul & Stutley, 2010). Farmers also

purchase insurance to be covered against personal risks (health, death) and to protect their property and assets. These insurance products are outside the scope of this research.

1.2.1.1. Crop insurance products

For crops, named-peril insurance is the most widely available type of insurance. Named-peril insurance protects crops against a specific risk, usually hail. It is possible to add other pre-defined perils, like frost, or floods; such products are known as combined insurance in Europe. Claims are calculated by estimating the percentage of damage to the crop, multiplied by a pre-agreed value (production costs or a pre-agreed value of the crop revenue).

Multi-peril crop insurance (MPCI) guarantees an insured yield against multiple hazards that can cause yield losses. This insured yield is calculated as a percentage of the historical average yield. If the actual yield falls below the insured yield, the insurer pays a claim to the policyholder to cover the loss. Claims are calculated by the difference between the insured and the actual yield, multiplied by a pre-agreed value of the crop value.

Named-peril insurance and MPCI are both indemnity-based contracts. Loss adjustment traditionally implies the visit of an expert assessing two things: (i) whether the loss is due to an insured peril and (ii) the magnitude of the loss. The expert loss assessment will determine whether a claim payment is due or not, and its amount.

Revenue insurance combines MPCI with hedging techniques (futures) against price volatility. It is very common in the United States. Revenue insurance guarantees a minimum revenue for farmers who are protected against yield losses and crop price fluctuations.

Besides traditional indemnity-based crop insurance products, index-insurance is a new insurance approach. Index-insurance does not pay claim against actual losses. Losses are estimated thanks to an index, a proxy using third party data (see Section 3 below for more details). Index-insurance is available in a growing number of countries, and is particularly interesting to cover smallholder farmers, for which indemnity-based insurance would not be feasible due to the high costs of loss adjustment compared with the sum insured.

1.2.1.2. Livestock insurance products

Livestock insurance contracts protect against the risks of animal accident or mortality. They sometimes include a cover against diseases, but not preventable diseases. Livestock insurance contracts may require that farmers implement some prevention measures, like vaccination or

veterinary controls of insured animals. Animal mortality depends a lot on farmer's behavior, so livestock insurance is often plagued with adverse selection and fraud.

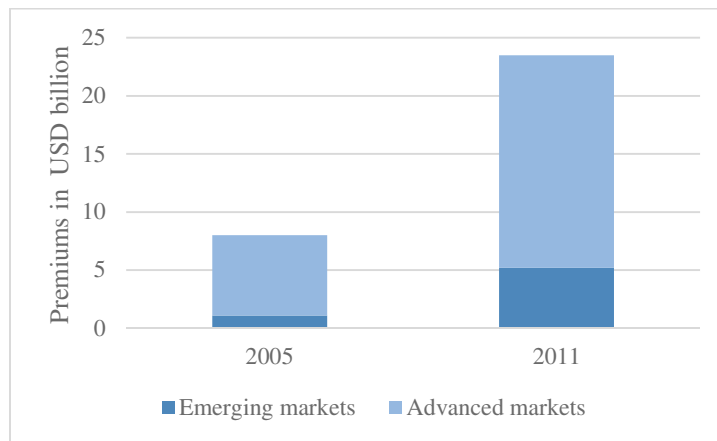
Index-based livestock insurance is available in a few countries. It protects herders against animal mortality, and estimates losses thanks to average animal mortality per locality (Mongolia) or average vegetation available for animal feed (Kenya, Ethiopia).

1.2.2. Agricultural insurance markets around the world

The first agricultural insurance products emerged more than 200 years ago in Europe. Hail was the first peril insured and remains until today the most widely available cover. The Roosevelt administration introduced the first MPCCI contract in the United States in the 1930s. Between the 1950s and 1980s, governments of Asia and Latin America provided public agricultural insurance, often in linkage with national agricultural credit programs. These programs were often terminated in the 1980s and 1990s, due to their poor results and a paradigm shift towards more liberalism in public policies. In Europe, some governments started subsidizing MPCCI in the 1980s, with an acceleration of this trend in the 1990s and 2000s. Globally, the trend in the last two decades has been to provide agricultural insurance through the private sector, generally with support from the national governments.

Agricultural insurance is growing rapidly around the world. Global premiums tripled between 2005 and 2011, going from \$ 8 billion to \$ 23.5 billion (Kalra & Xing, 2013). This is equivalent to an annual 20% growth rate. The share of emerging markets in total premiums went from 13.4% to 22% over the same period. In these markets, agricultural insurance premiums more than quadrupled, corresponding to a 30% annual growth rate. China and India were driving the emerging markets growth. These two countries account for 62% of premiums in emerging markets in 2011.

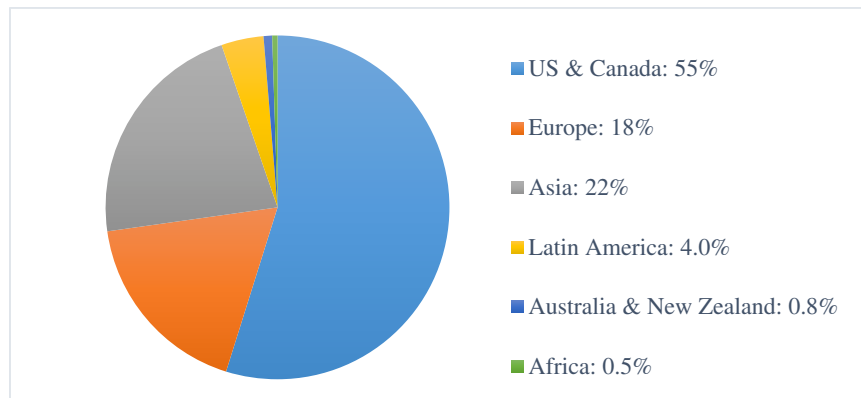
Figure 1 - Estimated agricultural insurance premiums worldwide in 2005 and 2011



Source: Swiss Re (2013)

Despite the rapid growth in emerging markets, USA & Canada remain the largest agricultural insurance market, with 55% of premiums collected. Europe comes third with 18% of total premiums. The shares of Latin America (4%) and Africa (0.5%) remain particularly low, comparatively to their weight in food production and world population.

Figure 2 - Estimated geographic distribution of agricultural insurance premiums in 2011



Source: Swiss Re (2013)

Unfortunately, to the author's knowledge, there was no study published that aimed at estimating global agricultural insurance premiums, since Swiss Re's publication in 2013, which was based on 2011 data. Since 2011, it is reasonable to think that agricultural insurance markets have most likely grown. Indeed, many developing countries have expanded their agricultural insurance programs or launched new pilots. Hess, Hazell & Kuhn (Hess et al., 2016) estimate that there are 198 million policyholders in developing countries, with 37 schemes operating. Most of these policyholders are in China (80%) or India (16%).

Table 1 - Agricultural insurance schemes in developing countries

	Number of policyholders (in millions)	Number of schemes	Weighted average subsidy (estimation)
Africa	0,65	18	37%
India	32,2	4	64%
China	160	-	77%
Rest of Asia	1,1	7	64%
Latin America	3,3	8	91%

Source: Hess et al. (2016)

2. The business model of agricultural insurance in discussion

2.1. Conditions of insurability

Not all perils are insurable. Skees, Barnett & Hartell (2005) and Shaik et. al (2006) identify five ideal conditions of insurability.

- (i) **Determinable and measurable loss:** it must be possible to determine whether or not a loss occurred, if it was caused by an insured peril, and to measure the magnitude of the loss
- (ii) **Accidental and unintentional loss:** an insurance should pay claims only for random events over which the policyholder has little or no control. However, the policyholder's behavior can increase the probability and/or the magnitude of loss. Monitoring policyholders' behavior can be costly or even impossible, which opens the door to moral hazard situations. Fraud is an extreme case of moral hazard. Even in the absence of unethical or illegal actions, moral hazard can be the rational economic decision of a policyholder to reduce risk prevention and mitigation measures when being insured.
- (iii) **Sufficient data is available for risk classification:** Insurers must be able to accurately estimate the level of risks of clients and set the premium accordingly. Otherwise, adverse selection may occur, especially if policyholders have better information on their risk exposure than the insurer. Those who benefit from low premiums relatively to their real risk will be more likely to purchase insurance, while those who are charged premiums too high will drop out.
- (iv) **Calculable expected frequency and magnitude of loss:** Insurers calculate premium rates based on the frequency and the severity of expected losses. Insurers

need reliable data on historical losses, as well as information on future possible distribution of losses.

- (v) **Large number of independent exposure units:** Risk pooling is more efficient when losses are uncorrelated or not highly correlated. Thanks to the law of large numbers, the variability of losses of the aggregate portfolio decreases as the number of policies increases.

In practice, these five conditions are rarely met altogether. Insurers often address the violation of one or several criteria by increasing premium rates. However, if premiums are too high, there might be no demand. Shaik et al. (2006) add a sixth insurability condition, stating that (vi) **premiums must be economically feasible**. For perils that deviate significantly from the five ideal conditions, premiums may exceed the clients' willingness to pay, and therefore there would be no market.

Regarding crop and livestock insurance, the first criterion is often met, though it requires significant expertise from the insurer. The second criterion is more challenging. Crop and livestock losses are related to external and non-controllable shocks, like weather hazards or animal accidents. However, farming practices do affect the frequency and severity of losses, so insurers must implement monitoring systems and incentives to comply with the second criterion. Data availability is in many cases a challenge, which makes the third and the fourth criteria hard to meet. Historical yield and animal mortality data may be insufficient or unreliable, especially in developing countries.

If the first four criteria can be met over time, through the collection and improvement of data and monitoring systems, the fifth criterion poses a long-lasting challenge. The very nature of agricultural risk contradicts the condition of independent losses. Indeed, crop losses are often highly spatially correlated, which makes risk pooling inefficient (Miranda & Glauber, 1997). This should preclude the formation of an agricultural insurance market. However, such markets exist, but usually with some sort of public support.

2.2. Insuring the production of smallholder farmers

Insuring farm production is challenging, as the five insurability conditions are not met for agricultural risks. Targeting smallholder farmers comes with additional constraints. The number of smallholder farms is estimated between 400 and 500 million, and the number of people living in these households lies between 1.5 and 2.5 billion people (Christen & Anderson,

2013). Therefore, smallholder farmers' specific constraints have to be taken into account in order to extend insurance coverage to a large number of farmers.

In traditional insurance theory, risk-averse individuals are always willing to buy insurance at the actuarially fair price in order to maximize their utility, and they can accept to pay a premium above the expected loss, in order to reduce income volatility (Brau et al., 2011). In theory, the greater the risk-aversion, the greater the risk premium an individual is willing to pay. Individuals will also prefer to pay a risk premium to protect themselves for large infrequent losses to preserve their wealth. Finally, the lower the initial level of wealth, the more clients are willing to buy insurance. Therefore, demand for insurance should be very high among smallholder farmers as their initial wealth is low and potential losses represent a significant percentage of their wealth.

The reality is quite the opposite: willingness to pay for insurance is particularly low among low-income households in general. Indeed, low-income clients do not know insurance contracts and have limited confidence in insurance companies (Brau et al., 2011). From the supply side, data availability is often deficient in low-income environments, which makes risk-classification and premium calculation challenging (Biener & Eling, 2012; Brau et al., 2011). To make things worse, risk pools are too small, which limits both the potential of risk diversification and the possibilities to generate internal data over time (Biener, 2013). Insurance for low-income clients also faces the issue of high transaction costs in comparison with the premiums and sums insured. This is particularly true for loss adjustment of yield losses. The cost to send an expert evaluate losses for a smallholder farmer might exceed the yearly premium paid by the farmer or even the potential claim. Traditional loss adjustment methods bear high transaction costs that are not compatible with the economic feasibility of premiums for smallholder farmers. Agricultural insurance for smallholder farmers cannot operate under the same business and operational model as in other markets. In particular, operational costs need to be drastically reduced to make insurance affordable for clients and viable for insurers.

Moreover, smallholder farmers often live in remote areas and lack access to basic services taken as granted for many other citizens: transport, education, information, markets, or finance. Insuring smallholder farmers not only requires to lower costs; the distribution, awareness-raising and marketing mix need to address these clients' specific needs and constraints.

2.3. Can agricultural insurance exist without subsidies? Viability of insurance programs

In a 1992 article, Hazell analyses the viability of seven public agricultural insurance programs in the 1970's and 1980's (Hazell, 1992). He finds that these insurance programs' financial performance is disastrous, and that actuarial principles are often not applied. To be financially viable, an insurer must collect more premiums than it spends annually on indemnities and administration costs. Let us denote P the premiums collected, I the indemnities paid to policyholders and A the administration costs borne by the insurer. For an insurer to be financially solvent, the "Hazell ratio" Z must comply with the following condition:

$$Z = \frac{A + I}{P} < 1$$

All the programs analyzed by Hazell fail to meet this condition. They are only able to run because they receive public subsidies. It is possible to disaggregate the Hazell ratio into two components: the producer loss ratio I/P and the administration cost ratio A/P . Among the seven insurance programs studied, the producer loss ratio ranges between 0.99 in Japan to 5.11 in India. When I/P is above 1, the commercial premium is set below the actuarially fair premium. In such cases, farmers receive more in indemnities than they pay in premium. From the farmers' perspective, purchasing insurance is a very profitable investment: every dollar spent in insurance premium in India is equivalent to a 5.11-dollar claim payment on average.

Administration costs can also undermine the viability of an insurance program. In the sample of Hazell, the A/P ratio is comprised between 0.28 and 3.57. When A/P is above 1, the premiums collected do not even cover the administration costs of the insurance program.

Hazell et al. (Hazell, Sberro-Kessler, & Varangis, 2017) ran the same calculations a few years later using data from Mahul & Stutley (2010). Except in Japan, all producers' loss ratios decreased significantly, indicating a better viability of these insurance programs. However, only one program (Mexico) had an I/P ratio below 1, meaning the insurance scheme may be able to operate without subsidy (the level of administration costs A/P remains to be analyzed).

Table 2 – Producer loss ratios in seven countries

Country	Producer Loss Ratio I/P			
	Brazil	1975-81	4.29	2004-2007
Costa Rica	1970-89	2.26	2003-2007	1.75
India	1985-89	5.11	2003-2007	3.36

Japan	1985-89	0.99	2003-2005	1.84
Mexico	1980-89	3.18	2003-2007	0.72
Philippines	1981-89	3.94	2003-2007	1.42
US	1980-89	1.87	2003-2007	1.70

Source Hazell et al. (2017)

Skees, Hazell & Miranda (1999) propose several reasons for the insolvency of agricultural insurance programs. The main reason identified is that agricultural risks fail to meet insurability conditions, so an agricultural insurance scheme cannot operate without public support. The authors also point other explanations for failure, such as the mandate of public insurers to work with smallholder farmers, which increases administration costs, the fact that the government may systematically cover losses, which gives no incentives to public insurers to monitor fraudulent claims, and the use of insurance for political motives, like when excessive claims are paid prior to elections. Crop insurance programs can also be too specialized on certain crops, regions or types of farmers, which limits the size of the risk pool and the effect of diversification.

3. Index insurance, a new paradigm for agricultural insurance

For many years, agricultural insurance has been available only to large-scale commercial farmers, and only for those living in countries with pro-insurance policies. However, technological innovations are disrupting traditional agricultural insurance markets. Relying on alternative sources of data for risk classification, premium calculation and loss adjustment, index insurance is profoundly modifying the business model of agricultural insurance. Index insurance extends the scope of insurability to new risks and new types of farmers.

3.1. Principles of index insurance

In traditional crop and livestock insurance, insurers pay claims when farmers suffer from an actual loss. An external event, like hail or a drought negatively affected yields, or animals died because of a non-preventable disease. In some cases, assessing production loss can be unpractical, costly or simply impossible. Index insurance overcomes this difficulty by relying on a variable, a proxy that estimates accurately the production loss. Unlike traditional agricultural insurance, index insurance payments are not triggered by the observation of a production loss, but by the level of an index, which is itself correlated with the level of production. When the index value goes below a pre-defined threshold (i.e. the insured level of

production), insurers pay indemnities to policyholders. Policyholders do not need to file a claim, the index automatically calculates losses, and claims are paid accordingly.

3.1.1. Crop indices

Crop insurance indices fall into three categories (Collin, 2018).

Area-yield indices

Like in traditional crop insurance, experts evaluate yield losses through actual observation in the field, except that instead of assessing yields of each individual farmer filing a claim, experts measure the production of a representative sample of farmers. The index value of a certain area corresponds to the average yield measured in this area.

Compared to other index technologies, area-yield indices are easier to understand for all stakeholders, as they are similar to traditional insurance techniques, applied on a sample. Furthermore, area-yield indices allow accounting for all perils that can affect yields, including pests. However, an area-yield index requires good historical yield data, which is seldom available. Furthermore, conducting crop-cutting experiments to evaluate average yields in each area is costly and the results can be available several months after the season, which further delays indemnities' payment.

Weather indices

Weather indices rely on a network of ground weather stations and captors, measuring different meteorological variables: rainfall, air and soil humidity, wind speed. Rainfall indices are the most common meteorological indices, as in many contexts, water-availability is the main factor affecting yields. The index will estimate yields by comparing rainfall with the water needs of the crop during each growth phase of the plant.

Weather indices are relatively easy to understand. Farmers know how weather affects yields and they can observe meteorological variables themselves. Nevertheless, in many countries there is no sufficient historical meteorological data to build an index. Reliability of current data being collected can also be an issue, though automated weather stations tend to increase the timeliness and accuracy of data. Finally, the weather station network is often not dense enough to allow an accurate yield assessment at the local level.

Remote-sensed indices

These indices are based on data provided by satellites. Different techniques using radar captors or satellite imagery are used to evaluate rainfall or vegetation growth.

Remote-sensed data is available for the whole planet, with a good level of accuracy. In the case of medium-resolution images, there is more than 30 years of data. However, remote-sensing indices are hard to explain to the different stakeholders. They also require significant initial investments and expertise to be set-up, though in the long run they can be easier and cheaper to administer than area-yield or weather indices.

3.1.2. Livestock indices

Though less common than for crops, livestock index insurance also exists. We can identify two types of indices.

Mortality indices

In this technique, animal losses are estimated by measuring average animal mortality per area. In its construct, it is quite similar to an area-yield index, except that it relies on animal censuses instead of crop cutting experiments. Such an approach is being implemented in Mongolia (Mahul & Skees, 2007). The Government has been conducting an annual census of adult animals, and recorded animal mortality per district (“soum”) for more than 50 years. Such data include all causes of animal losses. Mortality indices are not common. The quality and availability of animal mortality data in Mongolia is rather exceptional. The data collection process is strictly controlled to ensure its accuracy. Animal losses per species are available at the local level since 1971. These favorable conditions made possible the creation of the livestock index insurance program.

Pasture availability indices

As animal mortality data is scarce, an alternative variable that insurers can use is the availability of pasture. In arid and semi-arid areas, nomad pastoralists face the risk of drought, which results in the lack of pasture and possibly livestock’s starvation. An index measuring the availability of pasture can predict accurately animal losses. In Kenya, an index-based livestock insurance scheme is running, using satellite data to measure the quality of pastureland every 10-16 days (*Index-based livestock insurance as an innovative tool against drought loss: Good practices and impact analysis from northern Kenya.*, 2018). This data forms the input to build a statistical model of animal mortality per region. When losses exceed a determined threshold, herders receive an insurance payout. Pasture availability indices are like satellite-based crop indices,

with the additional component of using the estimation of vegetation growth to predict animal losses.

3.2. Benefits

The benefits of index insurance techniques compared to traditional indemnity-based insurance have been extensively studied (Barnett & Mahul, 2007; Collin, 2018; Hazell et al., 2010).

Index insurance overcomes the issues of adverse selection and moral hazard, which are intrinsic to most insurance contracts. Index insurance does not operate at the farm level, but at a larger scale. Individual farmers' risk profiles do not really matter at this scale, eliminating the problem of adverse selection. An individual farmer's production will not influence significantly the value of the index, limiting moral hazard issues. All the policyholders in a certain area have the same contract, pay the same premium and receive the same indemnity per insured unit. Therefore, insured farmers have the same incentives to obtain a good level of production than a non-insured farmer. The insurance contract covers only the risk that is beyond the control of farmers, evacuating farm-specific practices, which are difficult to monitor.

Another set of advantages lies in the administration of the insurance scheme. If the initial upfront investments to create an index insurance contract can be high, there are large savings opportunities in the running of the program. In particular, index insurance does not require assessing individual losses, which opens the door to insuring smallholder farmers who would otherwise not be insurable.

Finally, index insurance increases transparency in the system. Losses are not measured based on an individual expertise, but rather on third-party data provided by a reliable source. Policyholders may have more trust in this third-party data provider than in the insurance company loss adjuster. Reinsurers and financial markets may also be more willing to take risks if they trust the indices.

3.3. Limitations

Index insurance relies on data. This data must be accurate, available at a sufficiently small scale and over a sufficient long time. Those conditions are not always met, especially in developing countries. Statistical methods or the combination of several data sources can compensate only

partially the absence of data. Over time, the index insurance scheme will generate its own data, which should improve the quality of predictions.

The most important shortfall met by index insurance is “basis risk”. Basis risk happens when the index does not reflect the real losses suffered by farmers. Therefore, individual farmers experiencing a loss may not receive the compensation they should get. On the other hand, they may benefit from an insurance payout without suffering any loss. Such situations undermine the confidence in the insurance scheme, and place farmers at risk.

Sandmark et. al (2013) identify three types of basis risk:

- Spatial: when the granularity of the index is not sufficient. For example, two villages located in the same area (same data point in the index) may experience different losses
- Temporal: there can be a lag between the event and its impact on the crop
- Crop-specific: the correlation between the index and the actual yield can be low. The index does not properly identify the factors provoking losses.

Research is still needed to improve the quality of indices and reduce basis risk. Increasing data availability is also a way to improve the quality of indexes. It is possible to reduce spatial basis risk by increasing the granularity of an index, setting up more weather stations for example, or increasing the resolution of satellite images. Another approach is to modify the contract design with a double trigger (Carter, 2011). The first trigger is based on measured yields at the village/community level. However, at such a small scale, farmers can collude and influence the index measurements. A second trigger at a larger scale validates the reality of widespread losses. The first trigger is designed to improve the correlation between losses and payments while the second trigger controls the absence of moral hazard. Finally, a third approach to mitigate basis risk is to insure groups or larger entities rather than individual farmers. Sometimes called “mesoinsurance”, this approach aims at protecting entities that are exposed to aggregate yield losses risk, rather than idiosyncratic risks. Such entities can keep claim payments, or they can use the payouts to compensate individual farmers according to their individual losses, as these entities might be in a good position to assess actual losses.

Despite its limitations, index insurance bears the potential to extend risk coverage to farmers who were previously excluded from insurance. It also has a different cost structure from traditional indemnity-based insurance, and benefits from economies of scale. Index insurance can therefore disrupt the business model of agricultural insurance.

4. Reinsurance in agriculture

4.1. Reinsurers as market enablers

As seen in 2.1, agricultural risks are difficult to insure because of their covariant nature. Reinsurance can relax this constraint, by allowing insurers to transfer part of the risk. Reinsurance companies hold large portfolios, spread across several types of businesses and geographies. They are therefore in a better position than most national insurance companies to efficiently diversify risk. Moreover, reinsurance companies have built very large reserves which allows them to cope with large-scale loss events. By absorbing large losses, reinsurance can make an insurance company's results smoother and more predictable. This normally means that the insurer's exposure is reduced, and therefore limits the need to raise capital. With reinsurance, insurers can issue policies with larger limits than they would otherwise be able to.

Insurers and reinsurers sign a contract, called a reinsurance treaty, which defines the modalities of the risk-sharing agreement. Two types of risk-sharing agreements are the most common:

- proportional or "quota-share" reinsurance: under a quota share agreement, a fixed percentage of each insurance policy is transferred from the insurer to the reinsurer; usually, the ceding company seeks a quota share agreement to reduce the need for capital.
- non-proportional or "stop-loss" reinsurance: stop-loss reinsurance covers losses after a threshold of claims has been exceeded; stop-loss reinsurance allows insurance to underwrite catastrophic risks.

Besides the risk-transfer instruments, reinsurance companies also bring insurers technical and actuarial expertise. In some markets, local insurers may lack the experience or the capacity to properly rate premiums and assess probable maximum losses. Reinsurers can support their clients, and bring their know-how acquired in various markets. The largest reinsurance companies are private, but some countries have also set-up a national public reinsurance company when private reinsurance capacity was not available or not satisfying.

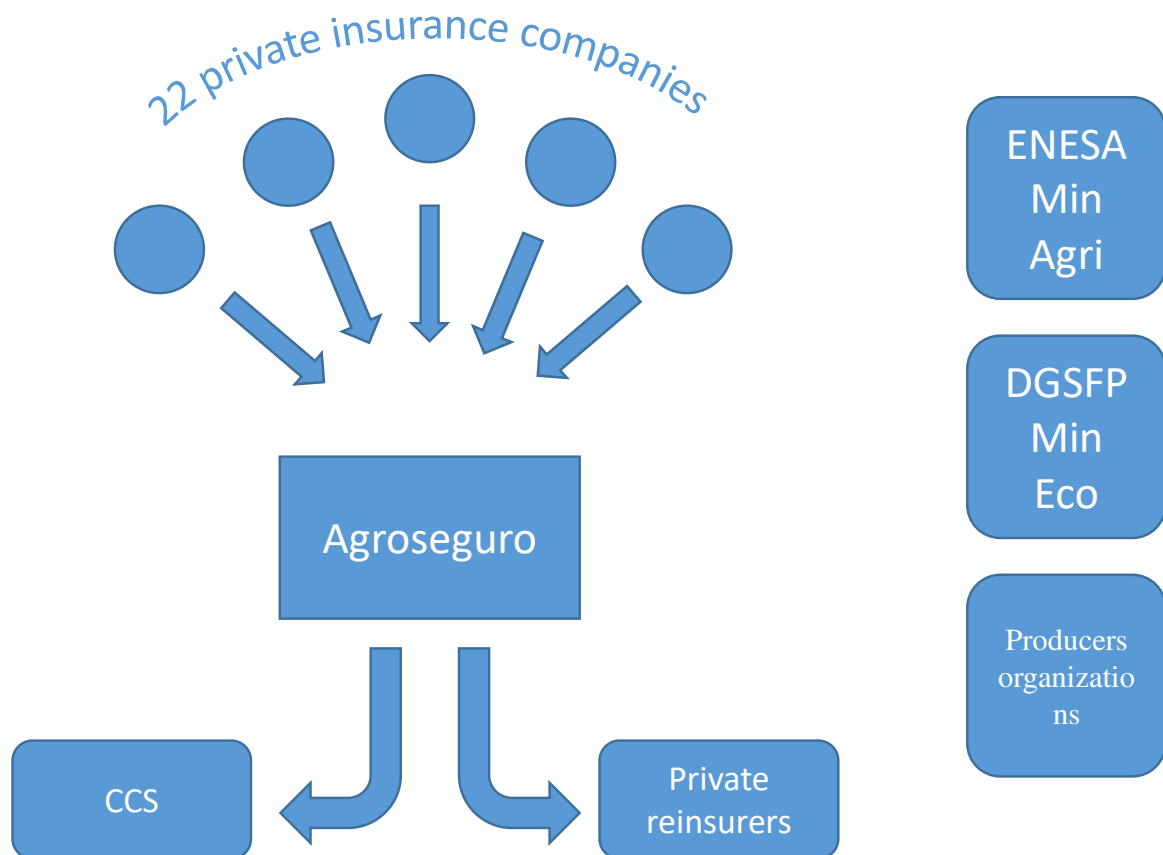
4.2. The example of the Spanish scheme

Spain offers an interesting example of public-private collaboration to provide insurance to a large number of farmers. The Spanish agricultural insurance system was created in 1978. It covers all productions (agriculture, livestock, aquaculture, forests), against all natural risks. The

Spanish system is an original public-private partnership based on the voluntary participation of private insurance companies in a co-insurance pool (Agroseguro, 2015). This pool is managed by Agroseguro, a company owned by the insurance companies. Agroseguro does not bear the risk itself, it only manages the co-insurance pool. Policies are grouped into 3 categories: A (experimental), B (viable) and C (cost of destroying dead animals). The participation of each company in each category is adjusted each year, according to its share in the sale of the corresponding insurance products.

The system leaves an important place to the State. Premium rates are determined by the co-insurance pool and then validated by the State. The State also validates the characteristics of the contracts, and determines as part of an annual plan the cultivation areas on the basis of which state subsidies are paid. Competition between insurance companies only affects the costs and services of marketing their products. The purchase of insurance is necessary to obtain certain exceptional production aid or disaster aid schemes (direct compensatory payments, interest subsidies and loan guarantees). In addition, renewing insurance policies allows for higher policy discounts and subsidies.

Figure 3 – The Spanish Public-Private Partnership



Private insurers

- Carry the risk
- Market insurance products
- Compulsory participation in the Agroseguro co-insurance pool
- Agroseguro shareholders

Agroseguro

- Issues policies
- Directly receives state and regional subsidies (producers pay premiums net of subsidies)
- Manages claims reports and assessments
- Compensates policy-holders on behalf of insurers
- Performs statistical and actuarial studies
- Manages reinsurance with the CCS and the private reinsurers on behalf of insurance companies

CCS: Consorcio de Compensación de Seguros

- Public company supervised by the Ministry of the Economy
- Compulsory reinsurer of the co-insurance pool, according to a percentage defined annually by the Ministry of the Economy
- Provides stop-loss reinsurance

Private reinsurers

- Each insurance company decides how much of the risk it wishes to transfer to the private reinsurers
- Reinsurers provide stop-loss reinsurance

ENESA: Entidad Estatal de Seguros Agrarios

- Public body dependent on the Ministry of Agriculture
- Defines the government strategy (annual agricultural insurance plan)
- Manages the grant budget
- Defines the subscription dates, the insurable yields and the premium rates
- Conducts viability studies for each product

DGSFP: Dirección General de Seguros y Fondos de Pensiones

- Administrative body dependent on the Ministry of the Economy
- Supervises insurance contracts
- Defines the claims expertise standards
- Collaborates with ENESA on the strategy of the co-insurance pool and the criteria for the distribution of grants

Producers' organizations

- Represent the sector within ENESA
- Allow farmers to take out group insurance policies

The insurance take-up varies depending on the production, from less than 3% for grasslands, to nearly 90% for fruit production (Agroseguro, 2017). The amount of premiums increased almost continuously until 2008, before starting to decline, then recovered from 2015. The amount of subsidies followed the same trend.

Figure 4 – Agroseguro premiums

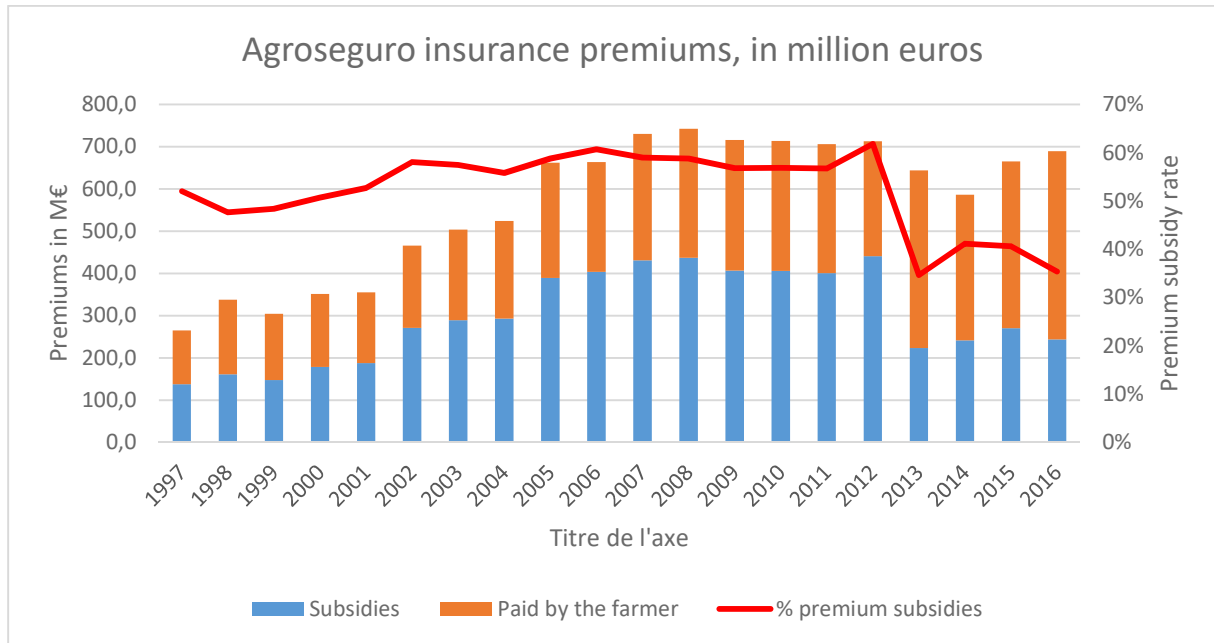
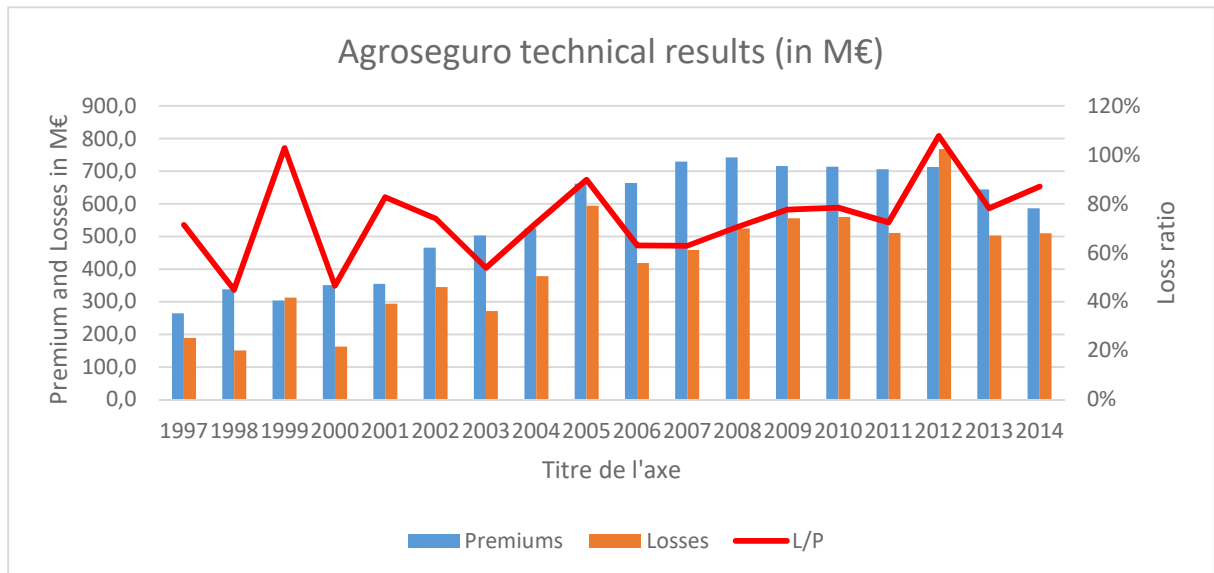


Figure 5 – Agroseguro technical results



4.3. Interviews with reinsurers

4.3.1. Context

The largest reinsurance companies operate on a global scale, which allows them to improve risk diversification across different business lines, and different countries. This unique position in the insurance value chain gives reinsurance professionals a very broad and global perspective on agricultural insurance markets. Therefore, it appears relevant and insightful to interview a small sample of agricultural underwriters working in reinsurance. Those interviews were conducted at the end of the research work, in order to fine tune research questions and get feedback on the results of the thesis.

4.3.2. Objectives

Reinsurance professionals were interviewed on three topics that are transversal in this research work: (i) market failures in the agricultural insurance markets and the conditions of insurability; (ii) the role of governments in supporting agricultural insurance markets; and (iii) innovations and other drivers that will likely affect future market development.

4.3.3. Methodology and sample

7 people were interviewed, during 5 meetings with 5 different companies. Four of the companies interviewed are among the largest reinsurance companies in the world, and one company is a national public reinsurer. All the professionals interviewed are either agricultural underwriters, or working in the research and development department of their company. All are experts in agricultural and/or catastrophic risks. The people in the sample were identified thanks to Pacifica.

The interviews were all conducted remotely, through video calls, using the Zoom or Microsoft Teams apps. Interviews lasted between 30 minutes and one hour. One interview was conducted in English, the other four were conducted in French. Interviews took place in May and June 2021.

An interview guide was prepared prior to the interviews, with open questions around the three themes presented above. After the first interview, the interview guide was refined. The interview guide and the results of the first interview were shared with the thesis supervisor and a Pacifica representative, in order to improve the questionnaire.

4.3.4. Results

Market failures in agricultural insurance

The first topic discussed is the topic of agricultural insurance market failures. All the professionals interviewed agreed that, only name peril insurance (usually hail insurance) can exist without direct public intervention. Experience shows that multi-peril crop insurance has grown only in countries where premium subsidies are available. Two interviews raised the issue of agricultural prices and margins. Agriculture tends to be a low-margin activity, it is therefore not conceivable for most farmers, including in developed economies, to pay the full price of insurance and dedicate several points of margin for a risk management instrument. The market has focused on insuring crops, livestock insurance representing a very small fraction of the business. Indeed, livestock mortality risk proves to be more complex to insure, one of the reasons being that farming practices have a very large impact on losses and are difficult to control. Spain is a notable exception, with livestock insurance weighting close to a third of agricultural insurance premiums. Overall, market development is always driven by policy. Market development for multi-peril crop insurance always follows a voluntarist policy, which most often takes the form of premium subsidies.

Role of government

All the reinsurers interviewed underlined the importance of assessing the public policy and support mechanisms in place to evaluate the market potential for agricultural insurance. However, this analysis of the public policy does not translate into models, or even a standardized evaluation grid of the public-private partnerships. Such a model would be used to integrate the public sector into the reinsurance price calculation, and the amount of capital to mobilize. One professional interviewed mentioned an attempt to build such a model internally around the year 2010, but the company abandoned the project. Another interview pointed the fact that some market research companies are developing an offer in this topic, providing data and markets analytics to support reinsurers' decision making, but it remains very nascent and not central in their analysis.

On the contrary, market assessment appears to be very ad hoc, with lots of factors to take into account as there are a lot of different set-ups among countries. There is a great variety of public-private partnership models, no country replicating exactly what can be observed in another country. Indeed, governments can activate and mix a variety of policy instruments (see chapter 2). Another factor limiting the standardization of market assessments is the fact that farming

practices can also be radically different between countries, especially between developed and developing economies. Access to credit, inputs and technology are very heterogeneous, resulting in average yields and yield volatilities that vary a lot from one country to the other. The reinsurer's assessment also includes an analysis of the players operating in the market (local insurers, brokers, aggregators), the history of the local insurance market and the quality and availability of data.

Three interviews insisted on the importance of the relationship with the local insurer. Reinsurers assess the quality of operations' execution, in particular for loss adjustment. The go/no-go decision is not always purely technical. A reinsurance company may agree to make a deal even if the deal does not satisfy its usual requirements, in order to maintain a good relationship with a client. The reinsurance sector is a business with few clients (insurance companies), so reinsurers have to take into account the total business they have with a client when evaluating the level of risk they accept to take. Reinsurers invest on the medium and long term. They don't invest resources if they expect to withdraw within five years.

The expectations of reinsurers towards the public sector can be grouped into three categories:

- visibility: reinsurers expect a stable regulatory environment. The reinsurers interviewed insisted that they invest for the long term and can't do so if the market is unpredictable. Changes in policy or delays in paying premium subsidies affect negatively market growth. Consistency is also a key point: two reinsurers mentioned the fact that government payments to farmers after severe production losses undermine market development, even in the presence of premium subsidies. Three reinsurers also indicated that technical expertise within government often leads to more consistent and predictable policies, and a better dialogue between the public and the private sectors.

- data and transparency: when there is no insurance history, reinsurance companies can only rely on secondary data, often public data, to estimate historical yields and potential losses. Governments have a role to play in the provision of public goods and improving transparency. The cases of Spain and the United States were cited in all the interviews, both because they are among the largest agricultural insurance schemes, but also because the government agencies publish a lot of information available to the public.

- risk-sharing: the role of governments as risk-takers was not unanimously appreciated. Unsurprisingly, the public reinsurance company insisted the most on this aspect. The professional interviewed defended the idea that the private sector only has a limited capacity to

take on catastrophic risk. He also supported the idea that public reinsurance rates are stable over the years, unlike reinsurance rates which tend to be volatile. Two private reinsurers also recognized that the public sector can play a role in covering the most extreme layer of risk. However, for two other interviewees, risk-taking capacity is not the most limiting factor at this stage of market development. One professional even rejected the idea that public reinsurance could make insurance more affordable, as price is first driven by the technical rate.

We can see that there is a consensus around the idea that public policy must be predictable, and that governments have role to play to increase transparency and supply data. The role of the public sector as a risk-taker itself is more controversial, though the examples of Spain and the United States are often cited as examples of success.

In the end, reinsurance companies scrutinize the 3 “Ps” of PPPs: they assess the public policy, the track record of the private players, and the quality of the partnerships established between the public and the private sector.

Perspectives of development

All the professionals interviewed watch closely the innovations taking place in the agricultural insurance sector. Their appreciation of a new approach like index insurance may vary: some see it as a “fad”, others have more confidence in its potential to open new markets. As one interviewee said, “more than 90% of our agricultural business is traditional reinsurance”, so it is still difficult to say what innovation will actually disrupt the market.

In terms of geographies, nowadays the market is concentrated on a few countries that have put in place favorable policies: the United States, some European countries, and a few large emerging economies like China and India. However, some reinsurers are willing to explore new markets. One reinsurance company in particular has a very proactive approach to work in countries where they consider there is potential for growth, even if the market conditions are not optimal currently. That company explained that they adopt a “sandbox approach”. When a country with significant market potential takes a pro-insurance policy, the company will try to get into the market, even if the policy is far from being perfect. The company will usually limit its exposure, observe the market, accumulate historical data and learn. Another company described something similar: when starting from scratch, it is usually easier to start with hail insurance, and then build from this base. When asked about the potential to address smallholder farmers in developing economies, one interviewee appears to be voluntarist in serving such markets and clearly sees an opportunity, two expressed caution, as they don’t see yet any viable

business model to work with this segment, and another indicated that the attempts in these directions have been so far motivated by Corporate Social Responsibility considerations more than by commercial imperatives, and are therefore limited in size.

4.3.5. Discussion

Despite the small sample size of the people interviewed, it is possible to draw preliminary conclusions. There is a consensus around the fact that multi-peril crop insurance cannot exist without direct public support. Reinsurers also rely on governments to improve market transparency and expect them to implement consistent and predictable policies. The question whether governments should bear part of the risk themselves is debated and there is no consensus of what this role should exactly be. Another area of discussion lies in the perspectives for the market. Is index insurance likely to disrupt agricultural insurance practices? Are smallholder farmers a viable business opportunity for the future? As the research intends to work on the business model and the public-private partnerships in agricultural insurance, the interviews allowed to clarify where there is a consensus among practitioners, and what issues are still in debate.

5. Problem statement

From the observations made in the four previous paragraphs, it is possible to conclude that agricultural insurance cannot develop beyond a nascent stage on a purely market-based functioning. The nature of agricultural risks prevents the development of an efficient agricultural insurance market without public intervention, though some recent innovations bear the potential to improve agricultural insurance affordability.

5.1. Research hypotheses

The current thesis will review the rationale and modalities of public intervention in agricultural insurance markets. Afterwards, it will test three research hypotheses addressing issues related to the agricultural insurance business model and public policy choices. Those hypotheses examine challenges that are affecting the development of large, efficient and inclusive agricultural insurance markets.

Policy-makers have various instruments available to reduce farmers' vulnerability and income volatility. In some cases, those instruments can undermine each other. It is the case between disaster assistance funds, providing relief to farmers suffering production losses, which

compete with agricultural insurance. The first hypothesis will analyze whether supporting agricultural insurance through the provision of premium subsidies can be a substitute to a disaster fund (H1).

Smallholder farmers living in developing economies usually have no access to agricultural insurance markets. There is simply no offer, or the insurance contracts are not properly designed to address their specific constraints. Working with smallholder farmers in low-income environments requires more changes than just offering the same services at a lower-scale or a lower price. It is essential to reengineer products and processes in order to satisfy the needs of this particular segment. This is the subject of the second hypothesis (H2).

Financial services providers can play a role in the distribution of insurance policies. Credit and insurance complement each other and there are efficiency gains in offering both services together. In low-income environments, microfinance institutions (MFIs) have established trusted relationships with the targeted clients. However, MFIs will only get involved in the distribution of insurance if there is a business case. This is what the third research hypothesis will analyze (H3).

The three research hypotheses formulated are listed and detailed below.

(H1) For governments willing to reduce farmers' income volatility, agricultural insurance can be a substitute to disaster assistance programs.

Adopting the policy-makers' perspective, the thesis will investigate whether an agricultural insurance product can meet its objective to reduce farmers' income volatility. Then it will analyze the implications of switching from one instrument to the other, considering the impact on public expenditures as well as qualitative criteria.

(H2) Offering agricultural insurance to smallholder farmers requires a specific design of product features and business operations.

This hypothesis implies that it is not possible to do "business-as-usual" at a lower scale when working with smallholder farmers. To test this hypothesis, the thesis mobilizes different theoretical frameworks to assess the client value of agricultural insurance. These theoretical frameworks are used to analyze different dimensions of the client experience, such as the risk coverage, the distribution model, the premium collection, the enrolment and claim processes.

(H3) There is a business case for microfinance institutions to offer insurance to their clients

In order to test this hypothesis, the research will examine the reasons that could support MFIs' involvement in the insurance business. It will also review the risks and challenges it poses to MFIs, in order to see under which conditions the business case holds.

5.2. Data and case studies

Each research hypothesis is going to be tested in two case studies and one survey.

(C1): Drought risk for grasslands in France

The research hypothesis H1 is tested on the case of grassland insurance in France. A disaster fund is currently running in France to indemnify cattle breeders when grasslands produce animal feed below a certain threshold. A commercial index insurance product was launched in the market in 2016 to protect farmers against the very same risk. The analysis will use two types of data to compare the two risk management instruments. First, it presents the disaster fund payouts related to grassland production losses over the period 2003-2015. This data was obtained from the French Ministry of Agriculture. Second, the research uses the forage production index that serves as a reference for the commercial insurance product. The company Airbus Defense and Space produces this index, and the index was made available by Pacifica, the insurer commercializing the grasslands insurance product.

(C2): Agricultural insurance for smallholder farmers in Kenya

The second research hypothesis is tested on a case study of the Agricultural Climate Risk Enterprise Ltd (ACRE) in Kenya. The company offers three crop insurance products and one livestock insurance product. A field research was conducted, with interviews of different stakeholders and an analysis of the company's documentation. This research allowed collecting descriptive data of the insurance contracts features, as well as of the business processes and operations.

(S3) Survey of 36 MFIs in Africa and Asia

The third research hypothesis (H3) is tested thanks to an online survey directed towards MFIs in the portfolio of the Grameen Crédit Agricole Foundation, a social investor. An invitation to fill the survey was sent to all the 58 MFIs who were in the Foundation's portfolio in September 2017, and 36 filled it. The answers provided by the respondents was completed by financial and operational data on these MFIs collected and analyzed by the Grameen Crédit Agricole

Foundation itself. This survey allows understanding better how MFIs perceive insurance, what are the expected benefits and challenges of distributing insurance policies to their clients.

6. Conclusion

Agricultural risks are ill suited for the development of insurance products, mostly due to their covariant nature. The development of agricultural insurance markets around the world has been uneven, and somehow correlated with the level of government support. Smallholder farmers in developing countries remain in their vast majority excluded from agricultural insurance markets. However, technological innovations and new approaches such as index insurance are pushing the boundaries of insurability. The three research hypotheses will be tested in different types of economies and study some of the main challenges hindering the development of agricultural insurance markets. They should also provide insights for both insurance professionals and policy-makers on opportunities and strategies to relieve these barriers and extend coverage to a larger number of farmers.

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CHAPTER 2

FROM SUBSIDIES TO PUBLIC-PRIVATE PARTNERSHIPS: PUBLIC INTERVENTIONS IN THE AGRICULTURAL INSURANCE MARKET

From subsidies to public-private partnerships: public interventions in the agricultural insurance market

1. Context

Mahul and Stutley (2010) conducted a review of agricultural insurance programs around the world for the World Bank. They find that in 2007, 104 countries in the world were offering some kind of crop or livestock insurance. The authors surveyed more specifically 65 agricultural insurance programs, in high income, middle-income and low-income countries. 38 out of these 65 countries (58%) subsidize premiums. Premium subsidies are the most common form of subsidization of agricultural insurance, but governments can also provide public reinsurance subsidies, subsidies on administrative and operational costs, and loss adjustment subsidies. The total global cost for governments reached around \$10 billion, for a total gross premium of \$15.1 billion. Since then, the figures are likely to have risen up: emerging countries like China and India have significantly expanded their agricultural insurance programs, while at the same time many low and middle-income countries have launched pilots. Hazell et. al (2017) estimate that the United States, China and India are altogether collecting \$17.7 billion per year in agricultural insurance premiums.

As governments globally are dedicating increasing amounts of public resources to support the development of agricultural insurance markets, it is worthwhile to discuss the relevance of this policy trend. There is a strong corpus of academic literature analyzing market failures in agricultural insurance and the motives and means of governments to intervene to address these. Another source of literature is made of the reports published either by international organizations or by insurers and reinsurers. These documents provide information on the actual state of the market globally, its trends and figures. They also give qualitative insights on the challenges hindering the growth of the agricultural insurance market. Therefore, as a preliminary work regarding the three research hypotheses presented in chapter 1, it appears relevant to undertake a systematic literature review on the question of public policies in agricultural insurance. Many of the questions raised by the research work have already been addressed by scholars as well as practitioners. This literature review will aim at making a selection and a synthesis of the state of the knowledge in the field, qualify these findings and identify gaps where further research is needed.

This chapter will first present the methodology adopted for the literature review. It will then present the main findings on three main topics: it will question the rationale behind the use of public money to subsidize agricultural insurance; it will also examine whether there is a possibility to increase the efficiency of subsidies; finally, it will look at other forms of public intervention that can support the development of agricultural insurance. Finally, we will discuss these findings and put them in perspective with the doctoral work and the research hypotheses that are going to be developed in the further chapters.

2. Literature review methodology

2.1. Research objectives

The main objective of the literature review is to determine the relevant instruments for public policies regarding agricultural insurance.

The specific objectives of the literature review are to answer three questions: why should governments subsidize agricultural insurance; are premium subsidies an efficient instrument; what are the other instruments available to policy-makers to support agricultural insurance market development.

2.2. Data

The approach adopted is a systematic literature review. It compiles documents from academic literature as well as from the grey literature. The articles, reports and other documents included in this literature have been found using two search engines specialized for academic work: Google Scholar and Science Direct. These databases were chosen because they cover a broad range of journals. Even if these databases provide mostly academic sources, Google Scholar also identifies documents from the grey literature. Grey literature was also identified by inquiries on the general Google search engine.

The research of sources through search engines relied on the following keywords:

- “public-private partnerships” AND “agricultural insurance”
- “public policy” AND “agricultural insurance”
- “government” AND “agricultural insurance”
- “market failures” AND “agricultural insurance”
- “subsidies” AND “agricultural insurance”

The keywords were entered in English and in French, sources in the two languages have been included in the literature review.

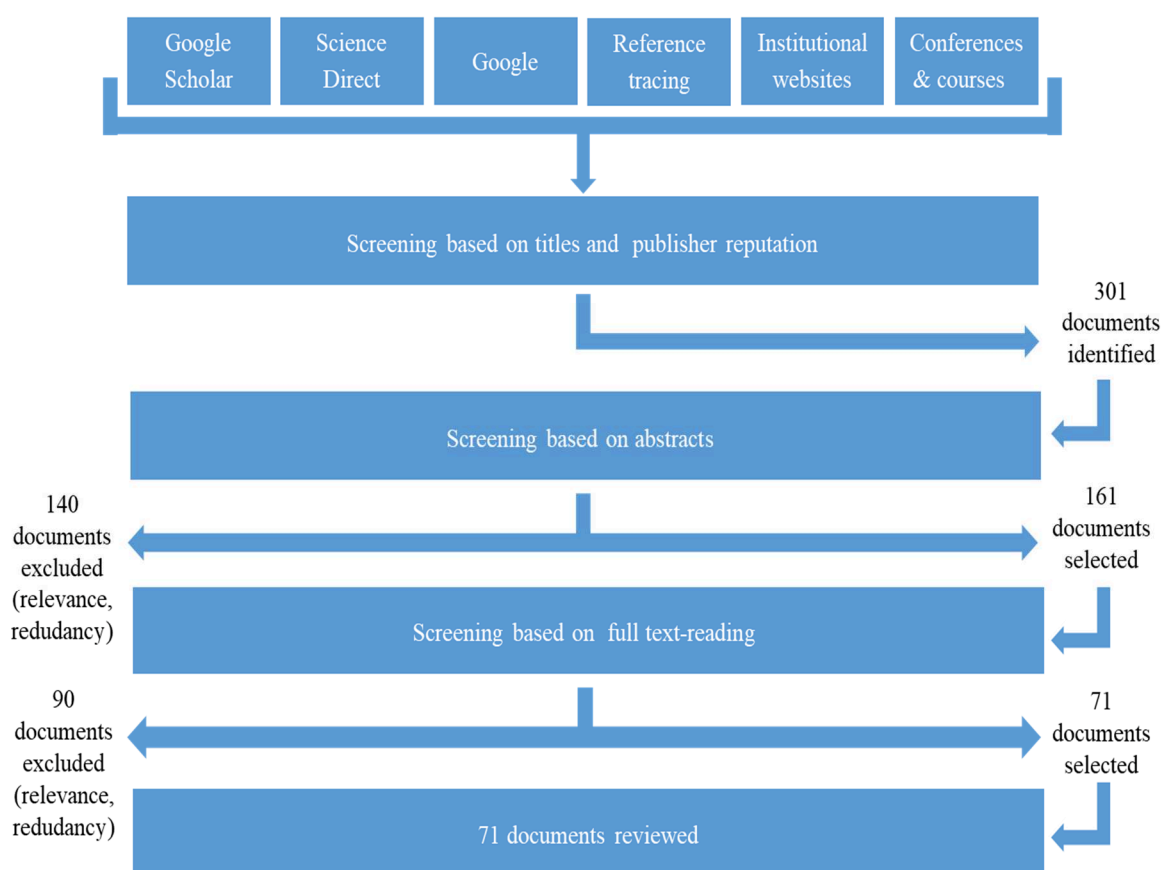
Reference tracing led to the identification of relevant sources, beyond those initial keywords. The literature review also identified sources by browsing the websites of specialized institutions: the Index Insurance Forum, managed by The Global Index Insurance Facility of the World, and the Impact Insurance Facility hosted within the International Labour Organization. The researcher also mobilized publications that he had identified in prior work and prior studies. He attended several conferences and seminars (in presence or online) that participated in enriching the corpus for the literature review. In particular, the researcher was rapporteur at the International Microinsurance Conference in Casablanca in 2015 ([Qureshi & Reinhard, 2016](#)). The data collection took place between 2015 and 2018, and include documents published between 1973 and 2018.

Regarding the selection of documents, sources from the grey literature were included only when they were published after 2010, in order to capture the most recent knowledge and reflect the latest developments of the market. On the contrary, no time limit was set for academic sources, as long as they were relevant. In particular, market failures affecting catastrophic and agricultural risks markets have been thoroughly studied and analyzed from the 1970s to the 1990s, and more recent academic work often keeps referring to these fundamental sources. In order to ensure a form of quality control, documents considered in the literature review are articles from peer-reviewed journals, books or individual book chapters, articles and reports published by reputable authors and/or institutions. The relevance of identified sources was assessed at several stages, applying filters: at each step, some documents are discarded and shortlisted documents are upgraded to the next step, for a further analysis and so on. The process went on as follows (see below Figure 6 : Flow chart of literature search and selection):

- 1) Selection based on the title: 301 documents shortlisted for the next step
- 2) Screening based on the abstracts: 161 documents for the next step
- 3) Screening based on full text reading: 71 documents comply with the relevance and quality criteria regarding the three questions asked for the literature review.

Documents were excluded along the different screening steps either because the focus of the article was not directly addressing the research questions for the literature review, or because they were redundant (several versions of the same article for example, or document not bringing any new relevant idea from prior documents).

Figure 6 : Flow chart of literature search and selection



3. Literature review: findings

The systematic literature review included 71 documents (see Figure 6 : Flow chart of literature search and selection). The documents were grouped per theme, each document addressing one, two or three research questions. The results for each research question are presented below.

3.1. Why should governments subsidize agricultural insurance?

Arguments in favor of public intervention usually fall into two categories. On the one hand, governments can use economic arguments like market failures, and the existence of externalities to justify public support for agricultural insurance. The second category relates to the pursuit of political and social goals. Premium subsidies can sometimes be seen as more efficient or more politically acceptable than other instruments to implement public policies.

Whatever the rationale behind the use of subsidies, policies in favor of agricultural insurance intend to increase the level of protection of farmers against natural risks, and boost the demand for agricultural insurance.

3.1.1. To address market failures and externalities

Informational asymmetries

Any insurance contract faces the problems of adverse selection and moral hazard. Adverse selection is the result of the imperfect correlation between the observable characteristics of agents and their risk exposure (Mahul, 1998). An insurance company will calculate premium rates according to the average population. This pricing leads the riskiest farmers to purchase more insurance, increasing the exposure of the insurer's portfolio. To maintain the equilibrium, the insurer increases premiums, pushing out the less exposed farmers, and increasing further the level of risk for the insurer. Eventually, premiums will be so high that no consumer is willing to buy insurance. Making insurance compulsory can be a way to overcome adverse selection, but it can be difficult to implement. In India, strong incentives to purchase insurance, like the possibility to obtain a credit at a concessional rate, coupled with premium subsidies, have increased the penetration of crop insurance and made possible the creation of a large pool of risks. Nevertheless, there is strong evidence that the National Agricultural Insurance Scheme was plagued with adverse selection (Mahul et al., 2012) before it was drastically reformed.

Moral hazard is also a consequence of informational asymmetries. Insured farmers can modify their farming practices and take more risk. Ramswami (1993) shows that the introduction of insurance can lead farmers to reduce their use of preventive measures (such as pesticides). The presence of a deductible can mitigate this effect though (Sundt, 1999).

Adverse selection and moral hazard are related to the difficulty faced by insurers to accurately classify risk and monitor farmers' behavior, especially when data is scarce and not qualitative. Informational asymmetries can result in high, and potentially prohibitive, premium rates, which prevents the creation of a private agricultural insurance market. Index insurance can overcome information adverse selection and moral hazard as it relies on an exogenous variable.

Systemic risks

Another market failure identified in the literature is the existence of systemic risk. Insurance markets function well for uncorrelated risks. For highly correlated risks, like price volatility, derivatives markets offer hedging possibilities. But as Skees and Barnett (1999) put it, natural risks are "in-between" risks, for which traditional insurance markets nor financial markets offer satisfying solutions.

A farmer's individual risk can be broken down into a specific risk (sometimes referred to as "idiosyncratic risk") and a systematic risk (Mahul, 1998). The first one has to do with farming practices, or localized events like hail. This first component is independent among farmers so insurers can efficiently pool these risks. Systematic risk affects a large number of farmers at the same time. It is the consequence of events like climatic shocks or a widespread disease. Such events affect an entire region, and are the reasons for the high spatial correlation of yields among farmers. In this case, risk pooling does not work efficiently. Systemic risk can jeopardize the solvency of insurance companies. Insurers need to make large reserves in order to cope with such risks. The cost of mobilizing capital to build such reserves often deters private insurers and investors to engage in agricultural insurance.

For Miranda & Glauber (1997), systemic risk, and not information asymmetries, is the real market failure for crop insurance. This finding has policy implications: in the presence of information asymmetries, private insurance will never be viable. However, if systemic risk is the problem, access to affordable reinsurance can enable a viable crop insurance market. Indeed, the systematic nature of a risk is linked to the size of the pool for diversification. A drought can be systematic at the country level, but insurable at a global scale. As they are supra-national actors, reinsurers can mutualize risks at a much larger scale than national insurers. Reinsurers diversify risks among different geographies and different business lines. Reinsurance protects the solvency of national insurance companies when these face exceptional losses. However, reinsurers bear high transaction costs that limit their efficiency (Mahul, 1998). Furthermore, even if several authors have proposed pricing models based on the separation between systemic and non-systemic risks (Chantarot et al., 2013; Mahul, 2001; Miranda, 1991), the current practice remains to transfer risks indiscriminately in one bulk (Collin, 2018).

Some authors dispute the existence of a market failure. For Jaffee & Russel (2006), the public sector should not be a substitute to the private sector, private markets are in capacity to cover catastrophe risks. For the authors, as loss modeling improves, there is no actuarial impediment for a purely private catastrophe insurance, as long as insurance companies have access to efficient capital markets. For Priest (1996), the State has no competitive advantage compared to the private sector in any of the three risk reduction functions of insurance: risk aggregation, risk segregation and control of moral hazard. He actually argues that the existence of governmental insurance or the potential of governmental relief is crowding-out private insurers. In the case where governments decide to maintain insurance subsidies or publicly-funded disaster assistance programs, Jaffee and Russel (2006) support the idea that the government should use

the market as a model for public intervention, adopt actuarial principles and encourage private insurers to participate.

Externalities

Goods and services produce externalities when the benefits they bring to society (positive externalities) or the costs (negative externalities) are not reflected in the market price. Individuals do not factor these effects in their purchasing decision. In the case of insurance, the global welfare of society increases when individuals purchase insurance (R. Vargas Hill et al., 2014). This effect is well-known for health insurance, as insured individuals are more likely to seek treatment rapidly, which will limit the spread of infectious diseases. In the case of agricultural insurance, it has been demonstrated that when individuals buy insurance, others learn about it. In China, Cai et al. (2011) show that receiving an insurance brings an informational externality, and increases take-up in the next period, as members of the community learn from seeing others' experience. Another positive externality brought by insurance lies in the fact that insured households are less burdensome for society when they experience a shock. Households losing everything after a catastrophe pose a liability to society (Cummins & Mahul, 2009). This is why property insurance is compulsory in some countries, like Turkey or the United States (R. Vargas Hill et al., 2014). It also holds true for agriculture: if farmers lose the entirety of their crop after a shock, governments will be compelled to provide some kind of relief.

Just like households, private companies do not factor externalities in their investments decisions. For example, an insurer investment in improving clients' knowledge of insurance may increase demand, but the returns of the investment will be public and benefit competitors as well. Furthermore, the impact of these trainings on insurance demand is uncertain, with some studies showing a positive impact (Cai et al., 2011; Ruth Vargas Hill et al., 2013), while others show no or moderate increase in take-up (Dercon et al., 2011). Therefore, in the absence of subsidy, there is little incentive to invest in insurance literacy, despite positive externalities.

3.1.2. To pursue political and social goals

If market failures in agricultural insurance markets are well documented, governments find other arguments to subsidize insurance. Subsidies are an instrument available for governments to pursue social and political goals.

Insurance as a substitute for disaster assistance programs and safety nets

When their citizens are affected by catastrophic events, governments are compelled to provide assistance to the population. In some cases, governments dedicate a part of their yearly budget to build reserves in disaster relief funds. These reserves require a strict discipline to be maintained: with scarce fiscal resources and many pressing needs, the temptation to use these funds for other purposes is great. In case of large-scale losses, the capacity of disaster funds are rapidly exhausted and governments must rely on international humanitarian appeals to fund the humanitarian response. It is also well-known that external shocks can push vulnerable households into a poverty trap (Barnett et al., 2008), with effects on poverty being observable several after the shock occurs.

Insurance reduces the need for emergency relief as affected farmers receive a payout that compensate at least part of the loss. It reduces the volatility of farm income and prevents farming households from falling into poverty after an external shock. From a public finance perspective, the cost of insurance subsidies is also more stable and predictable than disaster relief costs. It is also established that the quicker the humanitarian response is brought, the better the recovery for the affected population and the cheaper the cost of the response is (Dercon et al., 2005). Insurance also allows a more timely response (Hazell et al., 2010), without the need to go through a lengthy humanitarian appeal process.

Overall, governments can use insurance as a substitute to disaster assistance programs, allowing them to better plan public expenditures and be more cost-effective.

Insurance as a tool for the development of agriculture

Governments can decide to use premium subsidies to support the agricultural sector and food production. In many middle and high-income countries, insurance serve to support farm income (Hazell et al., 2017). This is the case when the annual insurance payout exceeds the unsubsidized part of the premium.

Governments also often explicitly use insurance as a tool to increase access to unlock access to credit for farmers (Meyer et al., 2017). Indeed, one of the reasons why financial institutions are reluctant to lend to farmers is the existence of production risk. By allowing lenders to absorb large covariate shocks, insurance should give the capacity to help financial institutions grow their agricultural loan portfolio for larger amounts and a larger number of farmers. However, there is no evidence that subsidized insurance has modified lending practices ex-ante (larger volumes, broader outreach, cheaper rates or longer maturities), nor that it has protected lending portfolios ex-post (Hazell et al., 2017).

There is ample evidence though that insurance has an impact on farmers' behavior. Randomized control trials have shown that insured farmers in Ghana increased farm expenditures, cultivated land and use of fertilizers (D. Karlan et al., 2014). In India, farmers who were offered weather-based index insurance adopted higher-yield seeds (Cole et al., 2017; Mobarak & Rosenzweig, 2013). Indeed, investment decisions are affected by the exposure to climate risk. Even if climatic risk is not the one with the bigger impact on farm profitability, it is the most difficult risk to diversify, and as a consequence the one with the more influence on consumption and investment decisions (Rosenzweig & Binswanger, 1993). This mechanism strengthens inequalities, as the most vulnerable and poorest farmers are the ones most likely to adopt low-risk low-productivity strategies. A better access to risk-coping mechanisms such as insurance is likely to modify farmers' investments, to increase the profitability of their investments while reducing income inequalities. Carter et al. (2016) developed a theoretical model to assess under which conditions index insurance can boost the adoption of new agricultural technologies. They show that index insurance is the most relevant when risk is high, highly covariant, and collateral requirements are high. In low collateral environments, the lender carries a substantial part of the risk. Index insurance will be effective if it is linked with the credit, as insurance reduces the risk rationing practiced by financial institutions and increases the volume of credit available to farmers.

Promoting inclusive insurance

Despite being particularly vulnerable, poor rural households are often excluded from agricultural insurance. Subsidizing premiums is a common mechanism to increase the participation of low-income households in insurance markets and promote equity in insurance coverage (R. Vargas Hill et al., 2014).

Research has shown that when insurance is subsidized, demand increases. Several studies attempted to estimate the price elasticity of agricultural insurance, through the randomization of premium subsidies. Price-elasticity of agricultural insurance was estimated at 0.94 in China (Cai et al., 2011), meaning that the demand for insurance falls by 0.94 percent when the price increases by 1 percent. Other studies estimated price-elasticity in India (Cole et al., 2013; Ruth Vargas Hill et al., 2013), Ghana (D. S. Karlan et al., 2012) and Ethiopia (Berhane et al., 2012) for values comprised between 0.55 and 0.99.

One difficulty when using premium subsidies to increase insurance access for low-income households is to make sure that the subsidies reach the intended target. Evidence shows that

insurance take-up is positively correlated with wealth (Eling et al., 2014), so it is likely that richer households will reap more benefit from this policy. For an efficient use of public resources, policy-makers must primarily identify precisely who the target population and design appropriate targeting mechanisms to ensure that the subsidies meet their purpose.

3.2. Are subsidies efficient?

There are different theoretical and empirical arguments to justify the existence of subsidies for agricultural insurance. In the absence of subsidies, market failures are precluding the formation of private agricultural insurance markets. Many policy-makers around the world are supporting agricultural insurance, whether it is to protect farmers' income, reduce their vulnerability or foster agricultural development. Even when governments recognize the relevance of agricultural insurance, they should ask if premium subsidies are the better use of public money, and if there are ways to increase their efficiency.

3.2.1. Defining smart subsidies

The notion of “smart subsidies” first appeared in the microfinance industry. Indeed, the microfinance promise was based on the idea that it could lift millions of people out of poverty while being profitable, or at least self-sufficient. Subsidies proved to be essential for many microfinance actors though, at least in the first years of operation. The question for many donors and governments was to define the appropriate level of subsidization.

For Jonathan Morduch (2005), “smart subsidies maximize social benefits while minimizing distortions and mistargeting”. This definition, introduced initially for the microfinance industry, can find many other applications, including for agricultural insurance.

R. Vargas Hill et al. (2014) propose some key principles for smart subsidies in inclusive insurance:

- (i) Clear objective: subsidies should address an identified market failure or pursue a clear social goal
- (ii) Transparent: rules of eligibility must be clearly stated.
- (iii) Targeted: subsidies should reach those in need in priority. For example the HARITA/R4 project in Ethiopia relied on the existing national safety net program to identify beneficiaries (R. Vargas Hill et al., 2014).

- (iv) Monitoring and evaluation: it is essential to define indicators of success and put in place a proper monitoring system in order to review the efficiency of subsidies.
- (v) Exit-strategy or long-term financing: once in place, subsidies are difficult to withdraw. Subsidies must have a clear exit-strategy or long-term financing before their introduction.
- (vi) Costs-contained: the fiscal burden of subsidies must be anticipated and controlled.

Subsidies will influence farming practices, so policy-makers should examine what incentives do premium subsidies give. By reducing the consequences of production losses, premium subsidies may encourage the cultivation of crops in areas where they would not be viable otherwise. Agricultural insurance programs can also have ambiguous effects on the environment. Some may be positive, as through moral hazard effects, insured farmers tend to reduce the use of agricultural chemicals (Babcock & Hennessy, 1996; V. H. Smith & Goodwin, 1996), resulting in less land and water pollution. However, some authors also showed that subsidized insurance programs have increased soil erosion (V. H. Smith & Goodwin, 2003) and encouraged the expansion of cultivation on environmentally sensitive land (Goodwin et al., 2004). These results outline the importance of designing subsidies with the right incentives.

Carter et al. (2014) looked at the specificity of index insurance. The quality of an index insurance contract is hard to assess for consumers. On top of that, unlike other insurance products, index insurance payouts are not frequent, limiting the possibilities of learning from others' experience. Therefore, governments and donors can decide to subsidize insurance "strategically" in order to help build the market. These subsidies pursue two goals: establish a market large enough so that private insurers are able to recover their fixed costs and make a profit; give time to insurers to accumulate data, and to consumers to learn about index insurance contracts. Such subsidies should be time-bound and are not intended to become permanent. Long-term subsidies are also relevant for catastrophic risks, given the social externalities.

3.2.2. Subsidies design

Insurance subsidies can take several forms. The survey conducted by Mahul & Stutley (2010) gives us an overview of the practices in 2008 for 65 countries. Total premiums collected amount to \$15.1 billion, of which 44 percent are covered through premium subsidies, and additional 24 percent in administrative, operational and excess claims subsidies.

63 percent of the studied countries offer some kind of upfront premium subsidy for crop insurance, and 35 percent of them offer universal premium subsidies. These subsidies cover a fixed proportional amount of the insurance premiums for all farmers, crops, and regions. Certain types of contracts (group contracts and multi-year contracts for example) are more heavily subsidized to encourage good risk-management practices. Some countries (11 percent of the sample) will also implement more targeted subsidies for vulnerable or marginalized farmers, specific crops or regions. The survey provides less detail on livestock insurance, though we know premium subsidies are available for 33 percent of the surveyed countries.

Administrative and operational subsidies are also available in some countries (16 percent of the sample). These subsidies are paid directly to insurers and reinsurers. Finally, governments can cover excess claims. In India for example, before reform, the National Agricultural Insurance Scheme (NAIS) was putting a cap on insurance premiums, meaning that premiums were not determined on actuarial principles. Subsidies were essential to cover claims, as insurance was priced below the actuarially fair price.

3.2.3. Evaluating the efficiency of premium subsidies

Subsidies can take different forms, but premium subsidies are the preferential tool of many governments, and the destination of most public funds to support agricultural insurance. Once the objectives and principles of premium subsidies are clearly stated, it is the policy-makers' responsibility to monitor these subsidies and evaluate their efficiency.

The Federal Crop Insurance Program in the United States, the largest crop insurance program in the world, has been extensively studied. Critics point the cost of the subsidies, which have grown constantly since the 1980s without eliminating ad-hoc payments when farmers face large losses (Glauber, 2007). As the US Farm policy shifted from direct payments to premium subsidies, the Federal Crop Insurance program has become a non-efficient way to transfer revenue to farmers (Babcock & Hart, 2015; V. H. Smith & Glauber, 2012). Analyzing three different legislative acts, Smith (2017) even sustains that the successive reforms of the Federal Crop Insurance Program were intended to benefit farmers and the private insurance sector, as a result of implicit and explicit coalition of farm interest groups and crop insurance interest groups. Some authors consider that a better design could improve the efficiency of these subsidies: Babcock and Hart (2015) defend that the cost of subsidies could be reduced by excluding agents' commissions; Skees (1999) proposes the introduction of subsidies in the form

of vouchers that farmers would be free to use in any form of risk management instrument they find relevant.

From a macro-economic perspective, economists have tried to estimate how agricultural insurance subsidies affect society's welfare. Regös (2015) builds the model of a small, developed economy in which agriculture represents a small part of the GDP, and in which prices are determined by international markets. He concludes that premium subsidies do not result in significant change of the economy's performance, but leads to a transfer of revenue from consumers to farmers. This transfer does not significantly affect consumers' welfare though, due to the small weight of agriculture in the economy. This impact is likely to be larger, though still limited, in a developing economy. Gohin (2017) also analyzed the welfare effect of agricultural insurance subsidies, examining the Federal Crop Insurance Program in the United States. The originality of his work is that he builds a dynamic model, taking into account the externalities of insurance on production and investment. He finds that withdrawing federal crop insurance subsidies would lead to a \$1.7 billion welfare loss for the American society. This result does not entirely dismiss the critics made on the Federal Crop Insurance Program, but it shows the importance of integrating spillover effects of premium subsidies when conducting a cost-benefit analysis.

Outside the United States, welfare analyses of premium subsidies programs are scarce. The Japanese (Tsujii, 1986) and Mexican (Bassoco et al., 1986) crop insurance subsidies have been studied in the 1980s, to conclude that net social returns were extremely low relatively to their cost. However, these were evaluation of classical Multi-Peril Crop Insurance programs. Since then, the landscape and design of agricultural insurance around the world has changed dramatically (Hess et al., 2016; Mahul & Stutley, 2010). The World Bank carried an ex-ante evaluation, prior to the introduction of an insurance program in Bangladesh (Quayyum et al., 2018). The report evaluates the fiscal burden for the government: between \$6 million and \$9 million per year, when about 10 percent of the area cultivated in paddy is covered. This amount represents approximately 1 percent of the Ministry of Agriculture's annual budget. The welfare analysis shows a 41 percent increase in crop income if insurance unlocks access to credit and higher-yield varieties. This type of evaluation is very insightful for decision-makers. Unfortunately, we have not been able to find ex-post evaluation premium subsidies besides the ones already mentioned above.

Ideally, policy-makers should not only assess whether subsidizing premiums increase society's welfare, they should also be able to compare subsidies with alternative investments and their respective expected or observed social returns. A team of researchers compared weather-index insurance premium subsidies with other types of public interventions in the Senegalese groundnut basin (RiCome et al., 2017). Coupling a crop growth model and an economic model, and using a weather-index insurance product existing in the market, they find that premium subsidies increase farmers' welfare, but only for those living in the driest areas, as for farmers living in the wetter area, rainfall variations are not their major constraint. Their analysis also finds that, if subsidies increase farmers' utilities, it is much less efficient than other instruments, like subsidizing credit, inputs, or simply transferring the amount of subsidy in cash.

There is now a large body of evidence that agricultural insurance brings benefits farmers and society in general (Bertram-Huemmer & Kraehnert, 2015; Cole et al., 2017, 2017; Mobarak & Rosenzweig, 2012). It also is true that no agricultural insurance programs managed to achieve a large scale without some sort of subsidies, especially premium subsidies (Mahul & Stutley, 2010). Therefore, many governments and donors are willing to finance premium subsidies as a way to increase agricultural insurance penetration and reap its benefits. Nevertheless, such subsidies could be more efficient if they were better designed. Governments may also use these resources in other ways to achieve better outcomes or higher welfare for the society. Evidence is still lacking though to evaluate if subsidizing agricultural insurance premium is the best use of public funds. Premium subsidies tend to be the preferential instruments for governments willing to increase agricultural insurance coverage. However, the role of governments is not limited to premium subsidies, and other mechanisms are available to support the development of agricultural insurance.

3.3. Beyond subsidies: other instruments for public intervention

Many governments subsidize agricultural insurance premiums with the objective to decrease the market price of insurance and increase take-up. Nevertheless, other mechanisms may achieve the same goal. Moreover, price is not the only challenge limiting agricultural insurance penetration. This finding calls for renewed public policies addressing specifically these other challenges.

3.3.1. Risk-sharing arrangements between the public and private sectors

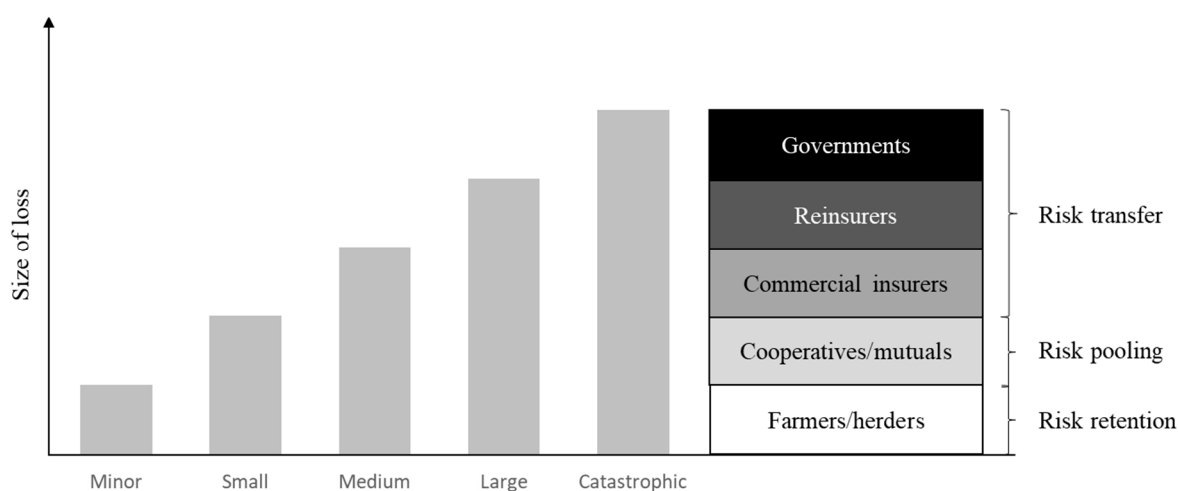
We saw that several authors deny the existence of a market failure for agricultural insurance, as international reinsurance and capital markets are in capacity to absorb large losses (Jaffee & Russell, 2006; Priest, 1996; Skees, 1999). Nevertheless, experience shows that reinsurance is not always available for catastrophic losses. In order to facilitate the supply of agricultural risk coverage, governments may decide to create their own insurance company and bear agricultural risk directly, or create a reinsurance company, with the objective that private insurers will progressively retain more and more risk.

Risk layering in a context of uncertainty

Building a viable agricultural insurance market takes time; insurers need to be confident about their risk exposure. For Carter (M. Carter, 2013), the lack of historical data creates uncertainty on potential losses. Insurers are uncertainty-averse, so they tend to price insurance not according to the average expected losses, but based on worst-case scenarios. These “uncertainty loadings” lead the private sector to charge commercial premiums 50%, 100% or even more above the actuarially fair premium (M. Carter, 2013). In some situations, when data is too sparse, insurers may simply refuse to price insurance contracts.

Therefore, there is a role for the public sector. Governments can be uncertainty-neutral, so a public reinsurance fund could price index insurance according to the average scenario, not the worst-case estimates, as it is typically the case for the private sector. In this public-private partnership, each actor can retain a different level of risk, according to its own capacity. This approach called “risk layering” (Antón, 2009; Carter, 2013; Mahul & Stutley, 2010; Jerry R. Skees & Barnett, 2006) intends to improve cost-efficiency through an optimal combination of technical and financial tools.

Figure 7 – Agricultural risk layering



Source: Mahul&Stutley (2010)

Such an approach can be more efficient from a fiscal point of view than offering premium subsidies, as extreme losses can represent a significant weight in the premium. In order to improve the efficiency of the public-private partnership, Carter, Long and Boucher (Carter, Long, & Boucher, 2011) propose that private and public actors use one single index to evaluate losses. They model an insurance contract based on individual rice yields in Ecuador. The first layer of risk (80% to 100% of the historical average yield) is the “risk-retention” layer. Farming households are able to manage such losses using a variety of traditional risk-coping mechanisms. The second level of risk (50% to 80% of the historical average) is the “commercial risk layer”. This type of event is expected to occur every five years or so. The third layer is the “catastrophic risk layer”, in which governments bear losses below 50% of the historical average yield. With this scheme, farmers benefit from a continuity of coverage, between private and public risk-bearers.

Contingent credit as a complement or substitute to reinsurance

However, many governments in developing countries do not have the capacity to provide reinsurance without depleting their resources. This barrier can be removed if governments can access a contingent credit line. One of the most documented example is the Index-Based Livestock Insurance (IBLI) in Mongolia (DeAngelis, 2013; Lailan, 2011; Mahul & Skees, 2007).

The example of Livestock Insurance in Mongolia

A Base Insurance Product (BIP) covers herders for livestock mortality rates comprised between 7 and 25% or 30% (depending on animal species). Losses are calculated through a livestock mortality index at the local “soum” level. Herders pay a commercial premium rate. The Government of Mongolia covers losses exceeding the commercial layer through a Disaster Response Product (DRP). In order to protect private insurers, a Livestock Insurance Indemnity Pool (LIIP) was created. With the LIIP, herders are protected from the risk of an insurer defaulting, and the livestock losses risk are separated from the insurers’ balance sheets. The Government of Mongolia offers a stop-loss reinsurance contract to the LIIP in exchange of a compulsory reinsurance premium.

In this scheme, private insurers’ liabilities are kept under control. Regarding the Government of Mongolia’s fiscal exposure, it is two-fold: through the DRP, and through the reinsurance agreement with the LIIP. The premiums paid by the LIIP go to a reserve fund. The Government of Mongolia can obtain a contingent loan from the World Bank if the reserve fund is exhausted and/or if DRP payments are due. This elaborate scheme gives clarity to both public and private decision-makers on their own liabilities.

Catastrophe risks to habitat, just like agricultural risks, are hard to insure because of potential extreme losses. In Turkey, earthquake insurance is compulsory for urban property owners and contracts are pooled in the Turkish Catastrophe Insurance Pool (Linnerooth-Bayer & Mechler, 2007). Homeowners’ fees depend on risk-reduction measures. In case a major catastrophe occurs, the TCIP benefits from reinsurance in the form of a very favorable contingent loan provided by the World Bank.

The Mongolian and the Turkish cases illustrate how public-private partnerships can extend beyond private insurers and national governments. International financial institutions, donors and NGOs can also play a role to ensure the success of insurance public-private partnerships (Linnerooth-Bayer & Mechler, 2007).

Potential of securitization of index insurance portfolios

Reinsurance is the most common form of transferring large-scale risks to international markets. However, reinsurance markets are known to be volatile: after a major loss event, premiums tend to increase dramatically (Skees et al., 2008). The first catastrophe-linked bonds (CAT bonds) were issued in the 1990’s as a response to reinsurance markets difficulty to deal with highly-

correlated risks (Mahul, 2001). CAT bonds transfer the risk from reinsurance markets to international capital markets. A CAT bond is a marketable security tied to a catastrophic event. If the event does not occur, investors receive a return. If the event does occur, the investor loses the interest and some-predefined portion of the capital (up to 100 percent). The CAT bond issuer uses the capital raised with the CAT bond to pay claims to policyholders.

Index insurance portfolios can be reinsured through CAT bonds, and such securities are attractive for both issuers and investors, under certain conditions. Collin (Collin, 2018) lists 6 criteria of a fair insurance index, in order to meet the expectations of farmers, insurers and index-bond investors.

Table 3 - Stakeholders' expectations towards a fair insurance index

Index characteristics	Farmers	Insurers	Investors
Quantifiability		X	X
Time consistency		X	X
Availability of historical data		X	X
Adequacy to real losses	X	X	
Transparency and reliability	X	X	X
Timely availability	X	X	X

Source: Collin (2018)

As index-based techniques allow a precise layering of risk, multiple layers can be defined and transferred to a variety of investors with different risk appetites and return expectations, from traditional to socially oriented investors (Skees et al., 2008). Collin (2018) showed that index-linked securities are attractive for investors as they are uncorrelated with capital markets and offer therefore a potential for diversification.

3.3.2. Creating an enabling environment

The public sector can intervene in agricultural insurance markets in a less direct fashion, but still playing an essential role. Efficient agricultural insurance markets require some infrastructure, as well as an adapted regulatory environment.

Governments' provision of public goods

Agricultural insurance, especially when it relies on index-based techniques, need data to function. When it comes to data, agricultural insurance operators face two challenges: availability and quality (*Agricultural Data and Insurance*, 2015). Agricultural insurance data is expensive and non-rivalrous (it can be consumed by many at the same time at no additional

cost). Therefore, data collection tend to be a natural monopoly. It makes no sense that each private insurer collects its own data, or sets-up its own weather stations network. Quality of data is also critical. Index-insurance products must accurately evaluate losses, otherwise farmers are exposed to basis risk. Poor quality products may even put farmers worse-off, and encourage risk-taking behavior without the expected coverage. Quality of data is also key to transfer risk to reinsurers and index-insurance bond investors.

Increasing availability and quality of data has positive spillover effects beyond insurance. Better data allows better decision-making for policy-makers and actors involved in the agricultural sector in general. It can also be argued that not only data, but indexes themselves could be public goods (Sandmark et al., 2013). This would encourage transparency in the market, as ensure that the market offers accurate products as indexes can be audited.

Beyond data, governments have a role to play by encouraging and funding research and development. The development and expansion of mobile phone coverage, satellite imagery, remote-sensing technology, automated-weather stations or big data are disrupting agricultural insurance. Governments can support research and innovation in this field. Governments can also contribute to the development of actuarial and sectorial expertise, through the offer of higher education training, or by setting-up Technical Support Units.

The public sector also has role to play in raising awareness on agricultural insurance. Some studies have shown that financial education can increase insurance take-up (De Bock & Gelade, 2012; Norton et al., 2014). However, private insurers have limited incentives to invest in awareness-raising campaigns, as these investments would also benefit their competitors. As greater financial education and insurance enrollment benefits the whole society, governments can fund insurance awareness-raising programs.

Legal environment

Insurance value being intangible, trust in the system is essential. Insurance regulators around the world define minimal capital requirements for insurance companies to make sure that insurers can face their liabilities. Index insurance raises additional concerns for regulators. As we have seen previously, basis risk poses a real threat to consumers, who might purchase an insurance contract that does not fulfil its promise. Farmers, especially in developing and emerging countries, may have limited knowledge of insurance. Index insurance is a new and complex product, it is essential that they understand well the contract, its limitations and

inherent basis risk. This calls for action from the regulator to protect consumers from unfair practices and false promises.

Following the definition given by Darby and Karni (1973), Clarke and Wren-Lewis (2013) categorize index insurance as a “credence good”. A credence good is a good whose quality is not observable prior to purchase, and at best only partially inferred after purchase. Indeed, index-insurance claims are based on an index, and customers have a poor understanding of these indexes. Secondly, opportunities to learn from others’ experience are limited, because index-insurance provides coverage against infrequent and spatially covariant events. Consequently, private insurers have no incentive to invest in quality indexes, trust in index-insurance contracts is low and insurance take-up remains limited. The regulator has a role to play to reinforce confidence in the system. It can license only the products that meet some minimal quality requirements, or deliver a certification standard, based on commonly accepted basis risk measurements (Carter et al., 2014).

Another legal challenge that is specific of index-insurance lies in the fact that some countries do not allow index-insurance, because claim payments are not determined by actual losses. It is a commonly accepted principle that policyholder must not make a profit from a loss event, meaning that claim payments must not exceed the actual loss. Insurance regulatory frameworks need to be adapted to the specific features of index-insurance loss adjustment techniques. For innovative products using non-traditional techniques, putting in place “sandboxes” where insurers can test their products at a small scale is a way to foster innovation, without losing focus on consumer protection.

Finally, insurance regulators and supervisors must keep in mind that compliance requirements can have a large impact on operational costs and commercial premiums (*Acces to Insurance Initiative*, 2016). In environments where clients have limited access to financial products, regulators need to balance the consumer protection imperative without creating compliance costs that would deter private actors from serving the low-income customers segment (Brix & McKee, 2010).

4. Discussion

4.1. Main results

The main results of the review are summarized in the conclusion of this chapter (Figure 8 – The agricultural insurance policy mix).

The systematic review of the existing literature shows that the failures inherent to the agricultural insurance market have for long been understood and analyzed. Whether the existence of these failures justifies public intervention remains subject to debate among scholars. Governments can also intervene in agricultural insurance markets to pursue political and social goals. Agricultural insurance is then seen as an instrument to complement disaster relief and safety nets, to modernize agriculture or to build a more inclusive economy.

The role of subsidies remains central in agricultural insurance public policies. Whether subsidies are the most efficient and effective instrument in the policy mix has seldom been analyzed though, despite increasing public resources being mobilized. Less frequently, governments have experimented other instruments to support agricultural insurance market development. In several countries, the public sector is bearing part of the risk itself, usually the most extreme layers, through the provision of public reinsurance or contingent credit. There is also a growing interest from financial markets to take on these extreme risks with the development of catastrophic bonds.

Governments can also support market development by supporting an enabling environment. The production of public goods is traditionally a government's prerogative. In the case of agricultural insurance, such public goods include data and infrastructure, knowledge, financial education and awareness-raising. In addition, policy-makers need to implement adequate regulation and supervision, balancing growth and innovation in the market with consumer protection requirements.

4.2. Contribution of the literature review

Among the resources identified and analyzed in this work, Mahul & Stutley (2010) conducted the most comprehensive review of existing agricultural insurance programs around the world. This survey remains the only known example of an attempt to describe government support to agricultural insurance at a global scale, based on quantitative data (including premium amounts, number of producers covered and premium subsidies amounts). There are two main limits to this work though: it relies on self-declared data reported by the insurance authorities of each country; since it was published in 2010, there are many signs that the agricultural insurance landscape has known important evolutions, with growth in emerging countries (Kalra & Xing, 2013) and technological innovations. This literature review takes a different and complementary approach to the work of Mahul and Stutley. Rather than aiming at describing in an exhaustive and quantified way government supports to agricultural insurance globally, the

review seeks to identify the means and rationale of public intervention modalities, and to link these modalities with policy objectives.

A striking characteristic of the documents included in the review is that many articles focus either on theoretical arguments, or take a macro perspective by providing global figures on premium amounts and in some cases number of producers or sums covered. Even when case studies were available, they often provided very limited details on the actual features of the insurance policies available (risks covered, exclusions, pricing, deductibles, payout, or distribution channels). Too often agricultural insurance is considered as a “black box”, without entering into the details of product design. Such qualitative details would bring valuable lessons to compare insurance contracts, understand differences in pricing, coverage or take-up in different markets. The author would also have wished to find more, and more recent evaluations on the viability and economic equilibrium of the public-private partnerships. Since the work of Hazell (1992), little has been done in this direction. A notable exception is Gohin’s work (2017) which proposes a welfare analysis of the United States Federal Crop Insurance Program. The research also failed to identify articles addressing the issue of agricultural insurance public-private partnerships governance. It remains a key issue though as such partnerships should not be considered only under a technical view, but also in perspective with policy objectives. Too often, articles and reports documenting agricultural insurance programs focus on the outreach of such programs and the market size, with little consideration for the dimensions of inclusivity, economic viability and level protection brought to farmers.

4.3. Strengths and limits

To the author’s knowledge, this is the first literature review addressing the question of public interventions in agricultural insurance markets. The mobilization of both academic and grey literature takes stock of the theoretical arguments within the scholars’ debate, with a grounding in the practitioners’ perspective and actual state of the market. The triangulation of several sources indicate that in some areas, a consensus has been reached, in particular on the question of the insurability of agricultural risks. This work also is original in the extent that it encompasses together developed, emerging and developing economies.

A limitation of this review is that it includes a lot of grey literature. This situation illustrates the fact that scientific literature on the question public policies and public-private partnerships in agricultural insurance is scarce, and underlines the relevance of this doctoral work to address this knowledge gap. Some of the reports and case studies included in the review were written

by actors with a direct interest in the agricultural insurance programs they document: donors or policy-makers. These actors are central in this field and are important knowledge producers, but more independent research and evaluation would greatly benefit the sector. Finally, this review is most likely non exhaustive, and other contributions to the debate may have been ignored. However, at the end of the literature search, the review reached a form of saturation as no new concept or theoretical argument arose with the integration of additional sources.

4.4. Perspectives

As mentioned earlier, despite the immense contribution of Mahul and Stutley's work (2010) to document agricultural insurance programs around the world, a lot has happened in this field since the publication of their study. The sector, including both scholars and practitioners, would greatly benefit from an update of this World Bank survey, in order to document the most recent evolutions. Such a comprehensive work would have to be carried by an international organization with sufficient legitimacy, such as the World Bank or another international organization. For the sake of research but also in order to guide policy-makers, the debate on agricultural insurance policies would benefit from more evaluations of these government interventions in support of agricultural insurance. Such evaluations should not be centered only on the issue of insurance take-up and outreach. The analysis of these programs economic viability, and the efficiency of public spending in regard of policy objectives would inform policy-makers on the right policy mix of instruments.

5. Conclusion: the agricultural insurance policy mix

After reviewing public policy instruments, it appears that governments can activate different levers to support agricultural insurance to reach different policy objectives. It is common to present price as the biggest challenge hindering the development of the agricultural insurance market, and the response in most cases has been the provision of premium subsidies. However, this assertion calls for two responses: (i) there are other barriers besides the price that limit the growth of agricultural insurance and (ii) premium subsidies may not be the only, and not always the most efficient instrument to lower agricultural insurance premiums.

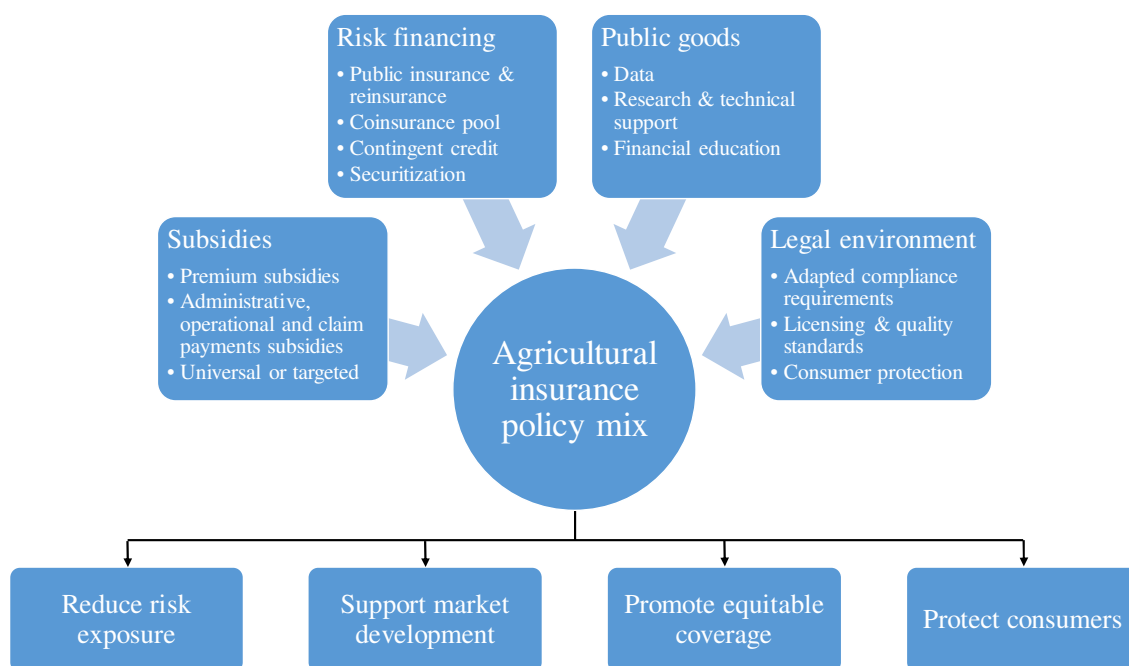
The literature review identified that agricultural insurance policies can pursue four different and complementary objectives:

- (i) increase outreach to reduce the risk-exposure of farmers (and other value chain actors)

- (ii) support the development of viable agricultural insurance markets
- (iii) protect consumers and ensure the quality of products
- (iv) promote equitable coverage for the most vulnerable and marginalized groups

For each of these objectives, different policy instruments are available and many times, several mechanisms must be activated at the same time. Finding the right policy mix assumes a thorough assessment of the challenges of each specific market, and of the ways to address these constraints.

Figure 8 – The agricultural insurance policy mix



Source: author

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CHAPTER 3

FROM CRISIS MANAGEMENT TO RISK MANAGEMENT IN AGRICULTURE: THE CASE OF GRASSLAND INSURANCE IN FRANCE

From crisis management to risk management in agriculture: the case of grassland insurance in France

1. Introduction

Adverse weather events expose farmers to potential economic losses. Governments willing to help managing agricultural risk can mobilize several instruments, which are usually classified into two categories (Antón, 2009) : ex-ante measures are implemented before the event takes place, whereas ex-post response occurs after the event.

In France, agricultural risks have been covered since 1964 by a government-sponsored disaster fund: the Fonds national de gestion des risques en agriculture (FNGRA). Reformed in 2010 (Loi de modernisation de l'agriculture et de la pêche, 2010), the FNGRA pursues 3 main goals: to compensate economic losses related to vegetal or animal diseases, to financially support the development of agricultural insurance, and to indemnify agricultural calamities. It is financed through a tax on insurance premiums paid by the farmers, and an equal contribution taken from the government's budget. In case of an extreme event, the government may decide to allocate an extra funding for the fund. The main shortcoming of this disaster fund, like any ad-hoc disaster response, is that the State lacks visibility on its financial intervention, which depends on the collected taxes and on the total damage. This is why the French Government asked private insurers to create new policies and decided to subsidize premiums, while focusing the FNGRA's compensations on non-insurable crops (Loi de modernisation de l'agriculture et de la pêche, 2010; Ménard, 2004). It has been the case with cereals in 2005 with the birth of the first multi-peril crop insurance in France, and in 2015 with the launch of grassland insurance.

In Europe and in France, the preferred agricultural risk management framework is moving from government-run programmes, providing ex-post assistance in case of an adverse, to insurance public-private partnerships, offering ex-ante solutions (EU, 2013). Is this change interesting for the State? Increasing amounts are invested through Public-private Partnerships (Wettenhall, 2003), and tools to assess their relevance appeared with the new public management wave. Most often these tools reflect investment and delays considerations through the use of indicators such as net present value and internal rate of return (Bonnafous & D'Arcier, 2013). They fit the study of financing, building and operating infrastructures, but are not suited to the insurance sector. Compared to the well documented sectors of healthcare (Torchia et al., 2015), transport, telecommunications or energy, few articles developed criteria and indicators to compare and

assess different compensation systems. For a first global approach between two existing systems, Hazell (1992) uses the cost (claims) to benefit (premium) ratio as indicator of an insurance system soundness. More interestingly in Finland, where the public system is also to be replaced by private insurance, a comparison between actual public intervention and simulated private insurance subsidy is conducted based on the public system data (Liesivaara et al., 2014).

Building on those methods, a comparison process adjusted to the French case is developed. For the period 2003-2015, a model based on biomass production data evaluates the economic loss. This model is used to set the premium for an insurance product guaranteeing a certain amount of grassland production. We present the impact on the government budget for each risk management policy: subsidizing insurance premiums or maintaining a disaster fund. We also assess each policy choice according to several public management criteria. This research provides an original contribution for governments and policy-makers when choosing which agricultural risk management instruments to support.

The chapter is structured as follows. First, it gives the policy context at the global, European and French levels. Section 3 describes the available datasets. Section 4 presents the model and the method applied, and section 5 its results. The final part discusses the interest for the State and the farmers to switch from an ex-post to an ex-ante system.

2. Policy framework

As we examine the risk management policy in France and the alternative between a compensation fund and support to insurance, it is useful to have a look also at the international and European context as it largely shapes the public support allowed and implemented in France.

2.1. The World Trade Organization Agreement on Agriculture

The Agreement on Agriculture (AoA) of the World Trade Organization (WTO), signed in Marrakech in 1994, classifies public aids into three categories: the green box, the blue box and the amber box. The blue box contains aids for goods with a production limitation. The green box contains measures that have “no, or at most minimal, trade-distorting effects or effects on production”, and are therefore exempt from reduction commitments (Annex 2 of the AoA). The amber box gathers all other types of public aids. Aids falling into the amber box are subject to

reduction commitments, unless they comply with the rule of “de minimis”: those are aids not exceeding 5% of agricultural production (10% in developing countries) and are not specific to a production.

The possibility to classify agriculture insurance public aids in the green box is often cited as one of the main reasons why many governments decided to subsidize agricultural insurance premiums in lieu of other support measure (J. W. Glauber, 2015). However, a more detailed look at the AoA requirements shows that most agricultural insurance subsidies do not qualify for the Green Box.

The AoA differentiates income insurance and income safety net programs (paragraph 7) on one hand, crop insurance and disaster assistance (paragraph 8) on the other hand. Income insurance and income safety net programs are classified in the Green Box if the “*income loss exceeds 30 per cent of average gross income or the equivalent in net income terms (...) in the preceding three-year period or a three-year average based on the preceding five-year period, excluding the highest and the lowest entry. The amount of such payments shall compensate for less than 70 per cent of the producer's income loss in the year*”.

For disaster relief and crop insurance, there needs to be a “*formal recognition by government authorities that a natural or like disaster () with a production loss which exceeds 30 per cent of the average of production in the preceding three-year period or a three-year average based on the preceding five-year period, excluding the highest and the lowest entry.*”

The necessity to have a formal recognition by government authorities is not compatible with insurance practice. Moreover, the three- or five-years’ reference for historical yields contradicts actuarial principles, as normally longer time series are preferred. It may actually lead to adverse selection if farmers buy insurance if the three-year average was exceptionally high and they predict a lower yield for the current year, and vice-versa if the historical reference is low, they might be tempted not to buy insurance. In the end, most governments declare agricultural insurance public aids in the Amber Box. However, these supports fall under the “*de minimis*” rule, and therefore are exempt from reduction commitments.

2.2. The European Union and the Common Agricultural Policy

When it was introduced in 1962, the Common Agricultural Policy (CAP) main objective was to maintain high and stable prices for agricultural production within the common market. From

1992, the CAP went through successive reforms in order to increase European Agriculture market orientation. Price support instruments were gradually removed in favor of direct income support for farmers. This evolution is reflected in the CAP expenditure: in 1992, market intervention mechanisms represented over 90% of the CAP budget, against 5% at the end of 1993. Direct payments, 94% of which are decoupled from production, are currently the main instrument of support.

The current CAP is in place for the period 2014-2020. It supports farmers through “Market support measures and direct subsidies” (Pillar 1) and “Rural Development Programmes” (Pillar 2). Risk management instruments were transferred from Pillar 1 to Pillar 2, and are therefore optional measures, which can be co-financed by Member States. They consist of three tools:

- Financial support for insurance premiums
- Mutual insurance funds, owned by the participants, to compensate farmers for production losses
- An income stabilization tool, to compensate severe income losses (30% over three years).

The European Commission regulation and guidelines define a framework for Member States intervention:

- Adverse climatic events can be assimilated to a natural disaster if production loss is above 30% (20% for less favoured areas) (articles 87 and 88; No 70/2001; EC regulation No 1857/2006; guidelines 2007-2013; 2006/C 319/01). Compensation cannot exceed 80% (90% for less favoured areas) of the income loss. The public authorities must formally acknowledge the weather event. Since 2010, the indemnity payment in case of a climatic event has been reduced by half if the farmer does not insure at least 50% of the production against the most frequent climatic risks.
- Financial support to insurance cannot exceed 65% of the premium (Article 70, No 73/2009; Article 37, No 1305/2013).

It appears that the definitions and thresholds adopted by the European Commission have been defined to comply with WTO rules (Bielza et al., 2007). It also seems that insurance is the preferred mechanism for risk management as certain aids are conditioned by the existence of insurance. In a 2005 communication, the European Commission states that “insurance provides an alternative to public ex post compensation payments for losses caused by natural disasters at EU and national or regional level” (EC COM, 2005).

2.3. The French framework

For many years, the risk management policy in France was focused on a disaster fund. The Fonds National de Garantie des Calamités Agricoles was created in 1964, replaced by the Fonds National de Gestion des Risques Agricoles in 2010 (*Loi n° 2010-874 du 27 juillet 2010 de modernisation de l'agriculture et de la pêche*). The FNGRA expenditures are classified into three sections (Direction de l'initiative parlementaire et des délégations, 2016):

- Financing indemnities in case of animal or vegetal disease, or an environmental incident
- Financing premium subsidies
- Indemnifying agricultural calamities

Agricultural calamities are production losses or damages on productive assets resulting from non-insurable risks. They are caused by a climatic event of exceptional magnitude (frost, drought, flood...) and are officially recognized by a ministerial decree.

Following several parliamentary reports (Babusiaux, 2000; Ménard, 2004), the French government decided to subsidize crop insurance premiums, and the first multi-peril crop insurance policies were launched in the market in 2005. Insurance policies are available for most crops and against all major risks. After a year of commercialization, 15% of the agricultural production and 25% of surfaces (excluding grasslands) are covered by insurance (Boyer, 2008). Commercial success was concentrated on cereals, concentrating three quarters of premium subsidies. Cereals traditionally received a small part of the indemnities from the disaster fund, as they are less exposed to risk. Another parliamentary report also notes that the existence of a public disaster fund limits the development of crop insurance (Mortemousque, 2007).

As they became insurable, cereals were excluded from the FNGCA/FNGRA in 2009 and wine in 2011. However, the government maintained other emergency aids, quite often in an uncoordinated and inefficient way (Cour des Comptes, 2012, 2013). It is still unclear whether the transition from a public ex post compensation to an insurance premium subsidies regime is beneficial for the government budget (Cour des Comptes, 2013).

In 2015, ten years after it was introduced in the French market, multi-peril crop insurance is not widely spread among farmers. Multi-peril crop insurance covers 26.8% of planted area for cereals, 23.2% for vine-growing, 15.4% for vegetables and 2.2% for fruits (Lidsky et al., 2017). Lidsky et al. propose two main reasons for this low penetration: the level of premium subsidies

was not constant and perceived as unpredictable, and farmers prefer hail insurance which is cheaper with a lower deductible.

3. Data

Two data sets are used; one is used to measure the cost of the French government's spending related to grassland production shocks over the period 2003-2015, and the other one to create an insurance product covering grassland production.

3.1. Disaster fund data

Data from the disaster fund was obtained directly from the French Ministry of Agriculture. For the period 2003 to 2015, the ministry provided a list of all indemnification decisions related to forage losses, per year and per department (France is divided in 101 departments). The amounts listed do not necessarily correspond to the credits effectively disbursed. Indeed, some affected farmers do not claim the indemnities they are entitled to receive, or in some rare cases, credits can be distributed in excess of the voted budget. As an illustration, we have the data for the period 2009-2012, and over this period, only 77% of the voted budget was actually disbursed to farmers.

Table 4 - Disbursed indemnities over the period by the FNGRA

Year	Disaster fund
2003	390,4
2004	16,2
2005	227,4
2006	138,7
2007	6,3
2008	0
2009	67,4
2010	118,1
2011	254,2
2012	1,5
2013	0
2014	0
2015	166,5
Total	1 386,7

Source: French Ministry of Agriculture

Adding the claims of orders from one year, we obtain the total amount awarded that given year (see Table 1). However, when important shocks occur, the total fund endowment does not cover the total loss. In those cases, additional claims are awarded the following years. On Table 1, the

claims are summed by shock's year rather than settlement year. In 2003 for example, year of severe drought, 332 million euros were awarded, but an extra 58 million of euros was paid during the subsequent years for that precise drought. In the following, we will say that 390 million euros were awarded in 2003. On the contrary, 87 million euros were awarded in 2004, but only 16 million euros regarding damages that effectively happened in 2004. The other part constitutes complementation for past years. In the following, we will say that 16 million euros were awarded in 2004.

3.2. Index data

Grass may be eaten by livestock, harvested twice to three a year, and there are no accounting tracks of its financial value or exact yields. For all those reasons, we consider a policy based on satellite data rather than traditional direct yield assessment. The index used is the Forage Production Index (FPI), derived from the fCover technology. The fCover measures the proportion of ground covered by active vegetation when the scene is observed vertically (Roumiguié et al., 2015). This measurement is based on medium resolution satellite imagery. For each year n , the FPI is the sum of the daily fCover values noted $fCover_i$, with i being the date of the day between February 1 and October 31. From this value, a part of non-productive vegetation (NPf) is subtracted, this last parameter being adjusted according to farming practices in each forage region of France.

$$FPI_n = \sum_{i=Feb\ 1}^{Oct\ 31} (fCover_i - i \times NPf)$$

The FPI allows to measure local grassland production without taking into account individual farmers' practices. The index is available since 2003 at the zip-code scale. Each zip code has one FPI by year, representing the level of biomass produced during the year (from February to October). The higher the value, the higher the production.

Table 5 - Descriptive table of FPI values

FPI	Minimum	Quartile 1	Average	Quartile 3	Maximum	Standard Deviation
2003	0.3	22.7	34.0	43.7	87.9	15.5
2004	12.3	37.7	50.6	63.0	104.6	15.4
2005	0.9	27.9	41.4	56.3	99.0	17.3
2006	5.3	31.4	41.5	51.7	96.1	12.2
2007	13.3	47.0	58.9	71.5	103.3	15.0

2008	8.9	42.0	51.3	59.8	97.1	11.8
2009	6.0	31.5	40.8	50.1	97.7	12.1
2010	1.8	34.0	42.6	50.4	102.3	13.0
2011	0.8	36.9	45.0	55.0	102.4	13.3
2012	2.5	33.7	46.8	61.7	97.5	17.1
2013	9.0	43.8	53.1	62.0	103.4	12.8
2014	0.0	49.0	58.7	69.2	118.9	14.4
2015	7.7	35.4	44.9	54.5	97.2	14.0

Figure 9 - Yearly distribution of FPI values

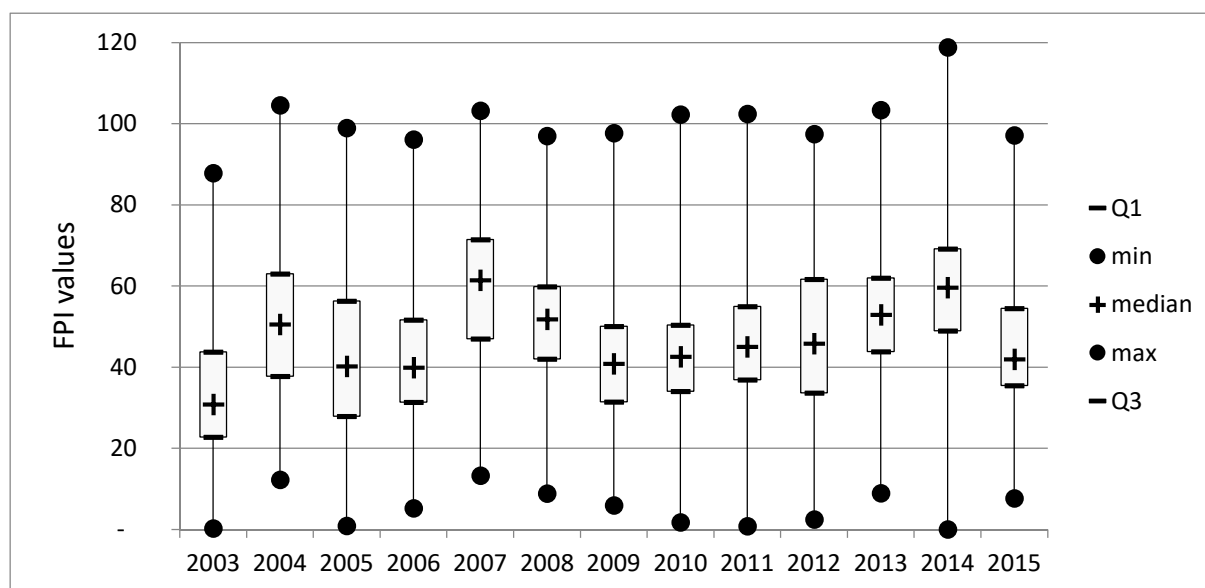


Table 5 shows some descriptive data about FPI. Figure 1 is a graphical presentation of the Table 2 values. The spread between minimal and maximal FPI values is explained by the difference of production from one region to another due to local specificities (e.g. weather or soil properties).

Table 2 and Figure 1 illustrate that 2003 is the year of lowest production for the majority of zip codes, with an average FPI value of 34 for the year. Conversely, 2007 is the year of the best production, with a 58.9 average FPI value, which is consistent with the FNGRA data.

4. Method

The aim is to compare the cost for the State of a public system of disaster relief for grassland production losses versus a private scheme of index insurance. The State is involved in claim settlement in the first case, and in premium subsidy in the second.

To compare the two systems, public and private, the State historical expenses due to FNGRA claim settlement are considered. On the other hand, insurance premium and premium subsidy

are modelled based on the index data introduced in the previous section. First, both systems are compared for the same level of coverage, corresponding to the coverage provided by the FNGRA. Then the private scheme is assessed for various levels of coverage, getting along with the market standards of agricultural insurance in France.

4.1 Private insurance system

The cost of the private scheme for the State is the subsidy amount required to support the insurance product described below. The index being available since 2003, it is possible to simulate the compensations that would have been awarded from 2003 to 2015.

The pure premium of the insurance policy is estimated with the expected value (Young, 2004) of those historical claims. A loading factor accounting for administration costs is added to the pure premium to obtain the commercial premium. The subsidy amount is easily deduced from this result.

The following scheme based on the FPI is considered: claims are triggered whenever the FPI falls below a certain guaranteed level, noted FPI_{gua} . This level is made of two components:

- An insured level FPI_{ins} , which is the Olympic average FPI (average value of the FPI over the last five years, excluding the lowest and highest years)¹
- A loss threshold expressed in percentage and chosen by the insured, which grants eligibility for compensation (in the following, the quantity $trigger = 1 - loss\ threshold$ is considered)

The guaranteed level $FPI_{gua} = FPI_{ins} \times trigger$.

The claim of year n is computed with:

- The Insured FPI, FPI_{ins}
- The FPI of year n , FPI_n
- The deductible or more conveniently $\alpha = 1 - deductible$. The deductible is the threshold of loss before the insurance will make any payment.
- The level of compensation, LoC , is the loss beyond the deductible covered by the insurance policy.
- The insured capital $K = capital\ insured\ by\ hectare * insured\ area$

The deductible, trigger and level of compensation are expressed in proportions, with values between 0 and 1.

¹ In practice, the insured FPI is the FPI's Olympic average. However, the FPI data is available since 2003, so Olympic averages can be calculated only from 2008. For the 2003-2007 period, the insured FPI is the average FPI for the period 2003-2015.

When there is no deductible, $\alpha = 1$

The claim amount C awarded for year n is:

$$\begin{cases} C_n = (\alpha \times FPI_{ins} - FPI_n) \times \frac{1}{FPI_{ins}} \times LoC \times K & \text{if } trigger \times FPI_{ins} - FPI_n > 0 \\ C_n = 0 & \text{if } trigger \times FPI_{ins} - FPI_n \leq 0 \end{cases}$$

When the FPI of the year is above or equal to the guaranteed FPI ($trigger \times FPI_{ins} - FPI_n \leq 0$), the insurance will make no payment ($C_n = 0$). For losses beyond the trigger ($trigger \times FPI_{ins} - FPI_n > 0$), the insurance will make a payment to compensate losses beyond the deductible, and according to the proportion of the level of compensation.

For example, if $loss\ threshold = 0.3$, $trigger = 0.7$. If $FPI_n = 0.8 \times FPI_{ins}$, then $trigger \times FPI_{ins} - FPI_n \leq 0$ and there will be no claim payment.

Now if $FPI_n = 0.6 \times FPI_{ins}$, which corresponds to a 40% loss, the insurance will make a payment. If we consider a level of compensation $LoC = 1$, and a deductible of 0.3 ($\alpha = 0.7$), the claim payment will be equal to:

$$\begin{aligned} C_n &= (\alpha \times FPI_{ins} - FPI_n) \times \frac{1}{FPI_{ins}} \times LoC \times K \\ &= (0.7 \times FPI_{ins} - 0.6 \times FPI_{ins}) \times \frac{1}{FPI_{ins}} \times 1 \times K \\ &= 0.1K \end{aligned}$$

In addition, the commercial premium is:

$$Commercial\ premium = \mathbb{E}(C) \times Loading\ factor$$

4.2 Public disaster relief system

No modeling is done to assess the claim amount, directly taken from the information given by the ministry of agriculture, as described in the “data” part.

The FNGRA indemnifies farmers when losses exceed 30% of the guaranteed production. The FNGRA covers 28% of the losses and no deductible is applied. Using the variables introduced in the 4.2 section above, for the FNGRA we have the following values:

- loss threshold = 30% so trigger = 0.7

- *deductible* = 0, so $\alpha = 1$
- *LoC* = 28

The FNGRA does not insure a value per hectare, but rather guarantees a minimum level of forage production (3000 forage units per dairy cow unit², which corresponds to the average ration of forage consumed by a cow over the year).

5. Results

5.1 Comparison between insurance products and disaster fund, at the same level of guarantees

We first compare a product, “product 1”, offering guarantees similar to the FNGRA scheme:

- loss threshold = 30% so trigger = 0.7
- deductible = 0, so $\alpha = 1$
- *LoC* = 0.28

The amount of capital insured *K* is a major determinant of the compensation received by the farmer in case of a shock. The FNGRA as such does not establish a level of capital insured by hectare, but a minimum forage production.

On the other hand, a pilot project has been implemented in France from 2013 to 2015 by a private insurer, covering grasslands against the risk of drought. For the approximately 200 farmers covered during the first three years of the project, the average capital insured per hectare was of roughly 800€. In this study, several levels of insured capital will be considered. 800€/ha as “close-to-practice” level, 600€/ha as low limit level and 1000€ as high-limit level.

Table 6 - Disbursed indemnities over the period for product 1 and the disaster fund. *K* = 800

Year	Product 1	Disaster fund
2003	572,1	390,4
2004	3,3	16,2
2005	306,1	227,4
2006	58,7	138,7
2007	0,6	6,3
2008	1,2	-
2009	72,0	67,4
2010	151,3	118,1
2011	47,3	254,2
2012	94,8	1,5

² <http://questions.assemblee-nationale.fr/q13/13-112903QE.htm>

2013	2,3	-
2014	2,8	-
2015	86,1	166,5
Total	1398,5	1 386,7

Figure 10 - Comparison of disbursed indemnities over the period between product 1 and the disaster fund. K = 800

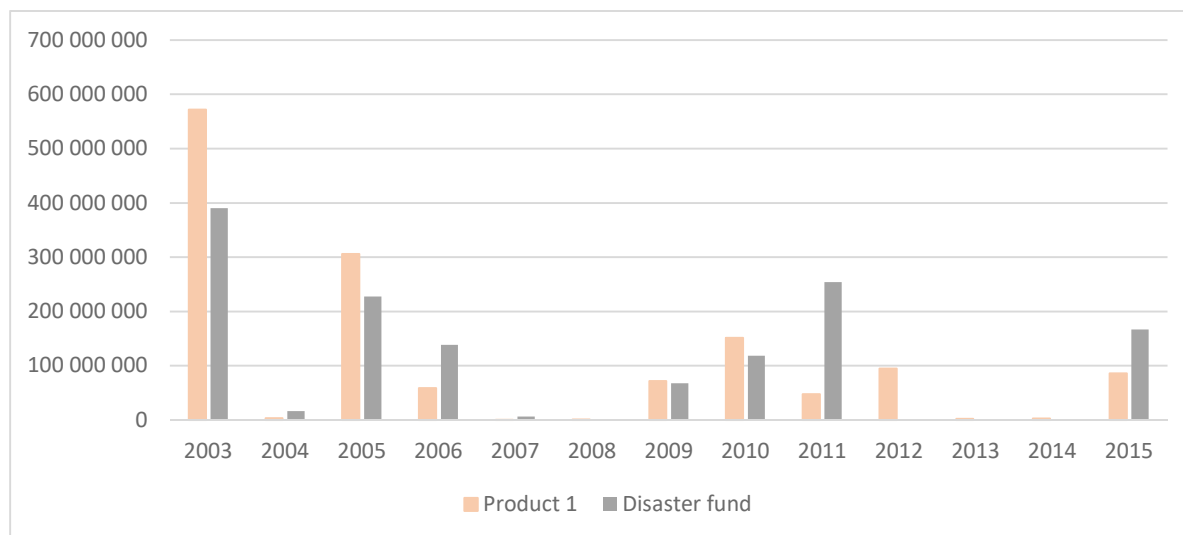


Table 6 presents the amounts disbursed over the period by the insurance product 1 and the disaster fund. Figure 6 is a graphic presentation of Table 6 values. For both coverage instruments, 2003 is the worst year for grassland production, with disbursements of 572 million euros for product 1 and 390.4 million euros for the disaster fund.

Considering a capital insured of 800€ per hectare, between 2003 and 2015, the index-based insurance product distributes 0.9% more in indemnities than the disaster fund. The index identifies major shocks, 2003 and 2005 being the worst years in terms of forage production. The insurance product indemnifies much more the farmers in 2010 (+28.1%) and less in 2011 (-81.4%).

With K =600, then farmers receive 24% less over the period compared with the disaster fund (see table 4, in section 5.2). However, even in this case the index-based insurance still indemnifies farmers more for the years 2003 and 2012.

Lastly, if we raise the capital insured per hectare to 1000€, the total amounts disbursed to farmed over the period reaches approximately 1.75 billion €, a 26% increase compared with the public disaster fund.

If both the FNGRA and the index insurance product seem to identify the major crisis, important differences remain if we examine each year separately. For example, the FNGRA indicates bigger shocks in 2006 and 2011, whereas the index measures medium losses in 2012 that the FNGRA ignores. This discrepancy can be explained by two main factors. First, their levels of reference are different: the index product is based on an average production, per zip code, over the period 2003-2015, while the FNGRA establishes an absolute threshold (3000 forage production units). Second, to claim an FNGRA indemnification, farmers must demonstrate a minimum 13% loss of the gross product of the whole farm. This rule clearly disadvantages diversified farms, in favour of specialized farms. Therefore, a climatic event affecting a region where mixed farming is dominant will result in lower disbursement from the disaster fund than a shock affecting a region characterized by specialized agriculture.

Besides these two factors, the 2011 year illustrates how the switch to index insurance can bring significant changes in the risk coverage of farmers. The 2011 springtime was characterized by a severe drought, which prevented farmers to make the first cut of grass. The disaster recognition intervened in July, earlier than ever before for forage losses³. The 2011 political context should be kept in mind as two major elections (presidential and legislatives) were to take place in May and June 2012. After the spring drought, several rains and a good growth of grass marked the 2011 summer. This is why the index does not measure a catastrophic year, as the grass growth of the summer and autumn compensate the poorly performing spring. Despite this situation, farmers received a compensation based on their situation at the beginning of July.

5.2 Modification of insurance product parameters

The features of the insurance product 1 match the level of guarantee of the national disaster fund but are quite different from the standard in crop insurance market. Indeed, product 1 has no deductible, but compensates losses at a very low level (28%). Therefore, we create another insurance product named “product 2”, for which we modify these parameters to put them in line with the standard practices:

- threshold = 30% so trigger = 0.7
- deductible = 30% so $\alpha = 0.7$
- LoC = 1

³ <http://questions.assemblee-nationale.fr/q13/13-112903QE.htm>

Table 7 - Disbursed indemnities over the period for product 1, product 2, and the disaster fund. K = 800

Year	Product 1	Product 2	Disaster fund
2003	572,1	794,3	390,4
2004	3,3	1,7	16,2
2005	306,1	326,7	227,4
2006	58,7	30,2	138,7
2007	0,6	0,2	6,3
2008	1,2	0,7	-
2009	72,0	48,8	67,4
2010	151,3	143,0	118,1
2011	47,3	42,1	254,2
2012	94,8	90,9	1,5
2013	2,3	1,4	-
2014	2,8	3,7	-
2015	86,1	66,0	166,5
Total	1398,5	1549,7	1 386,7

Figure 11 - Comparison of disbursed indemnities over the period between product 1, product 2 and the disaster fund. K = 800€

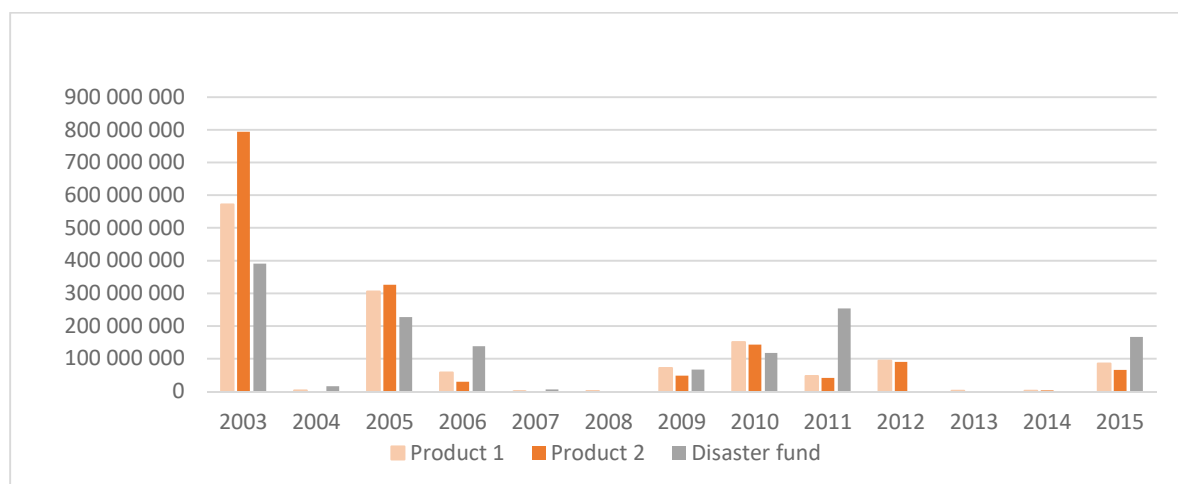


Table 7 presents the amounts disbursed over the period by the insurance product 1, insurance product 2 and the disaster fund. Figure 7 is a graphic presentation of Table 7 values. For all coverage instruments, 2003 is the worst year for grassland production, with disbursements of 572 million euros for product 1, 794 million euros for product 2 and 390 million euros for the disaster fund.

For K= 800, the global amount of indemnifications reaches 1.550 billion euros over the period, which is 12% above the sums distributed by the FNGRA, and 10.8% more than the index-insurance product previously examined (product 1). We can observe that this product

indemnifies more on the years of big shocks (2003,2005,2010) and less the years of low or medium intensity shocks (2004, 2006, 2009, 2011, 2015).

This result is confirmed when calculating the volatility of disbursements for each type of coverage. The standard deviation calculated in million euros is equal to 125.7 for the disaster fund, to 163.5 for the product 1 and to 211.9 for the product 2. It seems that the FNGRA distributes more regularly small amounts but is unable to cope with major disasters, when the insurance products allocate most of their disbursements for major events.

The correlation coefficient between product 1's disbursements and disaster fund's disbursements is $Corr(Product\ 1, Disaster\ Fund) = 0.82$

The correlation coefficient between product 2's disbursements and disaster fund's disbursements is $Corr(Product\ 2, Disaster\ Fund) = 0.80$

These values indicate a significant positive correlation between the disbursements of the two insurance products and the disbursements of the FNGRA.

The total amount of disbursements over the period varies according to the type of coverage (Disaster Fund or insurance) and the capital insured (600, 800 or 1000 euros per hectare).

Table 8 - Total cumulated indemnities in million euros received by the farmers depending on the sum insured

	Disaster Fund	Product 1	Product 2
K= 600	1 387	1 049	1 162
K= 800		1 399	1 550
K = 1000		1 748	1 937

Depending on the sum insured and the parameters of the insurance product, the indemnities received by the farmers vary from 1049 to 1937 million euros between 2003 and 2015, when the disaster fund disburses 1387 over the same period.

5.3 Cost for the State and for the clients

We have seen that it is possible to adjust the parameters of the index-insurance product so it can offer the same guarantees to the farmers as with the disaster fund (product 1). However, in order to assess the cost of the private scheme for the state and for the farmer, it is important to take into account the administration costs, through a premium loading.

In the first years of running an index-insurance, insurers tend to be quite conservative in their pricing. For this analysis, we have considered a target ratio of claim/premium at 0.75. We also compute the risk of model error, given the relative novelty of the product and the fact we only have 14 years of data. This risk of model error is set at 1.1.

Therefore, we can calculate a loading factor of $L = 1/0.75 \times 1.1 = 1.47$

Commercial Premium is then equal to $Pure\ Premium \times L$.

If we insure with product 1 the 10.5 million hectares of France, the yearly premium to insure the whole country is $107.6 \times 1.33 = 157.8$ million €. For product 2, this yearly premium amounts to $119.2 \times 1.47 = 174.8$ million €.

Now, if the insurer adopts a more conservative approach and seeks a ratio indemnities/premium at 0.6, the loading applied is $L = 1.83$. The commercial premium charged for the whole country rises to 197.2 and 218.5 million euro for product 1 and product 2 respectively.

The “loading factor” of the disaster fund is very difficult to assess: administrative costs, borrowing costs on financial markets... These administrative costs are very hard to estimate as they are spread among a variety of administrations and are not monitored separately. For example, how do we estimate the cost of a meeting at the ministry of agriculture attended by various experts and civil servants? Our hypothesis is that the public disaster fund and the private insurer bear the same costs and have the same risk appetite. Therefore, we apply the same loading factors to the FNGRA to calculate what a commercial premium would be. The main difference is that the French farmers contribute only to the resources of the fund, and do not support its administrative costs. In other words, they are not paying the loading factor.

Table 9 - Yearly premium in million euros to cover 10.5 million hectares of pasture

	FNGRA	Product 1	Product 2
Pure premium	107	108	119
Commercial Premium, loading = 1.47	157	158	175
Commercial Premium, loading = 1.83	196	197	219

In France, agricultural insurance premiums can be subsidized up to 65%. This has been the subsidization rate between 2013 and 2015 during the pilot phase of the grassland insurance project. Depending on which product the State is willing to promote and the loading factor

applied by the insurer the total cost for the State varies between 1033 and 142 million euros per year.

Table 10 - Premium cost for the State and for the farmer, depending on the coverage and the loading factor

	FNGRA		Product 1		Product 2	
	Total cost in million €	Cost per hectare in €	Total cost in million €	Cost per hectare in €	Total cost in million €	Cost per hectare in €
Pure premium	107	10,2	108	10,2	119	11,3
<i>incl. cost for the State</i>	54	5,1	70	6,7	77	7,4
<i>incl. cost for the farmer</i>	54	5,1	38	3,6	42	4,0
Commercial Premium, loading = 1.47	157	15	158	15	175	16,7
<i>incl. cost for the State</i>	104	9,9	103	9,8	114	10,8
<i>incl. cost for the farmer</i>	54	5,1	55	5,3	61	5,8
Commercial Premium, loading = 1.83	196	18,6	197	18,8	219	20,9
<i>incl. cost for the State</i>	142	13,6	128	12,2	142	13,6
<i>incl. cost for the farmer</i>	54	5,1	69	6,6	77	7,3

On average, the FNGRA has distributed 107 million euros per year over the period 2003 -2015. This cost is borne by the State, but the FNGRA is partially financed through a tax paid directly by farmers. Therefore, we will consider that the cost of the FNGRA disbursement is borne by farmers at 50%

6. Discussion

6.1 Discussion on the model's assumptions

For the purpose of comparison, we decided to assume that 100% of grasslands would be insured, as the FNGRA covers all the farmers. However, given current crop insurance penetration rates in the French market, this assumption appears quite unrealistic unless other measures are implemented to support agricultural insurance and increase its penetration rate.

The cost of insurance premium subsidies will also depend on the guarantees and the subsidy rate. We have seen that this subsidy rate fluctuated in the past, which is said to have hurt the development of multi-peril crop insurance (Lidsky et al., 2017). On the other hand, the latest evolutions of the European regulatory framework indicate that Member States will have the possibility to increase the subsidy from 65 to 70%, and lower deductible from 30 to 20% (Bachelet, 2017). Member States can use this possibility, but they may decide not to do so. If Member States decide to increase the level of subsidy and lower deductibles, this will automatically lead to increased spending, but how these changes will affect farmers' take-up of insurance is hard to predict.

Finally, to design the insurance scheme (product 1 and product 2), we used data from the period 2003-2015. During this period, the year 2003 was a year of extremely severe drought. We did not give any special weight for this year. The key question here is: was the 2003 drought a 1-in-100-year exceptional event, or just a 1-in-10-year event? The answer to this question will define what is the loss expected by insurer, and the corresponding premium.

6.2 Evaluating the alternative from the State's perspective

When it comes to evaluating public policies, a lot of different frameworks with their own methodology exist (Perret, 2010). However, certain criteria are recurrent. In this case, we will focus on three criteria:

- Effectiveness: does the policy reach its targets?
- Efficiency: is the policy cost-efficient?
- Sustainability: is the policy likely to have a long-term impact?

Two other dimensions are also classically assessed when performing a public policy evaluation but will not be used in our analysis:

- Relevance: Are the policy's objectives covering the different dimensions of the problem it is supposed to address?
- Coherence: Are the means and objectives of the public intervention coherent among themselves and with other public policies?

When comparing a disaster fund with an insurance approach, we do not question the relevance of the public authorities intervening in the management of agricultural risks, but we rather compare different tools available. In addition, the issue of coherence would involve analysing the other forms of public interventions (subsidies, tax exemptions, market interventions, tariffs...) which is out of the scope of this research.

In our analysis, we decided to integrate two additional criteria, transparency and fairness. Indeed, the two public policy options available have different implications for these two dimensions.

Effectiveness

The objective of the public intervention is to reduce the volatility of farmers' income by guaranteeing a minimum yield. Our dataset shows that the insurance fulfils better this objective by matching better the payouts with the loss. First, the use of an index guarantees a fair and transparent loss assessment at the local level, when the disaster fund relies on political decrees taken at the department or sub-department level. Second, the insurers' financial capacities and access to the reinsurance markets allow a larger disbursement capacity in case of a major shock. The 2003 drought depleted the FNGRA's resources, leading to a very low compensation of affected farmers in 2003, and delayed payments in 2004 and 2005. These two dimensions make that insurance's disbursements match better farmer's losses (and cash-flow needs) than the disaster fund.

Efficiency

It is difficult to compare the complete cost of the two tools as the cost of running the FNGRA is not visible and there is no such thing as a "loading factor" as we used it to estimate a commercial premium charged by an insurer. In the different scenarios presented in Table 4, the annual cost for the State to subsidize insurance for all French farmers is estimated between 93 and 124 million euros annually, against a euro 53 million annual average cost for the FNGRA. This assumes a 65% subsidy, and that 100% of the cattle breeders purchase the insurance. The second assumption appears rather unrealistic, while the rate of subsidy can be modified according the government's financial capacity. It should also be noted that Product 2 offers a higher protection to farmers. The impact on the public budget of switching from a disaster fund to insurance therefore depends on the farmer's participation, the subsidy rate and the level of coverage chosen.

Sustainability

The main advantage for the State to switch from ex-post compensation to ex-ante premium subsidies is that the costs are predictable. Insurance premiums are relatively stable over time, and even if there are variations, they are not comparable to the volatility of payouts from the fund. On the other hand, when relying on its own disaster fund, the State is not sure to have the

necessary resources to cope with a major shock. This was the case for the 2003 drought, for which payments were spread over three years as this exceptional event depleted the resources of the fund. An insurer is obliged by the prudential regulation to keep significant reserves. It also has the possibility to get access to the reinsurance market to protect itself from extreme events. Another risk faced by the disaster fund is that the government may choose to draw off from the reserves of the disaster fund in order to balance its budget. This is what happened in France with the 2016 budget⁴, for which 255 million euros were taken from the FNGRA reserves. If the government had chosen to subsidize insurance, it would not have been in capacity to reallocate the budget. The switch from one system to the other would then imply a clarification of the rules and protection offered to farmers, and a stricter commitment from the State.

Transparency and fairness

Though transparency and fairness are not always included in public policies evaluation, it seemed interesting to include them as the choice of one tool or the other has implications for these two dimensions.

An interesting feature for the State is that the forage insurance proposed here is based on an index that is transparent and objective. In particular, the index should not be subject to political pressure. It also operates at the zip-code level, whereas FNGRA indemnities are usually decided at the level of the department, or a sub-area of the department. The FNGRA has been criticized for its lack of objectivity regarding the decisions to give payouts, especially as most of payments followed demands from professional organizations and unions (Cour des Comptes, 2012).

Finally, it has been shown that the disaster fund payments were structurally focused on certain crops and certain regions (Boyer, 2008; Cordier et al., 2008). This means that some farmers are subsidizing others through their contributions to the fund. Subsidized farmers are not paying the real price for the risk they face, which may prevent needed structural evolutions in the farming sector (Mortemousque, 2007).

An important limitation of this reasoning lies in the capacity of the State to “tie its hands”. Indeed, Kydland and Prescott (1977) introduce the concept of “dynamic inconsistency” to explain the fact that States might be unable to implement socially optimal policies because they cannot convince agents that they will keep their promises. This theory finds its application in monetary economy, where a government’s declaration to limit inflation will have no effect as

⁴ <http://www.assemblee-nationale.fr/14/projets/pl3217.asp>

agents anticipate the government may decide to change its policy in order to boost growth and employment. Our situation may look very similar as a government may announce the withdrawal of a disaster fund in favour of an insurance system, but break its promise in case of a major shock because of political pressure, or to limit the scale of the crisis. Therefore, the incentive for farmers to buy insurance is seriously lowered as they anticipate a government's disbursement in case of a major shock. To a certain extent, this has been the case with United States Crop Insurance Program: even if crop insurance subsidies and take-up were increased dramatically in the 1980's and 1990's, the Congress continued to pass disaster bills to indemnify farmers (Glauber, 2007). It is also legitimate to question whether the government's goal is to actually implement socially optimal policies. It is well known since Buchanan and Tullock (1962) and more generally in the Public Choice literature that political decision-making outcomes can conflict with the general public's interest, especially when groups within the society are rent-seeking and successfully advocating their own interests. Farmers might be politically strong enough to influence the risk management policy and increase the government's participation even when it involves maintaining inefficiencies.

6.3 Client value

The academic literature on corporate risk management (CRM) offers studies on the link between corporate value and corporate hedging policies. Most of the studies use arguments that are derived from the financial theory or from the agency theory, and there is no consensus about the fact that risk-hedging creates corporate value. On the one hand, hedging activities create corporate value because they decrease fiscal payments, reduce the cost of financial distress, mitigate the underinvestment risk, or ease the external financing. On the other hand, hedging activities are costly.

When considering the perfect capital market hypothesis, firm's shareholders can manage their risk through diversification. In such a context, enterprise risk management does not bring value to shareholders. Theoretically, hedging systematic risk at the corporate level does not increase the shares value (Dufey and Srinivasulu, 1983). However, a more realistic approach has to take into account capital market imperfections, like agency costs resulting from conflicts between stakeholders, transaction costs related to external financing, or cost related to financial distress or tax scheme convexity. That is why, in the presence of capital market imperfections, corporate risk management can increase firm's value to shareholders. Aretz, Bartram and Dufey (2007) give a clear and comprehensive presentation of the CRM rationales, including:

- the mitigation of the underinvestment problem;
- the reduction of the cost coming from the shareholder tendency to opt for riskier investment projects, facing risk-adverse lenders;
- the reduction of the cost coming from managers who cannot simply diversify away their idiosyncratic risk, contrary to shareholders;
- the design of managers' incentives, in order to reduce the mismatch with the shareholder interest;
- the cost resulting from the mismatch between the firm's investment policy and the firm's financing policy;
- the reduction of the financial distress cost;
- the reduction of the corporate tax burden, resulting from fiscal schedule.

Those rationales for corporate risk management have been subject to empirical investigation: for example, papers by Nance *et al.* (1993), Tufano (1996), Haushalter (2000), or Allayanis and Weston (2001) give evidence for the different theoretical arguments applied to a variety of industries.

The case of farmers and "agri-producers" has been studied by McKinnon (1967), Finger (2012), using the « natural hedge » argument: the negative relationship between yields and prices is relevant to understand the farmer risk management decision making. The opportunity cost of pre-sold futures positions can be challenged by the use of crop insurance, because this last would pay only when the yield drops below a trigger. Following the idea that crop insurance and financial hedging may be partial substitutes, Walters (2015) examines the optimal trade-off between crop insurance, financial hedging, and publicly funded government programs in the US (disaster insurance program under the Farm Bill). The study shows that the choice of a combination between revenue protection crop insurance and agricultural risk coverage increases the expected revenue.

The insurance policy has several advantages not priced here, compared with the fund.

First, the insurance product is based on an index, for which the robustness was valuated during a scientific evaluation. It is not subject to manipulation from the insurer or the State. Therefore, we can argue that farmers may prefer this approach to an approach based on traditional insurance (requiring human expertise of the damage) or on a public approach, for which disbursements depend on a political decision. Farmers may also have more confidence that they will be compensated in proportion to the size of their loss. We have already mentioned that

during exceptional events like the 2003 droughts, the resources of the funds had been exhausted and farmers had to wait the following years to receive the full amount of the disbursements. This fear of the disaster fund's insolvency is strengthened when resources of the funds are diverted for other purposes. Conversely, insurers are constrained by prudential regulations and are therefore required to maintain sufficient reserves to be able to cope with large-scale shocks.

Another important difference between a disaster fund and an index-insurance product lies in the delay for settlement. The public disbursement must follow an official decree of natural catastrophe and evaluations from government experts to estimate the production loss. In case the fund lacks sufficient resources, the payment will be spread over several years. On the opposite, an index-based insurance does not require human expertise; it actually does not require any human decision as soon as the index is available. Payment can be very swift and the farmer's treasury management is improved.

Finally, unlike a disaster fund, an insurance policy is a risk management tool for a farm business. Its costs and payouts are predictable for the farmer. The farmer can also decide and adjust certain features of the policy: capital insured, threshold, deductible... Indeed, farmers have different capacities to cope with a shock, and have therefore different insurance needs. For cattle breeders, it will largely depend on the amount of hay in stock (Mosnier, 2015). With the disaster fund, farmers have no choice but to rely on the coverage features of the fund and especially a level of compensation set at only 28% of the losses.

7. Conclusion

Switching from a public disaster fund to a public-private partnership leads to an increase in public spending, as private insurers apply a loading on the pure premium, unlike the public fund for which the administration and operation cost is invisible in the public accounts. However, the fact this cost is invisible does not mean it does not exist. Moreover, the level of public spending due to premium subsidies depends on farmers' participation, loading factors applied by insurers, but also on the subsidization rate. The article provides a framework for government decision-makers to evaluate policy options according to budgetary considerations and a set of qualitative criteria.

To be effective, such a move would also require a very clear commitment from the public authorities that they stop ad-hoc disbursements following a disaster and concentrate their support on crop insurance subsidies. This is the way taken by the Netherlands, where the

introduction of multi-peril crop insurance in 2010, assorted with a 65% subsidy, coincided with a termination of the disaster fund. Since then, and despite adverse climatic events in 2010, 2012 and 2015, the Dutch government resisted political pressure to make any ad-hoc disbursement by referring to the public-private insurance scheme (Van Asseldonk, et al., 2016). The Dutch example proves that beyond public finance concerns, agricultural insurance public private partnerships are also politically feasible.

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CHAPTER 4

RETHINKING AGRICULTURAL INSURANCE FOR THE BOP – A KENYAN CASE STUDY

Rethinking agricultural insurance for the BoP – a Kenyan case study

1. Introduction

As seen in chapters 1 and 2, insuring farmers to protect them from natural and climatic risks poses a certain number of challenges. The global volume of agricultural insurance premiums is mostly found in North America and Europe (55% and 18 % the world premium volume respectively), but the share of Asia is rapidly growing (Kalra & Xing, 2013). In 2011, Latin America accounts for 4% of the premiums, and Sub-Saharan Africa for about 0.5% (Kalra & Xing, 2013). To date, agricultural insurance programs in the developing world are either heavily subsidized, or are remaining at a pilot level and have not reached scale.

Low-income customers face specific challenges to get access to insurance products. Among them are the issues of price, liquidity, trust, financial education level and wealth (Cole et al., 2013). The idea that low-income customers experience price and non-price barriers to access some products or services is not new, and many of these challenges are not specific to the insurance sector. In 2004, CK Prahalad introduced the paradigm that there is a market at the “bottom of the pyramid” (Prahalad, 2004). The “BoP” (standing for “bottom of the pyramid” or “base of the pyramid”) represents the mass of the world population, and its aggregate purchasing power is important. However, they are currently under or poorly served by large companies. Most firms are not addressing properly the specific needs and constraints of the BoP segment, and are therefore missing a broad market. Anderson & Billou (Anderson & Billou, 2007) propose the “4As” framework to analyze the barriers preventing BoP customers to access needed goods and services. Firms must take into account the questions of Affordability, Availability, Acceptability and Awareness when they target BoP customers.

This article relies on the 4As framework to analyze the strategy implemented by Agriculture and Climate Risk Enterprise Ltd (ACRE), which operates under the brand name “ACRE Africa”. ACRE designs crop and livestock insurance products for farmers in Kenya, Tanzania and Rwanda, with a specific focus on smallholder farmers. The company was incorporated in 2014, and it follows the project “Kilimo Salama” that was initiated by the Syngenta Foundation for Sustainable Agriculture in 2009. Based on this case, the article aims at understanding how agricultural insurance needs to be redesigned to target the BoP. The case study is based on a series of 15 interviews with ACRE staff, clients and partners. It also relies on documentation provided by the company or the Grameen Crédit Agricole Foundation, one of its shareholders. All ACRE’s products and operations features are analyzed through the 4As framework, in order

to assess how well the products and customer experience perform against each criterion. This analytical framework is also confronted with a practitioner tool (PACE) that intends to assess the value of insurance products.

Section 2 reviews the literature on microinsurance demand. This literature will then be compared with the literature on the BoP paradigm. Section 3 presents the current state of practice and the methodologies developed around microinsurance. Section 4 describes the methodology and the data. The next section presents the main results, using the 4As framework and the PACE tool. The last section confronts the two analytical grids and establishes the main lessons that can be drawn from this case study.

2. Literature review

2.1. Risk management and microinsurance demand of smallholder farmers

Low-income farming households deploy a broad array of methods to manage natural and climate risks. These methods can be classified into two categories: risk reduction measures, and mitigation and coping mechanisms (Antón, 2009; Bryla-Tressler, 2011; Müller, Ramm, & Steinmann, 2014). Farmers can ex-ante try to reduce and prevent risks by implementing certain farming practices, like using drought-resistant seeds or develop irrigation. They can also diversify their crops and their sources of income by taking another job. After a shock happened, typical mitigation and coping mechanisms include relying on savings, community and national solidarity, selling assets or taking a loan.

These methods work quite well to manage frequent, low intensity events (Hazell et al., 2010). They made possible for communities to survive and thrive even in disaster-prone areas. These risk-avoidance strategies however bear an important opportunity cost: farmers often choose low-risk, low-return farming strategies. For example, a farmer may decide not to purchase high-yield seeds because they are perceived to be riskier. Low-income farming households are too vulnerable to depart from non-efficient methods. Some studies estimate that average agricultural income would be 10 to 20% higher in the absence of risk (Gautam et al., 1994; Sakurai & Reardon, 1997).

Another limitation of traditional risk management tools is that they may not offer sufficient protection in case of a catastrophic event. Poor households are often forced to sell productive assets like livestock after a shock, which affects their livelihoods in the long term. It is now

established that external shocks and asset depletion can “trap” vulnerable households into poverty (Barnett et al., 2008). Community-based mechanisms are also less effective to protect from covariant risks like floods and droughts (Christiaensen & Sarris, 2007). Indeed, many members of the community are affected and need support at the same time when large-scale catastrophic events occur.

With such imperfect risk management tools and a high-risk aversion, one would expect that demand for microinsurance products is high among low-income households (Brau et al., 2011; Cohen et al., 2003). When reviewing the literature on demand for microinsurance De Bock & Gelade (De Bock & Gelade, 2012) actually find quite the opposite. Take-up rates of index insurance products reach 20 % in Ethiopia (Hill & Robles, 2011), 17% in Malawi (Giné & Yang, 2009), 16% in India (Cole et al., 2013), between 6% and 36% in Ethiopia (Norton et al., 2011), 6% in India (Gaurav et al., 2011). In many of these randomized control trials (RCTs), insurance was subsidized. Why is insurance demand so low?

Farmers are typically risk-averse: they will prefer to exchange a certain sum (the insurance premium) on a regular basis to guarantee a certain amount of production outcome (Patt et al., 2009). A utility-maximizing farmer is therefore willing to pay more than the actuarially fair price of the policy. Theory suggests that the willingness to pay for insurance will depend on the farmer’s risk aversion, which means that setting the premium between the actuarially fair price and the farmer’s willingness to pay would suffice to sell the insurance policy (De Bock & Gelade, 2012; Patt et al., 2009). Two Empirical studies (Cole et al., 2013; Giné et al., 2008) have shown results contradicting this theory. Demand for crop insurance (in both cases, index insurance) is particularly low among the most risk-averse farmers. Karlan and Morduch (Karlan & Morduch, 2010) advance that uncertainty is about the product itself, and that farmers doubt that it will deliver its promise. For Binswanger-Mkhize (Binswanger-Mkhize, 2012), farmers are too cash and credit-constrained to transform their potential demand into an actual purchase. Clarke (Clarke, 2011) takes a different approach and develops a “theory of rational demand for index insurance”. Index insurance bears basis risk: the producer’s loss is imperfectly correlated with the index insurance payout. When basis risk happens, a farmer can end in a worse situation than if he/she had not purchased insurance: he paid the premium but he/she is not compensated for his/her loss. “The low observed demand for weather derivatives sold to poor farmers may be consistent with objective financial advice, rather than being a result of poor understanding, an unwillingness to experiment, or credit constraints.” (Clarke, 2011).

Overall, a variety of factors affects demand for microinsurance. Eling, Pradhan and Schmit (Eling et al., 2014) established a list of 12 characteristics determining demand for microinsurance and reviewed 41 papers to assess the effect of each of these factors.

Table 11 - Papers assessing the correlation between demand and a series of variables

Variable	Number of papers finding a correlation		
	Positive correlation	Negative correlation	Non-significant
Economic Factors			
1. Price of insurance (including transaction costs)		10	1
2. Wealth (access to credit/ liquidity) and income	4	1	5
Social and cultural factors			
3. Risk aversion	1	4	
4. Non-performance and basis risk		3	
5. Trust and peer effects	12		
6. Religion/fatalism	1		
7. Financial literacy	11		6
Structural Factors			
8. Informal Risk Sharing	1	2	
9. Quality of service	5		
10. Risk exposure	1		2
Personal and demographic factors			
11. Age	3	1	1
12. Gender (female is positive)	2	2	1

Source: adapted from Eling, Pradhan and Schmit (2014)

Price, risk aversion and basis risk appear to negatively correlate with demand, except in one paper finding that risk aversion correlates positively with demand (Ito & Kono, 2010). Depending on the studies, wealth, financial literacy and risk exposure are positively correlated with demand, or non-significant. The importance of informal risk sharing, age and gender are not clear, different empirical studies found contradictory results. Only one paper examined religion and found a positive correlation between religion and insurance demand (Cole et al., 2011). In a large number of studies, trust and peer effects, and quality of service are found to be positively correlated with demand.

2.2. Creating inclusive markets

In “The fortune at the Bottom of the Pyramid” (Prahalad, 2004), CK Prahalad states it is possible to “eradicate poverty through profits”. The fundamental assumption of Prahalad is that the poor are customers who have their needs improperly met. The World Resources Institute and the International Finance Corporation (World Resources Institute & International Finance Corporation, 2007) estimate that the bottom of the pyramid represents four billion people. The definition of the BoP is broader than the population below the poverty line. These 4 billion people earn individually less than 3000\$ of income annually (in local purchasing power), but their aggregated purchasing power represents \$5 trillion dollars. Despite their heterogeneity in cultures, habits, geographical locations, all BoP consumers share common characteristics. Basic services taken as granted in developed countries are often non-existent or inadequate for the BoP. BoP consumers often lack proper access to water and sanitation services, electricity, transportation services, basic health care, and have limited or no access to formal financial services. BoP markets are inefficient markets. This inefficiency negatively affects customers who pay a high price for inadequate products and services, and it is not uncommon for low-income customers to pay a higher price for some products and services than more affluent households. When comparing the prices between Dharavi, a shantytown of Mumbai, and Warden Road, an upper-class community in Mumbai suburb, Prahalad and Hammond (Prahalad et al., 2002) conclude that the poor live in a high-cost economy. The kilo of rice is 20% more expensive in Dharavi than in Warden Road. For diarrhea medication or a cubic meter of municipal-grade water, the “poverty premium” is respectively 20 and 37 times the price of the upper-class neighborhood. This paradox is, among other factors, the consequence of the high cost to reach the poor, the “last mile” problem (Counts, 2011; Vachani & Smith, 2008). The lack of infrastructure, especially for transport and telecommunication, creates a situation where it is more expensive to serve poor customers than the rich ones. This problem is particularly acute for rural areas where populations are even harder to reach and geographically dispersed. Hence, reaching BoP customers requires solving the “4As challenge”(Anderson & Billou, 2007).

Defining the 4As

Availability – the extent to which customers are able to readily acquire and use a product or service. Distribution channels in bottom of the economic pyramid (BOP) markets can be fragmented or non-existent and the task of simply getting products to people can be a major

hurdle to overcome. Companies need to explore alternative methods of delivering their products and services to even the most isolated BOP communities.

Affordability – the degree to which a firm’s goods or services are affordable to BOP consumers. Many low-income consumers in developing countries survive on daily wages, meaning that cash-flow can be a significant problem. Companies need to be able to deliver offerings at a price point that enables consumption by even the poorest consumers.

Acceptability – the extent to which consumers and others in the value chain are willing to consume, distribute or sell a product or service. In BOP markets, there is often a need to offer products and services that are adapted to the unique needs of both customers and distributors. Companies might need to respond to specific national or regional cultural or socioeconomic aspects, or to address the unique requirements of local business practices.

Awareness – the degree to which customers are aware of a product or service. With many BOP customers largely inaccessible to conventional advertising media, building awareness can be a significant challenge for companies wishing to serve low-income consumers in the developing world. To overcome these constraints companies must explore alternative communication channel.

Reproduced from Anderson & Billou, 2007

Most companies do not have the capacity to tackle these challenges on their own. This is why most BoP ventures are built around partnerships, between companies, MFIs and non-governmental organizations (NGOs). These partnerships between NGOs and for-profits do not come without costs and adjustments (Webb et al., 2010). Partners involved in a BoP venture may pursue different objectives and conflicts may weaken the alliance. Moreover, producers’ cooperatives, local businesses, churches, public services or governments, even if not formally integrated in the project, can be powerful enablers in the communities (UNDP, 2008).

The BoP “paradigm” evolved from the initial views of Prahalad to take more into account the importance of partnership creation. Tweaking some products’ features is not sufficient to address the needs of the BoP. This new approach is often referred to as “BoP 2.0” (Erik Simanis & Hart, 2008).

Table 12 – BoP paradigm evolution

BoP 1.0	BoP 2.0
BoP as consumers/producers	BoP as business partner

Deep listening	Deep dialogue
Reduce price points	Expand imagination
Redesign packaging, extend distribution	Marry capabilities, build shared commitment
Arm's length relationship mediated by NGOs	Direct, personal relationships facilitated by NGOs
"Selling to the Poor"	"Business co-venturing"

Reproduced from Simanis & Hart, 2008

Despite enormous potential, addressing the “BoP market” presents many challenges. A market exists only if there are buyers willing to pay and sellers able to cover their costs, including the cost of capital (Garrette & Karnani, 2010; Karnani, 2005). “If the supply and demand curves do not intersect, there will be no market, even if there is an unmet need”(Garrette & Karnani, 2010). Actually, many companies fail to address the BoP segment because they fail to adopt a “market creation” strategy, as opposed to “market entry” (Simanis, 2011). Entrepreneurs entering a new market face “information deficiency”. They can address this information gap through market research or establishing partnerships with businesses already active in this market. The situation is different when there is no existing market: there are no competitors, no customers to observe. Therefore, creating a new market carries a huge upside potential but involves much more complexity, requires higher amount of investment with a longer payback. Another common mistake of many BoP ventures is that their strategy could be summarized as follows: “low price, low margin, high volume” (Simanis, 2012). In markets that do not exist yet, assuming high penetration rates to balance the business model is simply unrealistic. BoP ventures need to find margin-boosting solutions if they want to be sustainable.

2.3. Unmet needs are not equivalent of untapped markets

Both the literature on microinsurance demand and on BoP markets come to the same conclusion: the existence of a need does not necessarily mean that there is a high demand for products and services addressing this need. Low-income households face various constraints (level of income, liquidity, remoteness) and information gaps that exclude them from insurance services. Therefore, microinsurance products must be designed to address the needs and constraints of these customers in order to meet their market.

3. The practitioners' perspective: assessing client value in microinsurance

3.1. Why and how assessing client value

The question of microinsurance clients receiving good value against their premiums is central for the microinsurance sector. Insurance providers and distributors aim at delivering good products to attract and retain clients. Governments and donors want to evaluate if microinsurance has a positive impact on the lives of the poor. In this chapter, we follow Matul, Tatin-Jaleran & Kelly (Matul et al., 2012) to adopt a client-focused definition of the client value, mixing the development and marketing perspectives. “Client value is about reducing vulnerability due to improved risk management practices that then contributes to improved well-being”, and this definition assumes that “valuable products are a means to accomplish clients’ goals and satisfy their needs” (Matul et al., 2012)

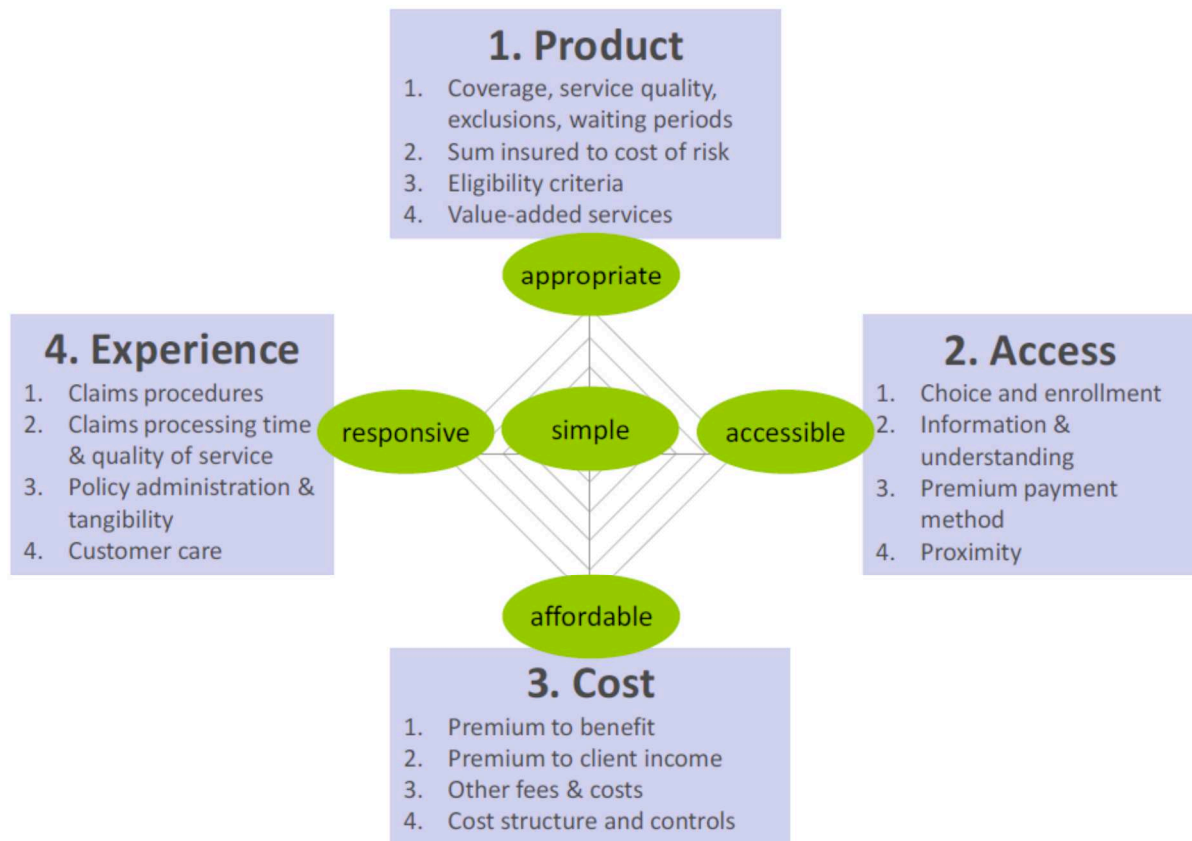
The issues of “client value”, “social performance” or “impact” gained a lot of attention in the early 2010’s and several methodologies were developed in order to track and measure client value (see Appendix 1). These approaches vary in the level of complexity involved, the sources of data and rationale. A market study will be more relevant at the product development stage to understand the needs and preferences of the target population while a client satisfaction study while focus on past and existing clients with an objective to improve an existing product. In this research, we decided to use the PACE tool developed by the Microinsurance Innovation Facility⁵ hosted at the International Labour Organization. Compared to other client value assessment approaches, the PACE tool is relatively simple to implement. It relies on secondary data, like employees and clients’ interviews, which were also useful for other aspects of this research.

3.2. The PACE tool

The purpose of the PACE tool is to help “practitioners develop a better value proposition for clients.” (Matul & Kelly, 2012). It aims at improving the client value rather than proving it, and is not a substitute for demand or impact studies. The PACE tool is structured around the four dimensions of Product, Access, Cost and Experience.

⁵ This facility is now called Impact Insurance Facility

Figure 12 - PACE added value analysis framework



Reproduced from PACE technical guide v1.0 2012

The underlying assumption behind this analytical framework is that microinsurance products need to be appropriate, accessible, affordable, responsive and simple to fulfill their purpose. A defining feature of the PACE methodology is that it looks at both the product characteristics and the related processes. Indeed, a very good product hard to access or not responsive to claims will deliver little value to the target population. In many microinsurance schemes, the room for improvement lies in the distribution or customer experience dimensions.

In its design, the PACE tool aims at comparing insurance products or risk management mechanisms addressing the same need. However, in the context of our study, alternatives were scarce, especially in the formal insurance market.

Each of the four dimension is divided into several sub-dimensions, corresponding to detailed criteria (see Appendix 2). Each sub-dimension is weighted relatively to its own importance, and receives a score between one (poor performance, ineffective and not appropriate to client needs) and five (strong performance, effective in almost all situations, with limited or no room for improvement). It can be argued that in some contexts, certain criteria are more important than

others, and therefore the weighting can be modified to give more importance to certain aspects. However, in this analysis we decided to keep the standard weights.

4. Case study: methodology and data

4.1. Research objectives

The primary objective of this case study is to evaluate the adequacy of ACRE's offer with the needs and constraints of their target clients, smallholder farmers.

The case study pursues three specific objectives: documenting ACRE's products and processes from a client's perspective to have a detailed description of the service brought to clients; assessing the relevance of ACRE's offer under the lens of the BoP literature, using the 4As framework; comparing this analysis from the scholar's perspective with a practitioner's tool, the PACE tool.

4.2. Method

The case study is a qualitative transversal study based on semi-directed interviews.

Studies based on a single case can be useful to test a one or several theories in order to confirm the model, question it or complete it (Yin, 2017). In this research, the case study allows to compare two approaches, the 4As framework and the PACE tool. Single-case studies also give the opportunity to provide a detailed description of the content. As noted by Sandmark et al. (2013), agricultural insurance research too often gives insufficient details on the actual insurance contracts, such as risks covered and exclusions, premium rates, deductibles and thresholds. It is often said that single case studies only have idiosyncratic value, and that it is impossible to draw more general conclusions (Thietart, 2014). However, if statistic generalizations are indeed not feasible, it is possible though to have at least a partial theoretical generalization (Hlady-Rispal, 2015).

Case studies also raise the question of the positioning of the researcher towards the case studied. Whereas positivist authors affirm the necessary exteriority of the researcher and the erasing of their own subjectivity (Friedberg, 1988), for ethno-methodologists neutrality is a myth and researchers necessarily have transformational influence on the object they study (Plane, 1996). In this research, the author had a dual and somehow ambiguous position vis-à-vis the people interviewed and the company. Indeed, the author was at the same time pursuing his research for

the completion of his PhD while also working for the Grameen Crédit Agricole Foundation, one of ACRE's shareholders. It was clearly stated from the beginning that the interviews would serve primarily the author's research, but of course, there was no Chinese wall in place within the Foundation and the author never claimed that there would be confidentiality towards his employer.

4.3.Data collection

4.3.1. Interviews

This study is based on data gathered during 2 weeks of fieldwork in April 2017 in Kenya. The author led 15 interviews with the objective to understand the operations and strategy of ACRE. 8 ACRE staff were interviewed at the headquarters level in Nairobi. Additionally, 3 ACRE employees based in the field were interviewed in the Meru region. The author also met with two farmers who are ACRE's clients (in Meru and Thika) and with two intermediaries (an agroveter shop manager in Thika and a dairy cooperative in Meru).

An open, semi-structured protocol guided these interviews, focusing on ACRE's operational processes and products, and how these features may affect the client's experience. Moreover, the interviews at HQ level also explored the company's strategy and its evolution over time.

All interviews were conducted individually, except for the two Business Development Officers who were interviewed together. The grid for the interviews was established prior to the fieldwork and was adapted to the profile of the interviewee. Indeed, the interviewees hold different positions: employee, client or partner (agroveter shop manager, dairy cooperative manager) of ACRE. Moreover, even within employees, each person had their own area of expertise and perspective on the company's products and operations. The grid also evolved incrementally during the fieldwork as the understanding of ACRE's functioning increased and new questions arose through the fieldwork process.

The selection of people interviewed was made in collaboration with ACRE. The objective was to have a diversity of profiles and perspectives. All the staff at HQ with management responsibilities has been interviewed. It was assumed that HQ staff would bring a more strategic vision, in their respective areas of responsibilities. Regarding the field staff, their focus is in sales and promotion activities, and they interact more regularly with the end clients or the aggregators. They were chosen because they hold different positions and different levels of

seniority. The sites for the field visit were selected based on the variety of agricultural activities and taking into account practical factors (distance mainly).

All interviews were conducted in English, which is not the mother tongue of neither the author nor the interviewees, but is the working language within ACRE. Translation was sometimes needed for the interviews with farmers, and ACRE staff brought their support in the matter. During the interviews in the Meru and Thika regions, an ACRE's employee always accompanied the author.

Table 13 – List of interviews

Location	Category	Interviewees
Nairobi – ACRE HQ	ACRE HQ staff	<ul style="list-style-type: none"> - Business development Officers (2) - CEO - Business analyst - Chief Actuary - Agriclimate data analyst - HR manager - Platform manager
Thika	Intermediary	<ul style="list-style-type: none"> - Agroveter shop manager
Thika	Client	<ul style="list-style-type: none"> - Farmer (replanting guarantee)
Meru	ACRE field staff	<ul style="list-style-type: none"> - Account Associate - Portfolio Manager - Field promoter
Meru	Intermediary	<ul style="list-style-type: none"> - Dairy Cooperative Manager
Meru	Client	<ul style="list-style-type: none"> - Farmer (replanting guarantee)

4.3.2. Other sources of data

On top of the interviews, the author had the opportunity to follow the Portfolio manager and the Account Associate for half a day, during their meetings with clients in the Meru area. This gave the opportunity for the researcher to observe the sales process in action.

The author also had access to other types of documents, made available before, during and after the fieldwork. These sources notably include products information sheets, organization charts, board meetings material and some company's internal documentation on processes. Such documents were provided either directly by ACRE, found on the company's website, or provided by the Grameen Crédit Agricole Foundation, in its capacity of ACRE's shareholder and board member. Additionally, during the field work, the researcher had the possibility to witness a demonstration of the company's internal software, which helped understand how

ACRE stores, organizes and manages the data it uses to run its operation and create insurance products.

4.4. Data analysis

All interviews were recorded with a smartphone, except one due to technical reasons. The author took manual notes during the interviews, and all interview recordings were transcribed, analyzed and summarized after the fieldwork.

The research ensured that a triangulation of different sources was implemented to attain the research objectives, whether these sources are different interviews with different people, or the analysis of documentation. The relative importance of the different topics was influenced by how frequently these topics would be raised during the interviews, by the diversity of the interviewees who would raise these topics, and by their legitimacy according to their area of expertise to address the issue.

In the end, the data analysis process was guided by the two frameworks that had been previously identified: an academic framework, the 4As framework, and a practitioners' framework, the PACE tool. These two analytical frameworks were described extensively in the sections 2.2 and 3.2 of this chapter.

5. Results

5.1. Description of ACRE

All the fieldwork was conducted in Kenya. ACRE also proposes its products in Rwanda and Tanzania, and most findings from this research would probably be relevant for these two countries, but the case study will focus on ACRE's work in Kenya.

5.1.1. Presentation of the company

ACRE follows the project Kilimo Salama initiated by the Syngenta Foundation for Sustainable Agriculture in 2009. It develops and offers affordable insurance products to African farmers (smallholder to large-scale commercial farmers). The Kilimo Salama project transformed into a company in 2014, and in 2017, it operates in three countries: Kenya, Rwanda and Tanzania.

ACRE is not an insurance company. It is rather a service provider for the agricultural insurance market. ACRE main services are:

- product development: ACRE designs the insurance products, defining guarantees, calculating risks and premiums
- data collection: ACRE collects and analyzes different natures of data to design the insurance products: ground data obtained from weather stations, satellite data, and yield data
- brokerage: ACRE finds insurance and reinsurance capacity for its products
- marketing and distribution: ACRE markets the products that are sold under ACRE Africa brand name and is in charge to manage the relationships with the aggregators who are distributing the products
- financial education: ACRE implements communication campaigns to educate farmers about agricultural insurance
- portfolio monitoring: ACRE tracks losses so insurers can issue payments to affected farmers

5.1.2. Partnerships and role in the value chain

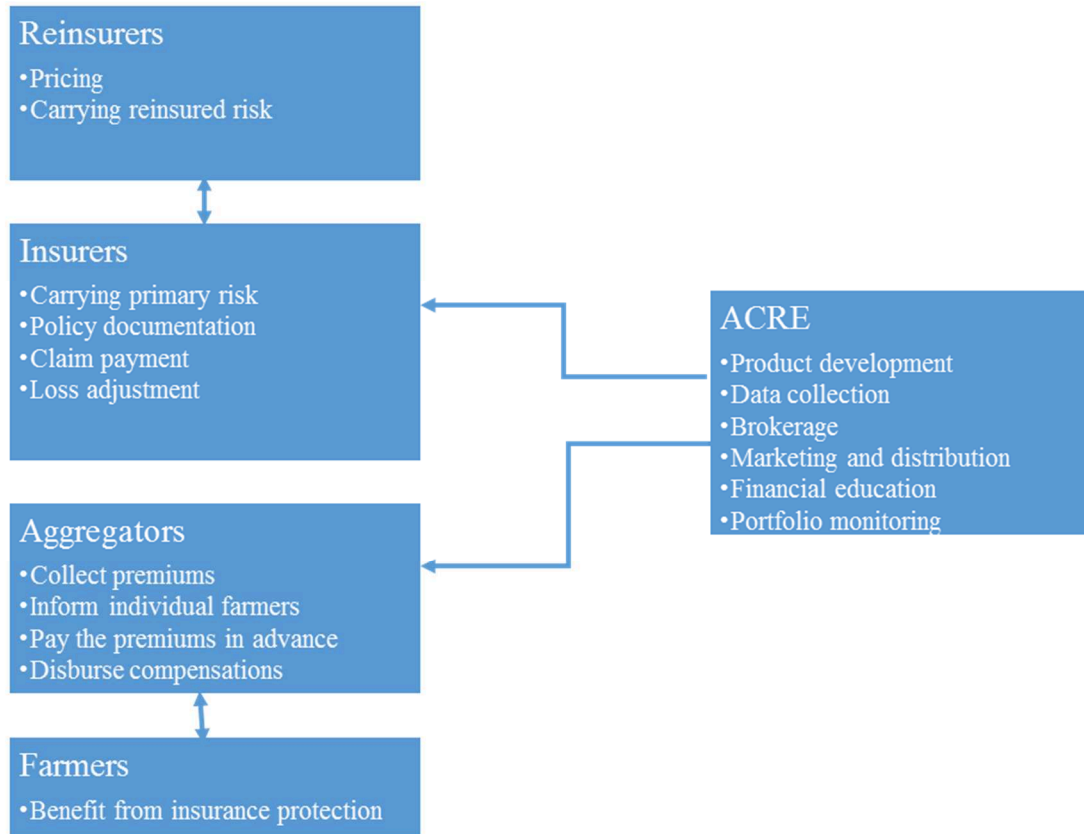
ACRE serves as an intermediary between the supply and demand, and as a market maker and product developer. Depending on the country, it operates as an insurance agent or an insurance surveyor.

For each insurance product it designs, ACRE finds insurance and reinsurance capacity. ACRE established business relationships with several local insurers and international reinsurers. If ACRE is not carrying risk itself, ACRE does make the risk analysis and actuarial calculations. ACRE and the insurers and reinsurers use this analysis and the indexes developed by ACRE to establish the level of premiums. In case of a loss event, the insurers and reinsurers pay the claim. For some products, losses are not always assessed by an index (see paragraph 3.2.3 below). In this case, the insurance company is in charge of the loss adjustment.

Regarding distribution, ACRE does not market its products to individual farmers, which would be too costly and ineffective (Mukherjee et al., 2017). ACRE works through aggregators, i.e. organizations that are directly dealing with large numbers of farmers. These aggregators can be financial institutions like banks or MFIs, producers' organizations, NGOs or farm input suppliers. Working through aggregators is a way to get access to a large number of potential clients. When the aggregator has established a long-term and trustful relationship with farmers, ACRE products will benefit from this positive image. Partnering with aggregators also makes it simpler to bundle insurance with other products and services. Insurance is usually bundled

with farm inputs, credit, extension services or commercialization. Bundling improves the value proposition of insurance, and makes it more attractive to farmers (Mukherjee et al., 2017). Aggregators participate in the marketing effort towards clients. Payments go through these aggregators, as they usually collect the premiums and receive claim payments.

Figure 13 – ACRE’s role in the value chain



Source: author

ACRE is what Bernhardt, Steinmann and McCord call a “microinsurance intermediary” (Bernhardt et al., 2012). In traditional insurance markets, intermediaries serve as matchmakers between demand and an existing supply. In microinsurance markets, intermediaries have a more significant role than the matchmaking function, they are markets makers. From a client perspective, their value lies in building a formal market that caters their needs, bringing new products and establishing new delivery channels. On the insurer’s side, microinsurance intermediaries provide valuable information on a potential market.

5.1.3. Products

For the research, we will analyze four agricultural insurance products offered by ACRE.

The replanting guarantee

The replanting guarantee (RPG) is ACRE's flagship product. It is an insurance bundled with seeds. The RPG covers the risk of poor rainfall during the plant's germination phase. Upon opening the bag of seeds, the farmer will find a scratch card, similar in design to phone credit scratch cards. This card contains a unique code and instructions. Farmers are asked to send the code by SMS to a platform, which activates the cover for the next 14 days. Weather will be monitored at the farmer's location and in the event of insufficient rainfall, farmers directly receive on their mobile phone a compensation equals to the price of the bag of seeds.

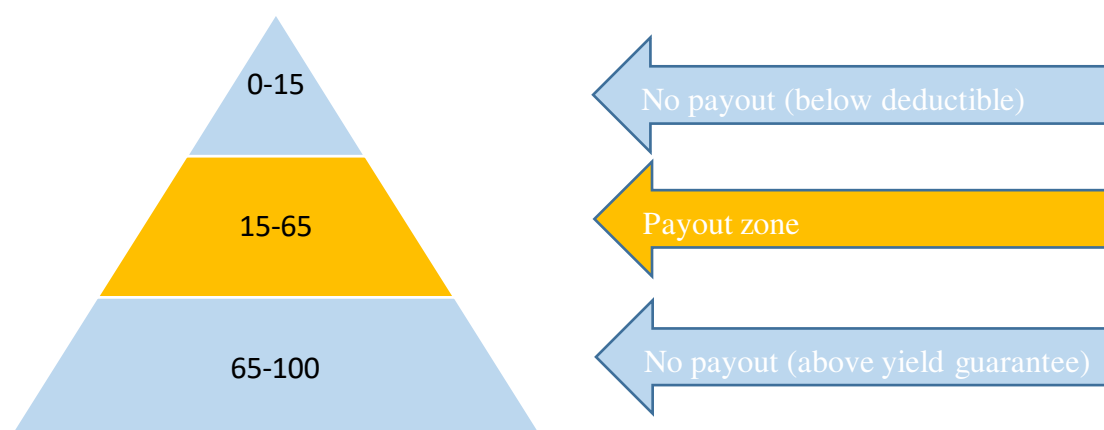
The product is entirely free for the farmer: the insurance is already included in the price of the bag of seeds at no additional cost. The premium is paid by the seed manufacturer. Farmers do not have to fill any form; all transactions are made directly through the mobile platform.

Top-up option

This product is an option to complement the replanting guarantee. It gives the possibility for the farmer to extend the coverage period to the whole season, after the germination phase when the free insurance expires. ACRE was piloting this product during the field trip. Farmers who had registered to the RPG were informed by SMS about the possibility to extend their free coverage. Farmers need to call a hotline where a salesperson will explain the guarantees of the product and enroll clients. The farmer pays the top-up option premium. Like the RPG, all transactions are operated by mobile phone.

Hybrid cover

The hybrid cover is a crop insurance combining index insurance and more traditional Multi-Peril Crop Insurance (MPCI) yield guarantee. This means some risks are monitored with an index (drought or excessive rainfall), while other risks are monitored through traditional, in-the-field loss adjustment methods (pests, diseases, hail, frost, fire). This combination of methods allows benefiting from the advantages of index insurance for the most common, rainfall-related risks, while also protecting farmers against a broader range of risks that are difficult to track with an index. The hybrid cover is available for many different crops (maize, wheat, potatoes, sorghum...). It bears a 15% deductible and guarantees losses up to 65% of the guaranteed yield. Farmers can cover the cost of production or the value of the production, at a pre-agreed market value of the harvested crop.

Figure 14 – Hybrid cover payout structure

Source: reproduced from ACRE

The hybrid cover is marketed through financial institutions, NGOs and producers' organizations.

Livestock insurance

The livestock insurance covers dairy cows between 1 and 8 years old against some causes of death, like non-preventable diseases and accidents. A veterinary doctor examines each cow before enrollment, to assess its value and if there is any pre-existing condition. A set of vaccines are mandatory. After the animal's death, the veterinary doctor will determine the cause of death to validate it is covered by the insurance policy. The sum insured is 80% of the animal resale value. Premium rate is at 3.5% of the sum insured if the sum insured is below 1 million Kenyan shillings (KES), and 2.5% from 1 million KES and above. There is also a 1000 KES (approximately 10 US dollars) vaccination fee per animal. The livestock insurance is marketed mostly through dairy cooperatives.

Summary of products' features

Table 14 – Summary of products' features

	RPG	Top-up option	Hybrid cover	Livestock insurance
Crop/Animal Covered	Maize	Maize	Maize, wheat, potatoes, sorghum	Dairy cows between 1 and 8 years old
Sum insured	Value of the seeds (450 KES per bag)	Value of the seeds (450 KES per bag)	Cost of production or harvest value	Animal resale value

Risks covered	Drought	Drought	Drought, excessive rainfall, frost damage, fire, hail, unavoidable pests or diseases	Accidental causes of death and non-preventable diseases
Payout	100% of the sum insured	100% of the sum insured	15 to 65% of the sum insured	80% of the sum insured
Premium	Free for the farmer	5-6%	Depending	2,5%-3,5% depending on the total sum insured
Distribution Channels	Included in the bag of seeds and mobile platform	Mobile platform	NGOs, producers' organizations and lending institutions	Dairy cooperatives and veterinary doctors

5.2. 4As Framework analysis

In this section, we will analyze each of the four insurance products previously described, using the 4As of Anderson & Billou as a framework. We will use their definition of each criterion.

5.2.1. Replanting guarantee

The RPG performs extremely well on the affordability criterion, as the premium is completely free for the farmer, the insurance being already included in the price of the bag of seeds. This bag of seeds is not more expensive than other brands and the interviews revealed it is the more popular brand and is generally perceived as a quality product. It also does not involve high transaction costs, as farmers can register directly with their mobile phone. The only cost borne by farmers is the cost of one SMS. No other cost is incurred during the coverage period or in case of a payment as the payment is made directly on the mobile money account of the farmers.

Bundling the insurance with the seeds makes the insurance readily available for the farmer. Seeds are sold in “agro-vet” shops. Agro-vet shops can be found in many rural towns in Kenya. They are the one-stop shop for farmers, where they can buy inputs, equipment, or services like soil analysis and consulting.

In terms of acceptability, the RPG has mixed results. The enrollment process is designed to be light and efficient for the farmers. It is very similar to buying phone credit, so farmers are comfortable with it. The claim and payment processes are automated, making it effortless for the farmer. Nevertheless, the sum insured (the value of the seeds) is very low compared to the farmer’s risk exposure and coverage is limited to the germination phase.

Awareness is also a challenge. Agrovet shop managers received training about the replanting guarantee, but they do not have time to explain individually to each client the insurance's benefits. ACRE's promotional posters are displayed inside the shop. ACRE hires seasonal rural promoters to organize awareness raising events with farmers' groups. These promoters are farmers themselves and they promote the seeds and the RPG within their communities. Farmers also receive information about the insurance with the scratch card placed in the bag. Once they register, they receive informational SMS, even when there is no payment. The interviews revealed that many farmers are not aware of the insurance. When they find the scratch card, many will discard it or they will think it is an authenticity certificate. The design of the scratch card evolved in order to increase enrollment, but the take-up rate remains low (unfortunately, the author did not get exact figures, but he was told only a fraction the scratch cards distributed with the seeds are activated).

5.2.2. Top-up option

The top-up option is an extension of the RPG. Only farmers who activated the RPG will have the possibility to "top-up" and extend the coverage to the whole season. The top-up option requires an upfront payment after the germination phase. All the process of delivering information and enrolling clients is made by phone (voice or SMS), which limits transaction costs for the farmer. The top-up product performs well in terms of availability. The farmer can take-up insurance from home and without filling any form, as long there is mobile phone network in the area. In terms of acceptability, it is an interesting complement to the RPG as it covers the relevant period for the farmer, the whole planting and growing season. However, the sum insured is the same as the RPG and only a fraction of the production costs are covered. Awareness-raising is done by the rural promoters and through SMS sent all along the season. When enrolling, farmers talk to a salesperson on the phone, so they receive adequate information about the product features.

5.2.3. Hybrid cover

The hybrid cover is more expensive than a pure index-insurance product. This is because more risks are covered (risks that cannot be monitored with an index) and because of loss adjustment costs. However, the hybrid cover is about 1% cheaper than conventional MPCCI available in the Kenyan market. Furthermore, no MPCCI is available for smallholder farmers. Liquidity to pay the premium upfront is not an issue as insurance is bundled with credit, or there are credit possibilities through the cooperatives.

The hybrid cover is sold through aggregators that are dealing with farmers on a regular basis. These aggregators are responsible for the enrolment and premium payment. Therefore, availability does not appear as an issue for the product.

Regarding acceptability, the hybrid cover is an interesting example of how an insurance product was reengineered to meet farmers' needs. ACRE's crop insurance was initially a pure index-insurance product based on weather and satellite data. However, when a disease devastated maize harvest in Kenya in 2013, the index-insurance product proved unable to protect farmers effectively. This is why ACRE decided to modify its crop insurance product, combining the index with conventional loss adjustment methods. The hybrid cover protects farmer against a broad range of risks. It is also customizable, as the farmer can choose to insure the value of inputs, the credit or the harvest value (depending on the aggregator). An issue may arise as losses are covered until 65%, so in the event of an extreme event, the farmer will be partially covered. This feature of the product illustrates the trade-off that can exist between affordability (not covering the most extreme losses makes the product much cheaper) and acceptability (capping losses may not adequately protect the farmers).

Finally, the awareness raising activities are made in partnership with the aggregators. Therefore, distribution channels must be trained in order to be in capacity to sell and explain the product. ACRE does not have a direct view on the sales process. The hybrid product is complex, requiring technical expertise that is often lacking with aggregators. However, ACRE benefits from the reputation of the distribution channels who are endorsing ACRE's products.

5.2.4. Livestock insurance

Livestock insurance is available to protect dairy cows. The premium is between 2.5 and 3.5% of the value of the cow, and there is an additional vaccination fee. The average sum insured is around 100 000KES, so the premium for a farmer owning less than 10 cows would be 3500 KES per cow. This can represent a large amount for a small farmer, especially as the insurance is not always linked with credit.

Enrollment goes through the dairy cooperatives or directly the veterinary doctors. In each case, the veterinary doctor is involved to assess the health and value of the animal. The whole process is paperless, veterinary doctors use an app to fill in the information and the animal value is automatically calculated. Farmers do not need to visit an office or bring documentation; the veterinary doctor will come directly to the farm for the enrolment, so insurance is easily available.

The livestock insurance product protects farmers against the risks they have no control over, like non-preventable diseases, or accidents like snakebites. In case the animal is sick and the veterinary recommends slaughtering the animal, farmers receive the insurance compensation. The insurance covers the main risk (death), but not the risk of disease, even if it affects the milk production. What is protected here is not the revenue, but the investment. A cow represents a large sum for a farming household, it is often their most valuable asset and a form of saving for rural families. Farmers can sell the animal when there is a need for liquidity. The livestock insurance addresses well the needs of the farmers to secure their assets. The insurance comes with risk-reduction measures (vaccination), which increases the value of the service.

Regarding awareness, the involvement of a person with a legitimacy (the veterinary doctor) increases the confidence of farmers in the product. However, there is a long list of risks covered and exclusions, which can make the product difficult to understand.

5.2.5. Summary of the 4As framework analysis

Table 15 – Summary of the 4As framework analysis

	RPG	Top-up option	Hybrid cover	Livestock insurance
Availability	+: bundled with seeds	+: bundled with seeds	+: sold through NGOs, producers' organizations and lending institutions	+: sold through dairy cooperatives and veterinary doctors
Affordability	+: product is free +: almost zero transaction costs	+: low transaction costs -: upfront payment needed	+/-: cheaper than MPCPI but more expensive than pure index +: bundled with credit +: low transaction costs	-: high upfront cost +: low transaction costs
Acceptability	+: easy to enrol -: low level of protection (coverage period and sum insured)	+: easy to enrol -: sum insured is low	+: covers a broad range of risks	+: covers the main risk +: comes with risk reduction measures
Awareness	+: presence of rural promoters +: information directly on the scratch card -: no involvement of agrovets	+: presence of rural promoters +: information given by SMS and call centre	+/-: depends on the capacity of the aggregators +: trusted aggregators -: complex product	+: trust in veterinary doctors -: complex product

	-: low understanding of the product			
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5.3.PACE tool results

Many of the findings from the 4As framework analysis can be used to fill the PACE tool. Some additional sub-dimensions need to be further explored like the 1.3 “Eligibility criteria”, 2.1 “Choice and enrolment” and 4.4 “Customer care”.

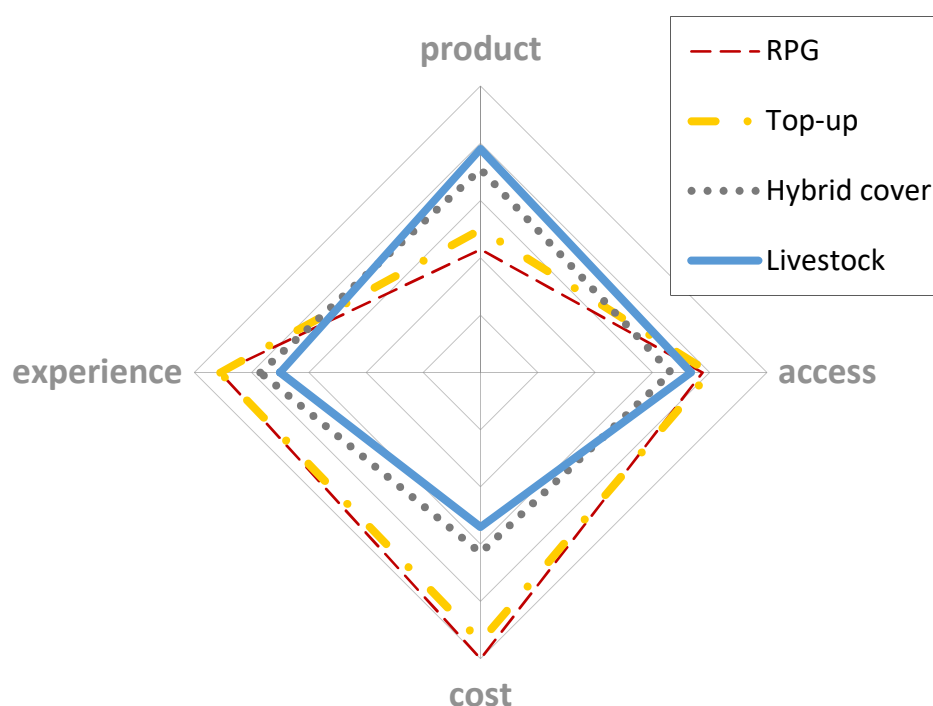
The detailed scoring on each sub-dimension is given in the table below.

Table 16 - PACE tool score of the ACRE products

Product name	Weights	RPG	Top-up	Hybrid cover	Livestock
1. PRODUCT		2,2	2,5	3,55	3,9
1.1 Coverage, service quality, exclusions and waiting periods	0,35	2,5	3,5	4	3,5
1.2 Sum insured in relation to cost of risk	0,35	1,5	1,5	4	4
1.3 Eligibility criteria	0,15	4	4	4	3,5
1.4 Value-added services	0,15	1	1	1	5
2. ACCESS		3,9	4	3,33	3,7
2.1 Choice and enrolment	0,35	4	4	3,5	3,5
2.2 Information and understanding	0,35	3	4	3	4
2.3 Premium payment method	0,15	5	3,5	3	3
2.4 Proximity	0,15	4,5	4,5	4	4
3. COST		5	4,7	3,15	2,7
3.1 Premium in relation to benefit	0,35	5	5	3	3
3.2 Premium in relation to client income	0,35	5	5	3	3
3.3 Other costs	0,15	5	4,5	4	2
3.4 Cost structure and controls	0,15	5	3,5	3	2
4. EXPERIENCE		4,6	4,6	3,85	3,5
4.1 Claim processing procedures	0,35	5	5	4	3
4.2 Claim processing time and/or quality of service provided	0,35	5	5	4	4
4.3 Policy administration and tangibility	0,15	3	3	3,5	3,5
4.4 Customer care	0,15	4	4	3,5	3,5

We summarized the results of the PACE tool in the chart below.

Figure 15 – PACE results



The explanations for the score of each sub-dimension are given in the table below.

Table 17 - Explanation for PACE scores

Product name	RPG	Top-up	Hybrid cover	Livestock
1. PRODUCT				
1.1 Coverage, service quality, exclusions and waiting periods	Covers against the risk of drought (main risk). Limited in duration (only germination phase). No possibility to customize the coverage (sum insured or risks covered). No exclusion. Immediate enrolment.	Covers against the risk of drought (main risk) and for the whole season. No possibility to customize the coverage (sum insured or risks covered). No exclusion. Immediate enrolment.	Covers a large variety of risks through a combination of methods. Product offered before the planting season.	Covers the risk of death but not the risk of disease. Exclusions for preventable risks.
1.2 Sum insured in relation to cost of risk	Very low sum of insured (cost of seeds) in relation to the risk (harvest value).	Very low sum of insured (cost of seeds) in relation to the risk (harvest value).	Possibility to choose the sum insured (cost of inputs or harvest value). Does not cover the most extreme events (above 65% loss).	80% of the animal resale value
1.3 Eligibility criteria	No client screening or exclusion. Requires a mobile phone and access to network. Partnership with the main operator	No client screening or exclusion. Requires a mobile phone and access to network. Partnership with the main operator	No client screening or exclusion. Enrolment through agregators, so farmer needs to be a client/member of a financial institution or producers' organization.	Sold through agregators so clients need to be members of a dairy cooperative (or a wealthy individual farmer).
1.4 Value-added services	None	None	None	Farmer receives insurance training and vaccination of cows.
2. ACCESS				

2.1 Choice and enrolment	Enrolment is voluntary. No possibility to customize the coverage. Option to opt out irrelevant (product is free and short term). Simple enrolment process with just one SMS. No documentation needed. Provides enrolment at the planting time. Information sent by SMS about the possibility to extend coverage period	Enrolment is voluntary. No possibility to customize the coverage. Option to opt out irrelevant (product is for one season). Simple enrolment process through a hotline. No documentation needed. Provides enrolment at the end of germination phase. No reminder sent to renew coverage for the following season.	Voluntary or mandatory (depends on the agregator). The agregator makes the decisions in the name of the clients, except for large individual farmers who can customize their own product. Reduced paperwork thanks to the partnerships with agregators. Insurance sold at the relevant moment (before planting).	Voluntary or mandatory (depends on the agregator). The agregator makes the decisions in the name of the clients, except for large individual farmers who can customize their own product. Reduced paperwork thanks to the partnerships with agregators and the app. Insurance sold throughout the year.
2.2 Information and understanding	The scratch card provides the essential information about the benefits and limitations of the product. Information about the season outcome sent by SMS. Limited understanding of the product features by the clients. Field promoters educate the clients about insurance.	All clients receive information via a hotline. Information about the season outcome sent by SMS. The contact via a hotline allows clients to ask questions.	A well-designed product info sheet summarizes the necessary information. Product is complex (combines index and traditional insurance methods). Need to educate the distribution channels, who will educate the farmers themselves	A well-designed product info sheet summarizes the necessary information. Financial education goes through veterinary doctors and producers' organizations (trusted partners).
2.3 Premium payment method	Free (paid by the seed manufacturer)	Payment via mobile money account in one instalment. No premium financing option offered, no subsidy.	Upfront payment needed. Premium financing options depend on the agregator, but it is often linked to a credit.	Upfront payment needed. Premium financing options depend on the agregator, but is often possible to deduct the premium from the payments made by the dairy cooperative to the farmer for the milk collection.
2.4 Proximity	Insurance bundled with the seeds, which are sold in agrovet shops in rural towns. Enrolment via SMS, at the farm, no need to travel.	Insurance bundled with the seeds, which are sold in agrovet shops in rural towns. Enrolment via phone, at the farm, no need to travel.	Enrolment through agregators who have already established close relationships with the farmers.	Enrolment through agregators who have already established close relationships with the farmers.
3. COST				
3.1 Premium in relation to benefit	Ratio risk coverage = 0 Ratio to all benefits = 0	Ratio risk coverage = 8 Ratio to all benefits = 11	Premium level is confidential, depends on the crop insured.	Ratio risk coverage = 1000 Ratio to all benefits = 875
3.2 Premium in relation to client income ⁶	Product is free	Less than 0.1% of monthly income.	Premium level is confidential, depends on the crop insured.	Premium to insure one cow = 2.4% of the annual average income
3.3 Other costs	Almost zero transaction cost involved for the client, except the cost of one SMS.	Almost zero transaction cost involved for the client, except the cost of one phone call.	No need to travel for enrolment or claims. No additional fee.	Vaccination fees (1000 KES). No need to travel for enrolment or claims.

⁶ Estimated monthly income: 12 190KES. The author used the 2016 GNI per capita in local currency, from the World Bank.

<https://data.worldbank.org/indicator/NY.GNP.PCAP.CN?locations=KE> accessed on 28 June 2018.

3.4 Cost structure and controls	Product is free	Product in pilot phase, so the registration process is costly (requires a call center). Possibility to go fully by SMS in the next season	Presence of a loss adjuster needed for some perils, but a good mix with index techniques to minimize labour costs. Requires large scale to take costs down.	High level of human interactions (veterinary doctor needed for enrolment and claim settlement), which will likely maintain the premium at a high level. App to support and ease the enrolment process. Requires large scale to take costs down.
4. EXPERIENCE				
4.1 Claim processing procedures	No need to file a claim, automatic index-based claim settlement	No need to file a claim, automatic index-based claim settlement	For perils covered by the index, no need to file a claim. But for the other perils, the farmer needs to call the company to have the visit of a loss adjuster.	Needs human expertise to validate the cause of death of the animal.
4.2 Claim processing time and/or quality of service provided	Claim is settled within 7 days after the end of coverage period. Claim paid directly on the mobile money account of the policy-holder.	Claim is settled within 7 days after the end of coverage period. Claim paid directly on the mobile money account of the policy-holder.	Claim is usually paid directly to the aggregator (to write-off a loan for example).	Claim is usually paid directly to the aggregator (to write-off a loan for example).
4.3 Policy administration and tangibility	Dematerialized policy issuance (SMS) right after registration. Basic information given (scratch card and SMS).	Dematerialized policy issuance (SMS) right after registration. Basic information given (scratch card and SMS).	Each client has a paper policy.	Each client has a paper policy.
4.4 Customer care	Call centre. Network of field promoters.	Call centre. Network of field promoters.	The entry point for complaints and feedback is the aggregator	The entry point for complaints and feedback is the aggregator

Any scoring based on qualitative criteria has its part of subjectivity, which means that another person could have given different scores. Nevertheless, the results obtained with the PACE tool are in line with the analysis based on the 4As framework. The RPG and the top-up products perform very well on the Cost dimension, and to a lesser extent Access and Experience dimensions. On the other hand, they perform poorly on the Product dimension. Indeed, the RPG and top-up are free or very cheap; they have very easy enrollment procedures and smooth claim processes. Nevertheless, they only cover a small fraction of the risk exposure of the farmer.

On the other hand, the Livestock and Hybrid cover products score much better on the Product dimension as they offer a more comprehensive cover to farmers. The Access and Experience dimensions receive good scores, as the relation with the aggregators eases the Enrolment and Claims processes, even if they are not as smooth as the total mobile experience offered by the RPG and the Top-up products. Finally, these products are more expensive, and this can be a significant barrier to the inclusivity of these products.

To summarize, the RPG and the top-up products propose a low-cost/low-coverage value proposition, whereas the Hybrid cover and the Livestock products propose a higher-cost/high-coverage value proposition. All products take advantage of existing distribution channels (mobile operators, aggregators) to smooth enrolment and claims processes. Whether there is a possibility to “graduate” from the low-cost product to the higher-coverage products is a question to explore and for which there is no evidence so far.

6. Discussion

6.1. Confronting two approaches: the 4As framework and the PACE tool

The PACE tool was designed by practitioners with the explicit purpose to improve the value proposition for microinsurance products in the market. On the other side, the 4As framework is a theoretical analytical framework built by academics. The 4As framework is not intended to rate any product or service. It is useful to understand and analyze marketing strategies deployed to reach the BoP segment. Nevertheless, it is interesting to see how these two approaches are somehow overlapping, and some dimensions of the PACE tool can be seen as a practical application of the 4As framework to microinsurance.

Table 18 - PACE tool sub-dimensions correspondence with the 4As framework

PACE tool	4As framework
1. PRODUCT	
1.1 Coverage, service quality, exclusions and waiting periods	Acceptability
1.2 Sum insured in relation to cost of risk	Acceptability
1.3 Eligibility criteria	Not addressed in the 4As framework
1.4 Value-added services	Acceptability
2. ACCESS	
2.1 Choice and enrolment	Availability (partially)
2.2 Information and understanding	Awareness
2.3 Premium payment method	Affordability
2.4 Proximity	Availability
3. COST	
3.1 Premium in relation to benefit	Affordability
3.2 Premium in relation to client income	Affordability
3.3 Other costs	Affordability
3.4 Cost structure and controls	Affordability
4. EXPERIENCE	
4.1 Claim processing procedures	Availability/Acceptability
4.2 Claim processing time and/or quality of service provided	Acceptability
4.3 Policy administration and tangibility	Acceptability
4.4 Customer care	Acceptability (partially)

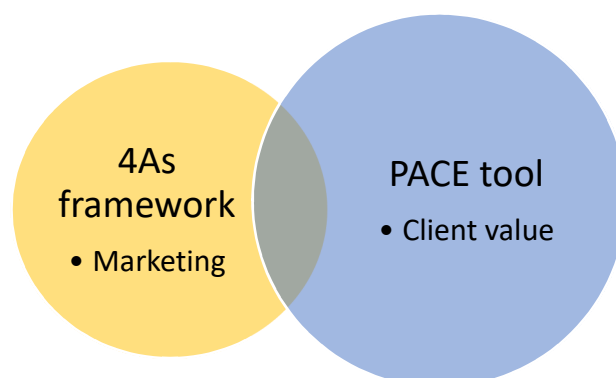
Source: author

The focus of each approach is however different. The PACE tool is a client-centered approach. This explains why some sub-dimensions, like the 1.3 eligibility criteria sub-dimension, are typically looking at the social performance of the product, whether it is inclusive or not. The notion of “social performance” is well established in the microfinance sector since the early 2000s (Lapenu et al., 2004). The social performance concept includes both the results on clients, and the management processes implemented by a lender (Bauwin, 2019). The French NGO CERISE developed a tool to monitor and measure this social performance: the social performance index. Currently in its fourth version, this tool (SPI4) evaluates the social performance of a financial institution under six dimensions, in line with the Universal Standards for Social Performance Management defined by the Social Performance Task Force (Wardle, 2017). These six standards are: define and monitor social goals; ensure board, management and employee commitment to social goals; design products, service and delivery channels that meet clients’ needs and preferences; treat clients responsibly; treat employees responsibly; balance financial and social performance.

The methodology developed in assessing the social performance of microfinance has been partially transferred to the PACE tool. The dimension 3 (design products, service and delivery channels that meet clients’ needs and preferences) is present in both the PACE tool and the 4As framework. However, unlike the 4As framework, the PACE tool addresses the standards 1 and 4 of social performance (define and monitor social goals; treat clients responsibly). For example, the 2.1 Choice and enrolment sub-dimension of the PACE tool will assess if enrolment is voluntary, or the option to opt-out. Such questions are irrelevant to the 4As framework, which will focus only on the simplicity of the process (assuming simplicity will boost sales). The 4As framework is business-focused, it aims at selling products and services for the BoP segment. The issues of client protection and social performance are central in the PACE tool, but they are present in the 4As framework only if they have a business implication. In other words, the 4As framework aims at analyzing marketing strategies to improve their effectiveness, whereas the PACE tool aims at improving the value proposition of microinsurance products. The marketing and the development aspects are equally important in the PACE tool whereas the

4As framework focuses on the marketing aspect, the development aspect being secondary and serving the marketing objective.

Figure 16 - Overlap between the 4As framework and the PACE tool



Source: author

It is fair to conclude that the PACE tool is more comprehensive and more accurate than the 4As framework to review a microinsurance scheme. It should not come as a surprise, as the 4As framework is applicable to any type of product or service designed for the BoP, whereas the PACE tool is an industry specific analytical grid. Chronologically, the PACE tool was created after the emergence of the BoP literature. The publication of “*The fortune at the Bottom of the Pyramid*” in 2004 received both praise and criticism, but it is clear that it has had a great influence on development practitioners and policy-makers, as well as multination corporations (Perrot, 2011). Anderson & Billou introduced the 4As framework in 2007 as analytical framework to pursue the work initiated by Prahalad. The PACE tool was presented in 2011. Though it does not explicitly refer to the 4As framework or even to the concept of Base of the Pyramid, we can consider the PACE tool as the practical, microinsurance-specific outcome of the research around BoP markets. The PACE tool integrates a multidimensional perspective just like the 4As framework, but in addition to the marketing considerations, it also adds the criteria of social performance and inclusivity.

6.2.Limits of the case study

A first limit of the case study lies in the selection of interviewees, which may lead to bias. Indeed, for practical reasons, the selection process for both employees and external stakeholders of ACRE heavily relied on one ACRE staff. The researcher being based outside the country of the field research, the first contact with the sample, the scheduling of interviewees and the field logistics were delegated. This is not really an issue for ACRE’s employees, as the researcher

could interview all HQ staff and representatives from all functions in the field. However, when it comes to external stakeholders, it is likely that ACRE contacted clients and partners who had positive views towards the company. The number of people interviewed outside the company is also relatively small. This study is no way intending to measure client or partners satisfaction, so there is no necessity to have a representative sample. However, some issues or topics could have been identified with a larger and more diverse sample of external stakeholders. In order to mitigate this issue, the research placed emphasis on triangulating sources and multiplying different perspectives in order to check the validity and exhaustiveness of the information collected.

Other limits of the study are classical with qualitative interview-based studies. The first one is the desirability bias: interviewees tend to say what they think the interviewer expects from them. In this situation, the researcher was also identified as a shareholder's representative which may further reinforce this bias. To balance this risk, each interviewee was reminded at the beginning of each meeting that the purpose of the interview was to inform research and not to make a report to the shareholder. It was also clearly stated to ACRE's management, the interviewees and the researcher's own employer that all interviews would be strictly confidential, and that interviewees would never be quoted with their names or function, so that no information could be linked to a specific person in particular. A second typical limit in interview-based data collection is the memory bias. People interviewed in the sample may simply forget some information or details during the interview. Nevertheless, the desk review of company documentation, the multiplication of interviews and the possibility for interviewees to contact the researcher after the meeting mitigate this memory bias.

6.3. Perspectives

6.3.1. Viability strategies for agricultural microinsurance

There are usually trade-offs among the four As, or among the four dimensions of the PACE tool. When deciding on a marketing strategy, microinsurance practitioners have to make a choice: do they provide an affordable product with a low level of protection, or do they increase the level of protection (increasing the sum insured, covering various risks and reducing basis risk) even it means that fewer clients will purchase their product? The hybrid cover is a good example of how a company navigates between these constraints and adapts the design of its product to move from one priority (affordability) to the other (protection).

However, formulating the problem as an issue of trade-off between price and protection is oversimplifying. Even a free product like the RPG can struggle to meet its market if clients do not perceive the value. Non-price challenges are equally important. In particular, the literature has demonstrated the importance of trust and peer effects within the target market, and how they can determine the uptake of insurance products. Innovative distribution channels, like aggregators or mobile distribution, not only reduce costs for insurance providers, they also address the issues of acceptability, availability and awareness. The same can be said about bundling. Packaging insurance with other services and products not only reduces distribution costs, it can also increase the perceived value of insurance and improve the overall client experience, like when insurance unlocks the access to agricultural credit. It is even possible to envision a situation where other actors involved in the value chain like farm input providers, off-takers, agricultural lenders or farmers' organizations, see their own interest in having farmers insured. Mukherjee et al. (2017) identify several reasons why bundling can be an interesting opportunity for insurance companies, farmers, and agricultural value chain actors.

For insurance companies:

- Increase outreach and market penetration without the need to build their own distribution channel in rural areas
- Utilize the partner's goodwill to convince farmers to try insurance
- Reduce cost of distribution, client education and premium collection
- Reduced anti-selection and fraud (especially for mandatory products)

For farmers :

- Access to insurance in a cost-effective way
- Easier access to credit, farm inputs, and market
- Access to a variety of services in a one-stop shop
- Ease of payment of premiums

For agricultural value chain actors:

- Reduce the risk for their own business
- Boost sales of their existing products by adding insurance as an additional benefit
- Increase loyalty
- Obtain additional revenues in the form of commissions

Not only value chain actors can distribute or package insurance with their own services, they can also be willing to share the cost of insurance premiums, rather than expecting commissions. In India, Pepsico buys the production of insured potato farmers at a better price (Mukherjee et al., 2017). This, and a guaranteed market output for their production make a strong value proposition for farmers. The alignment of interests between the different players is the key to the viability of the partnership and of the business case of agricultural insurance.

6.3.2. Perspectives for further research

This case study is based on a comprehensive description of the company's products and processes. It exploits such data with two analytical grids, the 4As framework and the PACE tool, to evaluate the adequacy of ACRE's offer with the needs and constraints of their target clients, smallholder farmers. This company-centered approach could be complemented with more client data. There are many methodological options to collect client data: focus groups, satisfaction survey, socio-economic survey... If quantitative data is collected, it would also be interesting to pair such data with data from the client data base. This would allow to segment clients according to several variables: type of insurance policy, crop cultivated or livestock, geographic area, client who received a payout vs client who have not, household social or economic characteristic...

Another dimension that could be further investigated is the economic equilibrium of each type of insurance policy. The focus of the study was placed on the adequacy of the products and processes with clients' needs, but any company needs to balance these considerations with operational efficiency and economic profitability objectives. Quite often, there is a trade-off between the client value, the premium rate and the company's profitability. When designing insurance contracts, companies need to consider these three dimensions and may have to make concessions on one dimension to preserve one or the two other dimensions. Having the full picture with all three dimensions would inform the decision-making process when practitioners design insurance policies for smallholder farmers.

7. Conclusion

This case study of Kenya illustrates the variety of strategies that are available to provide agricultural insurance to the BoP, both in terms of products than in the distribution. When Eling, Pradhan and Schmit (2014) review the literature to identify factors affecting demand for microinsurance, they consider two types of variables: client-related variables (wealth, risk-

aversion, trust, religion, financial literacy, access to informal risk sharing mechanisms, risk exposure, age, gender), and insurance products variables (price, non-performance and basis-risk, quality of service). Unsurprisingly, price and basis risk correlate negatively with demand, while quality of service correlates positively with demand. Defining quality of service as a variable raises two questions though. Is it possible to give a unique score to quality of service when this aspect is fundamentally multidimensional? How customers can accurately evaluate quality of service before purchasing insurance or before filing a claim? The same study offers insights to answer the second question, as it evidences that financial literacy is positively correlated with demand. It suggests that clients who are more able to understand an insurance policy are also more likely to purchase it. However, the study also shows that risk aversion is negatively correlated with uptake. For many low-income households, insurance is a “black box” and they are not willing to spend their limited resources to try a new product which value remains to be demonstrated.

The 4As framework and the PACE tools are useful in analyzing the multidimensional setting that determine the product uptake and its client value. These two analytical approaches also contribute to assess the viability of the agricultural insurance business model in integrating the different business partners involved. The findings from this study bring nuance to the academic consensus that price is negatively correlated with demand for microinsurance. Indeed, in the case analyzed, an insurance policy available for free is struggling to meet its market. This study confirms the hypothesis brought by Prahalad (2004), Anderson & Billou (2007) and Simanis & Hart (2008), stating that price is not the only barrier preventing low-income households to have access to certain products and services. Low-income households actually face a broad range of constraints beyond income and cash availability. This realization has led to a number of new marketing approaches, aiming at designing the whole client experience around the specific demand of BoP customers, rather than simply trying to reduce costs and marginally adapting higher-end products. In the insurance sector, it resulted in the elaboration and testing of various initiatives aiming at assessing client value of insurance policies, including the PACE tool. Just like the 4As framework, the PACE tool is multi-dimensional and client-centric. Unlike Anderson & Billou’s framework though, it integrates the criterion of social performance. Indeed, these tools come from different perspectives. The 4As framework takes place in the BoP marketing literature stream, where academics as well as practitioners are looking for ways for companies to expand into BoP markets and seize the opportunity to address this untapped segment. Even if it aims at improving understanding of BoP clients, it is fundamentally

business-focused and oriented towards the growth of sales. The PACE tool was developed a few years later by development practitioners. It builds on the multidimensional approach of the 4As frameworks, but adds a social performance and development agenda. It pursues an objective of inclusivity (insurance products must be available to the largest number of households) and checks that products effectively reduce risk exposure for policyholders.

Agricultural insurance as a stand-alone product has often met low demand, especially in low-income markets. This observation has led policy-makers around the world to subsidize insurance premiums, in order to increase insurance penetration. Indeed, the largest agricultural insurance markets are also the ones where insurance is the most heavily subsidized. Nevertheless, the agricultural insurance business case could also be strengthened by assessing insurance not a separate product, but as component of a larger value proposition, for farmers but also for other agricultural value chain actors and agricultural lenders. Involving such players requires first to understand where their interests lie, what their own constraints are, in order to build sustainable partnerships. The next chapter addresses this question of aligned interests and constraints for microfinance institutions, as they can play a key role in making insurance available for a large number of households who only have imperfect risk management solutions.

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CHAPTER 5

MICROFINANCE INSTITUTIONS AND INSURANCE: WHERE IS THE BUSINESS CASE?

Microfinance institutions and insurance: where is the business case?

1. Introduction: from microcredit to microinsurance

When the term “microcredit” was coined, it could give the impression that microcredit was just traditional credit at a smaller scale. However, it appeared from the start that in order to serve properly financially excluded clients, doing business as usual was not a viable option. The group lending methodology, coupled with joint liability, as found in the Grameen 1.0 model (Armendáriz & Morduch, 2010) is a good illustration. The size of the transaction was not the only, and probably not the most important, barrier preventing low-income households to access credit. Lenders were worried that in the absence of collateral, poor borrowers would not pay back their loans. The joint liability was an innovative response to the specific issues that arise when evaluating the creditworthiness of a low-income borrower. Acknowledging that low-income households need a variety of financial services beyond credit, the term “microfinance” started to replace the word “microcredit”. For the Consultative Group to Assist the Poor, “microfinance means building financial systems that serve the poor” (CGAP, 2004). In this context, the idea to provide insurance to the poor made its way. Churchill and Matul (2012) define microinsurance as “the protection of low-income people against specific perils in exchange for regular premium payments proportionate to the likelihood and cost of the risk involved”. This definition could apply to traditional insurance, except for its specific target: the poor. In order to reach this target, microinsurance providers need to adapt their processes and operations, and rethink the distribution model. In the same way as microcredit is not only a small credit, microinsurance is more than smaller amounts insured for smaller premiums.

Poor households do not only have to deal with the fact that their income is low. They are affected by what Collins et al. call the “triple whammy” (Collins et al., 2009). Low-income households have modest income, their cash-flows are irregular and unpredictable, and the financial products available to them do not properly address the households’ needs. This situation makes poor households particularly vulnerable to external shocks. Poverty and vulnerability reinforce each other: poverty erodes resilience mechanisms, while vulnerability increases the likelihood of poor households falling into a “poverty trap” from which they cannot escape (Barnett et al., 2008) because their assets are depleted.

Microfinance institutions serve the same type of clients that microinsurance aims at reaching. We have also seen that the needs for microinsurance services are important for this segment of population. Therefore, Microfinance Institutions appear to be ideal distribution channels for

microinsurance products. Nevertheless, evidence shows that only a fraction of MFIs offers microinsurance products, and when they do, they offer only a limited range of products. In particular, even when MFIs serve smallholder farmers, agricultural insurance remains scarce. Despite the need of risk management solutions of their clients, many MFIs do not propose microinsurance. How to explain this paradox?

This chapter will first examine theoretical arguments in favour of the distribution of microinsurance products by MFIs. It will then review the different organizational arrangements available for MFIs willing to offer insurance to their clients, and the challenges they face. The specific case of agricultural credit and insurance will be further analysed. Finally, we will see how these elements drawn from the literature compare with the results of a survey answered by 36 MFIs, and discuss the conditions under which MFIs can successfully offer insurance to their clients.

2. Offering microinsurance, a non-straightforward path for MFIs

2.1. MFIs' rationale to include insurance in their service offering

Mitigating credit risk

External shocks like death, sickness or natural catastrophes, affect low-income households: they reduce their incomes, deplete their savings and assets, and in some cases may undermine their long-term livelihoods. For example, if the breadwinner in a family gets sick, he/she will not be able to work and bring money home. The family will draw on savings in order to pay for medical expenses or simply to maintain consumption and day-to-day necessities. In some cases, the household will sell productive assets, like livestock, in order to get cash rapidly. This will affect the future income of the household. If a member of this household has a loan with an MFI, the probability that he/she will not be able to repay on time increases significantly. The literature shows that external shocks play a significant role in credit defaults (Bouquet et al., 2007; Schicks, 2010). An adverse shock causing a drop of income can push a borrower into over-indebtedness.

Therefore, insurance can be a useful tool for MFIs to control credit risk. To do so, MFIs would first need to examine the reasons for default, and in particular the shocks that are more likely to deteriorate the quality of their loan portfolio.

Different risks affect differently the portfolio quality of an institution. Death risk has a low probability (borrowers are unlikely to die during the duration of the loan) and can be easily diversified (it is very unlikely that many borrowers die at the same time). Nevertheless, in case the risk event happens (a borrower dies), the probability of default is extremely high: the MFI will be unable to get its money back, unless the client has a current or savings account within the institution with sufficient funds. Furthermore, if some clients in the portfolio have an outstanding loan much larger than average loan size, the death of one borrower may significantly deteriorate the portfolio quality of the institution. On the other hand, for an MFI with a large agricultural portfolio, a drought can result in a rapid increase of the portfolio at risk. In this case, the external shock exposes the MFI to the risk of bankruptcy.

Developing the business

Depending on the organizational arrangement (see section 2.2 below), an MFI distributing insurance products will obtain an additional income, usually in the form of a commission on each policy sold or through underwriting gains if the insurance bears the risk itself. Compulsory products linked with the credit are an easy way to reach scale quickly. In many institutions, borrowers are required to take-up a compulsory life insurance policy that covers the loan amount. This type of product is usually quite simple, standardized and cheap, in the sense that the premium represents a small part of the interest and is therefore almost “invisible” for the client. Credit life insurance is nowadays the second most common microinsurance product in Africa and in the Latin America and Caribbean region (Microinsurance Network, 2016; Microinsurance Network, 2018) both in terms of lives covered and in terms of premium amounts.

For products based on voluntary take-up, the MFI will need to invest, in the form of marketing campaigns, or time spent by loan officers explaining the products to the clients. Low-income clients often have a low financial literacy and a limited experience with insurance. Therefore, the effort and investment required to convince them to take insurance can be significantly more important than for more well-off clients. In this case, the business development opportunity needs to be assessed: products based on voluntary take-up often charge higher premiums, meaning the commission received by the MFI will also be higher, but they are harder to sell.

However, leveraging on the existing relationship established by MFIs with their clients, cross-selling opportunities exist. The new microinsurance products will benefit from the MFI’s reputation and trust. Therefore, the acquisition and transaction costs to sell insurance policies

should remain significantly lower than setting up a specialized distribution channel of insurance sales agents.

Selling insurance policies can also be the way for an MFI to attract new clients, especially those who are not interested by a loan. Selling to non-clients present however a higher risk of adverse selection (Roth et al., 2005).

Fulfilling the social mission

For MFIs having a strong social focus in their mission, linking insurance and credit can be a way to reach their social objectives.

We have seen that low-income households are particularly vulnerable, and therefore would benefit greatly from having access to adapted insurance products. Microinsurance improves the resilience of poor households by protecting their income, their assets and their livelihoods. Impact studies have also shown that even in the absence of a risk event, insurance can play a positive role.

Rademacher et al (2010) reviewed the impact of health microinsurance, and found that in 13 out of 15 studies, access to health microinsurance led to an increase in healthcare utilization. In another literature review, De Bock and Ontiveros (2013) find that for most health microinsurance schemes studied, it is possible to observe an increase in healthcare services utilization and a reduction in out-of-the pocket expenses. They also find that health and agricultural insurance reduce the recourse to expensive coping mechanisms, like selling productive assets. Insurance affects positively the livelihoods of the insured in the long term. Bertram-Huemmer and Kraenert (2015) led empirical research in Mongolia, to determine if index-based livestock insurance helps herders' households recover more rapidly. They find that after the 2009-2010 winter disaster that struck Mongolia, and caused the worst livestock losses ever recorded, households who had bought insurance and received a payment had a significantly larger herd size in 2011, 2012 and 2013 than those who had not purchased insurance. This case shows that a shock can have a long-lasting impact on affected households, and that the difference between indemnified and non-insured households can be observed even several years after the event. The J-PAL, CEGA and ATAI (2016) compiled several randomized control trials to measure impact of index insurance. The review shows that insurance modifies farmers' behaviour, even in the absence of a shock and of a payment. Insured farmers adopted riskier, but more profitable production strategies. In Ghana (Karlan, Osei, Osei-Akoto, & Udry, 2014), farmers were randomly offered free rainfall index-insurance, cash grants, both cash and

insurance, or nothing. Farmers receiving insurance increased total farming expenditure, fertilizer use, and land cultivated. They also increased the land dedicated to maize and decreased the production of drought resistant fruit crops like mango. Farmers receiving cash also increased their use of fertilizer, but with less dramatic impact on other production decisions. This result suggests that risk, not cash, is the main obstacle preventing farmers from changing their behaviour. In Andhra Pradesh and Tamil Nadu in India (Cole et al., 2017; Mobarak & Rosenzweig, 2012), farmers benefitting from weather index insurance shifted from drought-resistant varieties to higher-yield seeds. Similar effects were observed for area-yield insurance products. In China, expanding access to insurance led to 22 percent increase in the production of tobacco, the insured crop. In Mali, cooperatives that were offered crop insurance saw a 0.39 ha increase in planted land, a 15 percent increase over the comparison group.

Conclusion

From the MFIs' point of view, there are both financial and social arguments in favour of the provision of insurance services to their clients. Insurance can improve the quality of their portfolio by reducing the probability of default due to an uninsured shock event. It is also a source of additional income and a way to attract potential new clients. Insurance also has the capacity to improve the wellbeing and resilience of its clients, allowing MFIs to pursue further their social mission with the provision of an additional service.

2.2. Organizational set-ups for MFIs

Churchill and Roth (2006) identify four types of institutional arrangements available to MFIs willing to offer insurance to their clients.

The partner-agent model

McCord (2006) defined this model, which is based on a partnership between an insurance company and an MFI. In this model, MFIs play the role of an agent for the insurers. For MFIs, this model is probably the simpler, cheaper and faster way to start offering insurance products. By collaborating with an insurance company, MFIs limit their own risk exposure, increase their revenues through commissions and improve the protection for its clients and the MFI itself. From the insurer's point of view, MFIs represent an immediate access to a large number of low-income clients without having to deal with each client individually. This institutional arrangement is also positive for the clients who benefit from insurance services which access was initially limited. Collectively, they represent a large number of clients, which means that

the MFI can co-create with the insurer a product that suits their needs, and at a better rate. They can rely on the MFI to defend their interest and enforce the guarantee.

The broker model

An MFI (or a group of MFIs) can decide to create an insurance broker. This model is a refinement of the partner-agent model. The advantage of creating a dedicated brokerage company is to develop insurance expertise, in order to obtain better deals with insurers. As the broker is not tied to any specific insurer, it has the capacity to work with different companies in order to serve better the MFI and its clients.

Self-insurance

MFIs can decide to self-insure for various reasons. They may not be satisfied with the offer of existing insurers; they may consider that insurance is a very profitable business and want to keep the underwriting gains for themselves or they refuse to have their clients pay for the insurer's operating costs. Self-insurance can be a tempting option for basic credit life insurance, as the risks are usually not covariant and the main beneficiary is the insurance company itself. However, self-insurance must be considered very cautiously. Even for simple products, MFIs need to have a sufficiently large pool to diversify the risk. MFIs often lack the skills and assets to manage efficiently insurance products. With no access to the reinsurance market, covariant risks expose MFIs to catastrophic risks. So can poorly designed policies, or improper risk evaluation. CARD in the Philippines and TYM in Vietnam are two MFIs that almost went bankrupt after venturing into insurance. These two institutions had successfully piloted life insurance products before offering more covers to their clients, without having properly assessed the risks associated (Churchill & Roth, 2006).

Creating an insurance company

Rather than self-insuring, an MFI or group of MFIs may choose to create its own insurance company. This model can follow the broker model, once the brokerage company has accumulated sufficient expertise in underwriting and claim management. Compared to self-insurance, creating an insurance company bears several advantages:

- Clear separation of the insurance and credit risks
- Accumulation of insurance expertise
- Access to reinsurance markets
- Possibility to collaborate with different distribution channels.

This was the path taken by the Réseau des Caisses Populaires in Burkina Faso. This cooperative network initially self-insured the risk of death of their borrowers. Then it created its own life insurance company, which offers a greater variety of products: CIF-VIE Burkina. CIF-VIE Burkina even started to distribute its life insurance policies through other MFIs and financial institutions, reaching an even greater number of low-income clients.

2.3.Challenges faced by MFIs willing to distribute microinsurance

Demand challenges

As we have seen in chapter 4, demand for agricultural microinsurance products from smallholder farmers is low (see chapter 4, section 2.1). We can extend these results for all microinsurance products, and all low-income households in general. Indeed, they all face the same barriers: low financial literacy, especially with insurance, limited resources, imperfect adequacy between the insurance coverage and the real risk exposure, alternative risk management mechanisms.

Distributing insurance products to their clients requires an important investment in sales and marketing from MFIs. Such investments can be split between the MFI and the insurance company, as both parties are interested in achieving a high volume of sales. Nevertheless, given the current low demand of insurance (De Bock & Gelade, 2012), the return on investment is uncertain. In particular, MFIs may be worried to dedicate loan officers' time and attention in non-strategic products, instead of focusing on their core, profitable, lending business. Loan officers themselves are likely to be reluctant to sell microinsurance products if their variable remuneration remains based on the size and quality of their loan portfolio. Selling insurance through MFIs requires implementing specific incentives for loan officers.

Operational issues

An MFI selling microinsurance to its clients will have to modify its operational processes. First, as we have seen, insurance products are complex, which means that the staff will need training. Loan officers must be able to understand the features of the insurance products (risks and sum covered, exclusions, premium calculation...). They will also need to be able to explain these to the clients and give a convincing sales pitch. A case study of a rainfall index insurance product in India points that loan officers tend to offer always the same type of insurance, and not adapt to the needs of the clientele (Giné et al., 2010). Besides the salesforce, MFIs may want to acquire insurance expertise themselves. Even in the most common case in which they bear no

risk, MFIs need some insurance knowledge to select the most adequate products that fit their clients' needs, but also minimize the risk of default.

The MFI must also put in place processes for operations like enrolment, premium collection, policy issuance, claim management and payment. New administrative tasks will have to be performed, new forms issued and the MIS may need an update. All these adjustments can result in operational inefficiencies. An important aspect often overlooked is the resources needed to manage the partnership with the insurer and other stakeholders (Rendek, 2012). Before the introduction of the products, the partners must define together the right offer and the way they manage processes and how responsibilities and costs are shared. Once the partnership is operational and insurance policies are being sold, efficient reporting and communication channels are required to ensure a smooth implementation.

Risks

In the institutional arrangements involving a partnership with an insurance company, MFIs need to be careful on the selection of their partner. Any misconduct or failure from the partner may affect the MFI's own reputation and the trustful relationship it has built with its clients. In particular, if the insurance company fails to deliver its promise to indemnify policyholders in case of a risk event, clients will lose faith in the product, and possibly distrust the MFI that sold the product. For clients, the only entity they dealt with is the MFI, so they expect the MFI to keep its commitment regarding the insurance they bought. A bankruptcy or fraudulent intents to deny payouts would have devastating consequences on the MFI's reputation. Moreover, even if the insurer is solvent and honours the contract, the clients may feel that they are being cheated. Exclusions or overcomplicated administrative processes to file a claim can lead clients to believe that the insurer (and by extension the MFI) is not reliable. It is well established that microinsurance clients give a high importance to the promptness of claim settlement. Any administrative hurdle that unnecessarily delays payment should therefore be avoided.

In the case of an MFI bearing the risk itself, or when an MFI creates an insurance company on its own, large losses result in large liabilities and potentially bankruptcy. In particular, MFIs usually do not have in-house actuarial skills. Therefore, they may underestimate these risks and be unable to pay claims.

Another challenge is the issue of basis risk for index-insurance. If a farmer suffers a shock but the index fails to recognize the loss or underestimates it, two problems arise. The client is not compensated for the loss; he/she will likely not renew the policy and express discontent about

the product and the MFI. Furthermore, the absence of payout puts the client in difficulty to pay back his/her loan, exposing the MFI to a risk of default.

Finally, there is the risk of mismatch between the insurance product and the client risk exposure, if the insurance does not protect the client against the relevant risk, or if the level of protection is not sufficient. To continue with the example of a farmer, a farmer may buy a drought insurance cover but be exposed to many other perils. In addition, the policy may bear a very high deductible whereas the client has very limited resources to cope with a shock.

Conclusion

Broadening the range of services offered to their clients does not come without risks and costs associated. MFIs willing to offer insurance to their clients must evaluate if the business case is there. A study of a microinsurance scheme implemented by the Indian MFI ASA (Roth et al., 2005) shows that even when loading the premium handed over to the insurer by a factor of three, the profitability of the product is marginal. Cross-selling opportunities may not be as easy to catch as initially thought, considering the willingness to pay for insurance of low-income households.

3. The case of agriculture

3.1. Farmers, underserved among the underserved

If MFIs target segments of the population that are traditionally under or poorly served by financial institutions, they keep ignoring a large part of this population: farmers. Farmers, especially smallholder farmers, are perceived by many MFIs to be more difficult to serve because they bear specific risks and costs. Clarke and Dercon (2009) classified those challenges into four categories: information asymmetries, transaction costs, enforcement constraints, and ambiguity aversion. Information asymmetries have the well-known effect of restricting the provision of credit and insurance because of moral hazard and adverse selection behaviours. Transaction costs are high because financial services providers must deal with many small transactions, and geographically dispersed clients. These administrative and operational costs can represent a large proportion relatively to the size of the transaction (Rojas & Rojas, 1997). Enforcement problems arise when borrowers can be tempted to strategically default, and lenders have difficulty to distinguish between lack of capacity and lack of willingness to repay. The use of collateral to induce repayment in this context is often costly and ineffective, if not

limited by regulation. Finally, ambiguity aversion refers to the preference of MFIs to serve clients with whom they are familiar, rather than learning the complexities and specific risks of the agricultural sector (Binswanger & Rosenzweig, 1986). Meyer et al. (2017) add a fifth barrier, which is the systemic and covariant nature of agricultural risks, like price and production risks. In case these risks materialize, they will affect a large number of borrowers at the same time. Unlike larger lenders, MFIs have less possibility to diversify their risk spatially (Barnett et al., 2008). Hence, using a longitudinal dataset of agricultural MFIs in Mexico, Peru and Ecuador, Abrego & Guizar (2017) find that rainfall shocks have a significant negative impact on portfolio quality. In the absence of efficient mechanisms to manage those risks, MFIs are likely to ration credit in order to limit their exposure.

Some of these challenges exist for all MFIs clients, but they are exacerbated in the case of farmers. Röttger (2015) shows that traditional risk and cost management mechanisms commonly put in place by MFIs are not adapted for clients engaged in agriculture. For example, microcredits demand quick and frequent repayments whereas farmers obtain revenues only once they sell their crop, and would therefore prefer a bullet repayment at the end of the cycle. Maurer (2014) denies that lending to agriculture is significantly different and riskier than lending to other micro and small enterprises. Indeed, data showing a significantly higher risk of agricultural loans is scarce (Meyer, 2011). Nevertheless, only a fraction of the smallholder farmers' demand of financial services is currently satisfied. A 2016 report (Goldman et al., 2016) estimates that value chain actors, informal and informal financial institutions together provide 50 billion USD in credit to smallholder farmers in Africa, Latin America and South and South East Asia (excluding China), when the potential demand amounts to 200 billion dollars.

3.2. Insurance, the silver bullet to unlock agricultural credit markets?

Production risk pressures farmers and financial services providers, limiting the provision of credit. In the presence of risk, farmers can be reluctant to apply for a loan because they fear they will not be able to repay, especially when the lending institution requires a highly valued collateral (Boucher et al., 2008). Instead, farmers prefer adopting low-risk, low-yield production strategies. Even when they do apply for a loan, farmers may not obtain it because lenders choose to ration agricultural credit to limit their exposure to this production risk. In the presence of risk, agricultural credit markets are sub-optimal because bankable projects are not financed. Insurance, if it adequately protects the farmer and the lender against production risk, has the potential to unlock the credit supply and demand.

Farmers will be encouraged to buy insurance and borrow if they anticipate that the new investment will generate an extra income sufficient to cover the premium price. If the project fails due to an insured event, farmers will not be pushed into over-indebtedness as the claim payment can be used to repay the lender. One of the attractive features of credit-linked insurance is that the premium payment can be embedded within the loan, overcoming cash-flow constraints that farmers may face at the moment of buying insurance (Hess et al., 2016). Financial services providers can use insurance as a form of collateral. In particular, the insurance contract may specify that the lender is the first claimant of the payment, preventing borrowers to strategically default when there is a payment from the insurance. Carter et al. (2016) show with a theoretical model that the value of credit-linked insurance is the greatest in environments where farmers have limited collateral to offer. However, insurance is not efficient in all environments, especially when risk is not the primary barrier or when the nature of risk makes insurance relatively ineffective to cover the risk. In favorable conditions though, insurance is likely to boost credit markets and the adoption of improved technology, generating a positive outcome for the farming household. The question of whether insurance adequately covers against production risk has to do with the issue of basis risk in the case of index insurance. Indeed, as Clarke has shown (2011), an insured farmer can be worse-off in the case he/she faces a production loss without receiving a payment from the insurance, and having paid the premium.

3.3. Organizational options to link credit and insurance in agriculture

Insurance can remove some of the barriers preventing farmers to get access to credit, and the provision of credit appears as an efficient way to distribute agricultural insurance policies. The question of how to link credit and insurance, through which organizational arrangements and partnerships between Financial Services Providers (and in particular MFIs) and the insurance sector must be addressed. As index insurance is the current preferred approach to insure smallholder farmers against natural perils (Hazell et al., 2010; Hess et al., 2016), we will focus on this particular type of agricultural insurance. Skees and Barnett (2006) as well as Meyer et al. (2017) propose similar but not exactly identical classifications of credit and insurance linkage mechanisms. We synthesize these two classifications and identify five different modalities to link credit and insurance.

1) Insurance as a stand-alone product

Farmers buy insurance as a separate product from their loan, and enrolment is on a voluntary basis. Farmers can choose to insure a sum equivalent to the value of their loan, but also have the possibility to increase this amount, if they want to cover the value of their production. Farmers pay the premium up front. In this case, the MFI plays the role of a sales agent, insurance being just an additional service offered to its clients. MFIs collect premiums on behalf of the insurers and are remunerated through sales commissions.

2) Insurance embedded within credit

In this setting, insurance is automatically included in each agricultural loan. Insurance may be compulsory to be eligible to a loan, or it may replace other forms of collateral. Farmers can still have the option to cover more than the amount of their loan. The premium is added to the amount borrowed, so farmers do not have to make an upfront payment.

Making insurance compulsory brings several advantages: it makes possible to reach rapidly a critical scale, it reduces administrative and operations costs, it ensures that the whole loan portfolio is covered and it avoids adverse selection issues. The main drawback is that insurance increases the cost of credit. Farmers may not perceive the value of the insurance and see it merely as an additional cost. Farmers may choose to borrow from other sources, or be excluded from obtaining a loan because it simply is not affordable anymore. In markets where interest rates are low, the insurance premium will weigh more significantly in the total cost of the financing. On the contrary, when interest rates are high, the cost of insurance is less visible. Compulsory insurance also raises the question of the insurance client value: Does the insurance policy effectively protect the farmer against natural perils? What is the level of the basis risk? Is the insurance price “fair”?

When insurance is embedded within credit, the question of who receives the payment must also be raised. Usually, MFIs prefer to be the first claim recipient, in order to use the insurance payment to write-off the loan. Any residual amount would be transferred to the client. In some countries, regulation prevents such mechanisms and requires that the client, who paid the premium, is the policyholder. When farmers receive directly the payment, they still have the possibility to strategically default and use the cash received to smooth consumption. Insuring more than the loan amount is a way to ensure that the farmers’ consumption needs will be met in the case of a production loss, but this option increases the cost of insurance.

3) Portfolio cover

Portfolio (or “meso”) insurance has gained a lot of interest in the last years. Indeed, options 1) and 2) require managing multiple individual policies, which brings inefficiencies and costs. When take-up is on a voluntary basis, reaching scale has proved to be an issue (De Bock & Gelade, 2012). They also leave farmers exposed to basis risk. The portfolio cover approach overcomes these difficulties. With this setting, the MFI purchases index insurance for itself, to cover its own portfolio. Indeed, as natural perils and the resulting production losses faced by their borrowers affect portfolio quality, MFIs are willing to purchase insurance for themselves. The link between individual loans and insurance no longer exists. Insurance is rather used as an internal risk management tool to protect the MFI from defaults due to large and systemic risks. Large and systemic risks put MFIs in a difficult situation on the liquidity front. Clients are likely to withdraw their deposits to cope with the crisis when at the same time borrowers’ payment defaults increase.

One difficulty of meso-insurance is how to pay the insurance premium. As the borrowers do not directly benefit from the insurance cover, it is not possible to charge them the price of the premium. The only way to pay for the premium is to “hide” the cost of insurance inside the interest rate, which raises the question of competitiveness for the MFI. It may even be impossible if interest rates are capped by the regulation. Meso-cover are likely to be cheaper than individual covers though. First, there are a risk diversification and an economy of scale effects resulting from the creation of a large risk pool. Second, the level of protection needed by an MFI (which depends on the sum insured and the deductible) is likely smaller than the sum of individual policies. Indeed, we can assume that MFIs are more resilient to production losses than smallholder farmers, as they have more efficient coping mechanisms (like drawing on their provisions or accessing external capital). Furthermore, if production losses directly reduce farmers’ revenues, the effect is less direct for MFIs because farmers who suffer production losses will not always default on their loans. They may use other sources of income, sell assets or use their savings to maintain their creditworthiness towards the MFI. These elements combined suggest that the premium for a meso-cover insurance will likely be smaller than the sum of individual insurance policies. As Skees and Barnett (2006) put it, when considering buying a portfolio cover, MFIs must compare the cost of the premium with the cost of capital in a time of crisis.

Another limitation of the meso-cover is that the benefits do not trickle down directly to farmers. In the case of a shock leading to an insurance payment, the MFI is protected but the individual loans are not written-off and farmers will keep struggling to maintain a good repayment record

with the MFI. It is possible to imagine a situation in which an MFI recovers quite well from a large natural risk, but in which many of its clients are over-indebted and unable to apply for a new loan. Whether the MFI decides to use the claim payment to forgive loans is at its discretion and asks a number of questions (who gets to have their loan forgiven, what about the risk to set a precedent of loan forgiveness and the impact it may have on future portfolio quality...).

4) Hybrid meso and individual cover

This option takes elements from the options 2 and 3. Like in the meso-cover, the MFI purchases one index-insurance policy for its entire loan portfolio. However, the insurance proceeds are used to written-off individual loans, like in option 2. Skees and Barnett (2006) imagine a system in which the MFI assesses the actual losses suffered by the borrowers to write-off part or the entirety of the loan. In this system, the MFI decides on the allocation of the insurance payment according to its own evaluation of the production losses in the field. The main benefit of this model is that it mimics an indemnity-base insurance product as it compensates clients according to the actual individual losses. It avoids basis risk for individual farmers, while taking advantage of index-insurance markets.

This approach poses questions though. When there is no regulatory impediment, does the MFI have the capacity and legitimacy to assess production losses? In addition, if the MFI is willing and capable to perform these loss adjustments, the process will likely be time and resource consuming. One of the main benefits of index insurance is that losses are automatically calculated, which saves on loss adjustment costs and allows for prompt claim settlements. Skees and Barnett (2006) also identify another difficulty with this option. As the insurance payment is distributed to farmers in proportion to their individual losses, we are facing then a zero-sum game in which each farmer has interest to declare a loss hoping to receive part of the insurance proceeds. In the authors' words, "any payment made to one borrower reduces the amount available for other borrowers".

5) Index-insurance as a form of reinsurance

In markets where traditional indemnity-based agricultural insurance is the norm, but local insurance capacity is limited, index-insurance can be used as a form of reinsurance. Like in options 1) and 2), farmers purchase directly or with their loan an indemnity-based insurance. MFIs serve as a distribution channel, or in case 2) may be the policyholder. The problem is that in many countries, local insurance companies are not willing to take agricultural risks, due to the systemic nature of these risks (Hazell et al., 2010; Sandmark et al., 2013). Local insurance companies can choose to buy index-insurance as a form of reinsurance if this risk-transfer

mechanism is more cost-effective. In option 5, index insurance is a tool that facilitates the development of local agricultural insurance capacity through the transfer to international financial markets of large and catastrophic risks.

3.4. Conclusion

Distributing insurance through MFIs makes sense for many insurance business lines, like life and health insurance. In the case of agriculture, credit and insurance reinforce each other: insurance allows controlling default risk of agricultural loan portfolios; it can also increase the value proposition of credit by facilitating the adoption of new technologies and profitable productive strategies. Different credit and insurance linkage mechanisms are available, each with their own strengths and weaknesses. Quite often, there is a trade-off between offering a high level of protection to farmers and reaching a large scale at a low price.

4. Evidence from the field

4.1. Method and sample

The results presented here are drawn from an online survey. It was sent to 58 MFIs with which the Grameen Crédit Agricole Foundation had a business relationship. This means that all the MFIs surveyed had an on-going loan, guarantee, or equity investment from GCAF, or had hosted a due diligence mission in order to put in place such a transaction. The 58 MFIs were contacted by email in September 2017. The primary purpose of the survey was not to benefit this research, but rather to help GCAF define the best approach to support MFIs willing to engage in insurance, by understanding their interest and their challenges. However, lessons can be learnt from this survey about the attitude and perception of MFIs towards microinsurance. GCAF posted the survey on the www.surveymonkey.com website in English and in French. Each question appears on the screen after the other, so respondents do not have the possibility to anticipate on the next question. 36 out of the 58 MFIs (62%) who had received the invitation to fill the survey answered it.

Table 19 - Descriptive data of the MFIs' sample, per region

Region	Number of MFIs	Average number of active borrowers	Average loan balance in EUR	Average portfolio size in EUR	Average PAR30	Average number of clients per loan officer
ECA	3	18 464	827	12 013 813	2.6%	147

MENA	3	61 933	1 759	59 417 626	3.6%	284
SSEA	10	112 661	792	97 314 359	1.7%	308
SSA	20	26 302	327	7 719 087	6.2%	531
Total	36	52 607	617	37 272 768	4.4%	416

Table 20 - Descriptive data of the MFIs' sample, per portfolio size

Region	Number of MFIs	Average number of active borrowers	Average loan balance in EUR	Average portfolio size in EUR	Average PAR30	Average number of clients per loan officer
Tier 1	4	173 467	2 017	246 582 448	2.0%	221
Tier 2	14	57 855	677	19 492 314	2.9%	343
Tier 3	18	21 667	260	4 588 748	6.2%	517
Total	36	52 607	617	37 272 768	4,4%	416

The majority of the respondents are from Sub Saharan Africa (SSA), followed by South and South East Asia (SSEA), the Middle East and North Africa (MENA) and Europe and Central Asia (ECA). In the ECA region, the average loan balance per borrower is 827 euros, and the PAR30 (portfolio at risk, with arrears of 30 days or more) represents 2.6% of the total outstanding loan portfolio.

Half of the MFIs in the sample are Tier 3 MFIs (portfolio size below 10 million US dollars), 14 are Tier 2 (portfolio comprised between 10 and 100 million US dollars) and four are Tier 1 (portfolio above 100 million US dollars). On average, Tier 1 MFIs have a better portfolio quality, as measured by the PAR30 (2%), they disburse bigger loans (average loan balance is 2,107 euros) and their loan officers follow a smaller number of clients (221). On the other hand of the spectrum, Tier 3 MFIs have a lower quality of portfolio (PAR30 = 6.2%), they offer smaller loans (average loan balance = 260 euros) and show a larger number of clients per loan officer (517).

The MFIs in the sample are not a heterogeneous group. Some MFIs only lend to individuals when others rely on group lending, which partly explains the difference in clients per loan officer. The type of client they target and the local purchasing power has an impact on the average loan balance. Some are small institutions with a regional footprint whereas others have a national presence.

Table 21 - Heterogeneity of the sample

	Number of active borrowers	Average loan balance in EUR	Portfolio size in EUR	PAR30	Number of clients per loan officer
Min	3 109	79	1 005 179	0.1%	90
Median	27 330	301	9 924 171	3.6%	328
Average	52 607	617	37 272 768	4.4%	416
Max	326 892	3 844	440 187 482	13.8%	1 947
Std deviation	66 785	800	86 003 178	3.4%	364

The smaller MFI in terms of active borrowers has 3,109 active borrowers, when the larger has 326,892 active borrowers. The average loan balance varies between 79 and 3,844 euros across the portfolio. The size of the loan portfolio goes from 1 million euros for the smallest MFI, to 440 million euros for the largest. Portfolio quality is also extremely heterogeneous, with a PAR30 varying between 0.1% and 13.8%. The number of clients per loan officer is comprised between 90 and 1947, reflecting both differences in productivity and credit methodologies.

GCAF explicitly targets MFIs that have a strong presence in the rural areas and dedicate a significant part of their portfolio to lending to the agricultural sector. 13 MFIs from the sample are part of a special facility designed to provide financing and technical assistance to rural MFIs in Sub Saharan Africa.

We also checked if the MFIs from the sample had received a rating. We checked public ratings given by MF-Rating, MicroRate and M-Crill, the three agencies specialized in MFIs rating. However, only six MFIs in the sample had a recent rating (i.e. between 2016 and 2018) which does not allow drawing conclusions.

The survey is made of closed (yes/no or multiple choices) and open questions. As expected, the closed questions have a higher response rate than the open questions (participants had the possibility to skip questions). Open questions however provide rich and qualitative insights on issues like challenges limiting MFIs from entering the microinsurance market. The questionnaire is available in Appendix 3 - Online questionnaire filled by MFIs

4.2.Results

Rationale and challenges to offer microinsurance

69% of the surveyed MFIs currently offer some insurance to their clients, through different organizational arrangements and partnerships. This rate is higher in SSA (80%) than in the other regions: 67% in ECA and MENA, and only 50% in South East Asia.

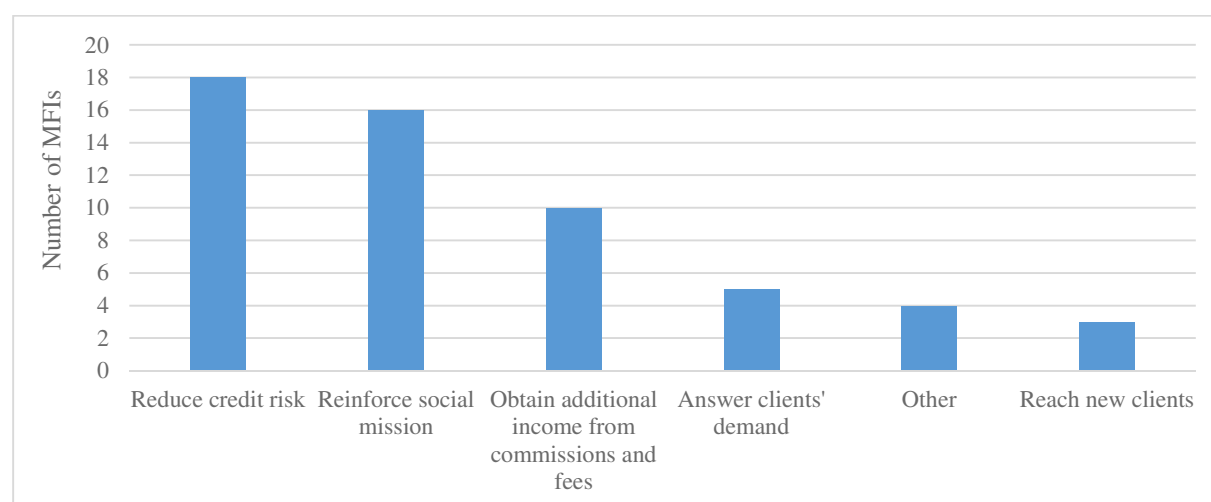
Table 22 – Answers to the question "Do you offer any insurance product(s) to your clients?"
NB: This includes mandatory credit life policies offered to borrowers.

Do you offer any insurance product(s) to your clients?	ECA	MENA	SEA	SSA	Total
No	1	1	5	4	11
Yes	2	2	5	16	25
Total général	3	3	10	20	36

For the MFIs that do not offer insurance, regulation is the most often cited barrier (5 out of 11), either because it prevents them to do so ("not allowed by central bank"), because regulation imposes an insurance agent license to offer insurance products, or because MFIs find the legislation not adapted ("the legislation is not developed for microinsurance in [country]"). The other reasons given are the lack of in-house expertise, the premiums that they consider not affordable, or in one case the absence of microinsurance offer in the market. One MFI stated microinsurance was not a strategic issue.

For MFIs offering insurance to their clients, the two most cited reasons to do so are the reduction of credit risk (72% of the MFIs) and the social mission (64%).

Figure 17 - Answers to the question: " What are your main reasons for offering insurance to your clients? Please select up to 3 answers."



15 out of the 25 MFIs indicated that insurance is mandatory, and 12 make life insurance mandatory in order to protect the client and the institution against the risk of death.

Business development reasons (obtaining additional income or reaching new clients) appears less important. For the five MFIs who stated that they offered microinsurance to answer their clients' demand, four out of five also cited the social mission as a reason, but only two cited the additional income they could get from it and none cited reaching new clients. It is risky to draw conclusions from such a small sample, but for the MFIs surveyed, answering clients' demand appears to be more about improving client's wellbeing than increasing revenues or the client base.

Only ten MFIs declared to offer voluntary insurance products. For half of them, the insurance has no impact on their lending methodology. One MFI stated that insurance lowers the interest rate, another MFI that it loosens the requirements to obtain a credit and another one that insurance is accepted as a collateral. One MFI mentioned that insurance affected positively the institution by strengthening the social mission and attracting more clients. On the other hand, one MFI related difficulties with a livestock insurance product, which in the end harmed the development of their livestock loan product because clients perceived it as too expensive and complex.

20 out of the 25 MFIs offering microinsurance gave specific details about the difficulties they faced when introducing insurance products. Ten MFIs advanced reasons around the fact that clients do not know or have experience with insurance products. Financial illiteracy and lack of trust towards the products are common among the clients: "a lot of clients don't believe to insurance system, because they didn't experience in past."; "uncertainty (sic) of whether the insurance firm will pay in case of death"; "lack of understanding"; "weak insurance culture due to the social context of [country]⁷". Five MFIs mentioned the price as one of the main obstacles: "clients are reluctant because they find the insurance premiums too high⁸"; "value for money challenge"; "additional cost to the borrower thereby making loans expensive". Other reasons mentioned have to do with the extra burden for loan officers, the commissions that are too low and the difficulty to negotiate with insurance companies. For these MFIs, the business case of microinsurance appears to be a challenge. One MFI cited religious beliefs to be an obstacle, and another cited regulation and staff training. Three MFIs stated they faced none or no major difficulty.

Opportunities for development

⁷ Original quote in French

⁸ Ibid

For the 25 MFIs that already offer microinsurance products, insurance is an area for development. 36% are already investing in the expansion of their insurance offer and 32% intend to do so in the short term (in 1 to 3 years).

Table 23 - Answers to the question "Do you have any current or future plans to expand your insurance offering?"

Do you have any current or future plans to expand your insurance offering?	Number of MFIs
No	3
Yes, we are already investing in it	9
Yes, in the short term (1-3 years)	8
Yes, in the long term (more than 3 years)	1
No answer	4
Total	25

For the 11 MFIs that do not have an existing insurance offer, most of them intend to introduce microinsurance products to their clients. From the total sample, only four MFIs (11%) do not offer insurance and do not plan to do so in the future. Their reasons advanced are regulatory obstacles for three of them, and the absence of microinsurance product in the market for one MFI.

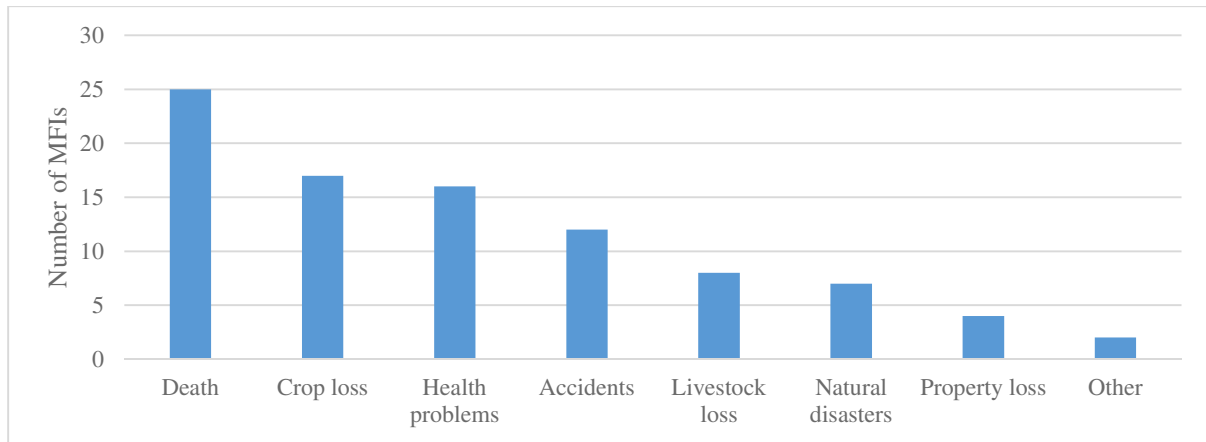
Table 24 - Answers to the question "Do you have any current or future plans to start offering insurance to your clients?"

Do you have any current or future plans to start offering insurance to your clients?	Number of MFIs
No	4
Yes, we are already investing in it	1
Yes, in the short term (1-3 years)	4
Yes, in the long term (more than 3 years)	2
Total	11

When asked about the risks that their clients would like to cover by insurance, the most commonly cited risks are death (69% of the total sample), crop loss (47%) and health problems (43%). 4 MFIs (11%) did not answer this question.

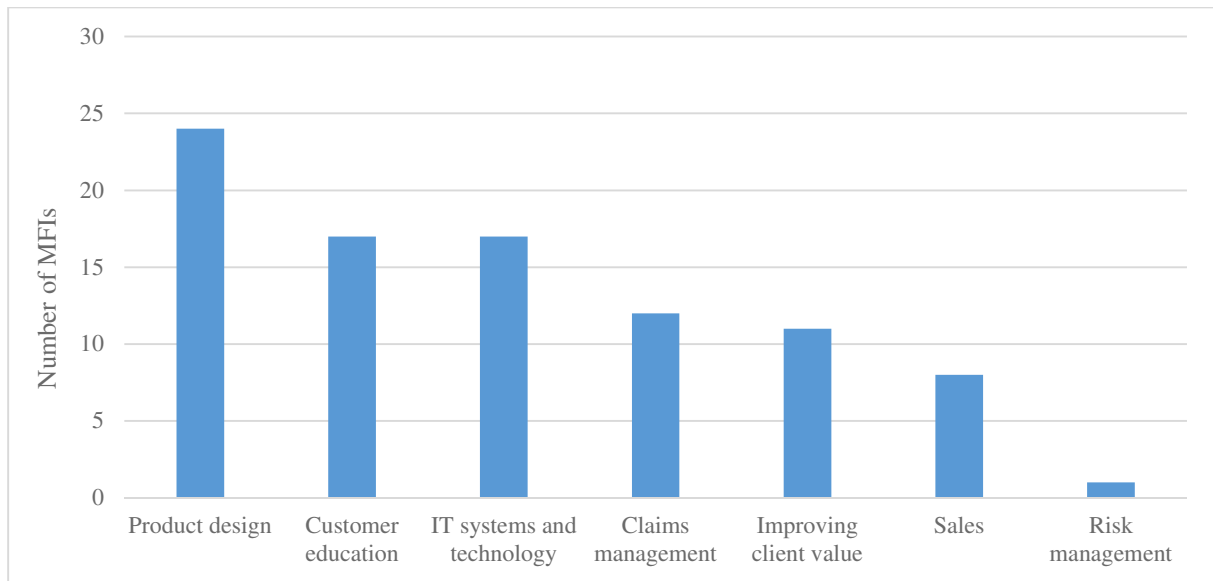
The high importance given to crop, but also livestock loss risk (22%) is most likely affected by the investment policy of GCAF, as this investors targets MFIs offering services to the rural and agricultural sectors.

Figure 18 - Answers to the question "Based on what you know about your clients, what would you say are the risks they would be most interested in covering through insurance? Please select up to 3 answers."



Regarding the support needed to introduce or expand the microinsurance offer, MFIs ask for assistance in the product design (67% of the sample), customer education and IT systems and technology (47% each). The high importance placed on customer education is consistent with the difficulties expressed by the MFIs regarding the lack of financial literacy and insurance culture of their clients. The question of technology did not pop up before in the survey but appears to be an important topic as almost half of the sample declared to need support in this field. 5 MFIs (14%) did not provide any answer to this question.

Figure 19 - Answers to the question "In which areas do you think your organization needs more support? Please select up to 3 answers."



5. Discussion

5.1. Sample

The MFIs surveyed here are far from being representative of the global microfinance industry. Instead, the sample illustrates the investment policy of GCAF. There is no MFI operating in the Latin America and Caribbean region, or from high-income countries of Europe or North America. Second, in terms of MFI portfolio size, Tier 2 and Tier 3 MFIs are over-represented. Tier 1 MFIs serve a large number of clients in the world and concentrate the larger part of microfinance portfolios, but they represent only 11% of the sample of the survey. In addition, GCAF tends to favor MFIs operating in rural areas and serving women, whereas the microfinance sector is mostly developed in urban areas. On the other hand, the sample also excludes MFIs that do not meet GCAF investment criteria because they are too small, or their performance is too weak (profitability, portfolio quality, operational self-sufficiency...). These MFIs are at the lower end of the Tier 3 segment (sometimes referred as “Tier 4”). Rather than representing the microfinance sector as a whole, the results of the survey are biased toward Tier 2 and large Tier 3 MFIs operating in Sub Saharan Africa and South and South East Asia.

5.2. Defining the business case of microinsurance for MFIs

As development practitioners and policy-makers identified the possibility to protect the poor through the provision of “micro” insurance products, it seemed natural to use the same

distribution channels used for credit and savings. MFIs would simply offer insurance as an additional service to their clients. Experience proved that selling insurance to the poor through MFIs was not easy. Challenges exist on both the demand and supply side. Especially, from the MFI perspective, the profitability of distributing insurance products is limited, which is consistent with what Roth et al (2005) found in a case study in India. The demand for such products by their clients is scarce, and the distribution of microinsurance involves high risks and operational costs. The MFIs survey found that they were in their majority already offering some kind of insurance to their clients, or planning to do so in the near future. Regulation or the absence of an insurance partner locally prevents some to venture in insurance, but almost all of them expressed some interest to offer this kind of service to their clients. Churchill and Roth (2006) identified four commercial objectives to drive MFIs into microinsurance: improving loyalty, increasing profitability through cross-selling, diversifying revenue inflows, and reaching new markets. For the MFIs in our survey, the motives however appear to be not so much about obtaining more revenues. Rather, MFIs seem to view microinsurance as a complementary service that strengthens their core lending business, improves risk management, and which is in line with their social mission.

In the absence of tangible demand for microinsurance products (De Bock & Gelade, 2012), MFIs are unlikely to engage in the distribution of a broad range of insurance products to their clients. Instead, they tend to prioritize on products that are easy to sell (or can be even made compulsory like credit life insurance) and that are the most likely to improve the quality of their portfolio. Understanding the personal risks of their clients, and how those affect portfolio quality, is key to select which products to offer to their clients.

In the case of agriculture, many MFIs limit their lending activity because they fear large and systemic risks. Insurance can provide a solution to control for production risks and make possible the growth of agricultural loan portfolios. Nevertheless, agricultural insurance is a complex and expensive product and even when credit and insurance are bundled, take-up remains a challenge.

5.3. Sketching a progression path for MFIs

The provision of credit-linked life insurance is becoming standard practice in the microfinance sector. However, it did not result in a widespread accumulation of insurance expertise. When asked in which area they would like to receive support, 67% of the MFIs in the sample cite

product design. Even for simple products like credit-life insurance, improvements can be made in the credit design in order to improve the protection of clients, by extending coverage when there is no outstanding loan, including other family members or increasing the sum insured to cover not only the loan but also provide a capital to the family.

Building on existing insurance products, MFIs can work to improve them and gradually extend their insurance offering. This paper proposes a 4-step progression path:

1) Start with cheap and compulsory products

This is where most MFIs are: their loans include a mandatory life insurance product that covers the outstanding amount of the loan in case the borrower dies. Usually, these products are cheap (premium rate is typically below 1% of the sum insured) and is therefore “invisible” for the client who may ignore that he/she is insured.

2) Improve compulsory products and/or propose optional additional coverages

Credit-life insurance has two virtues for an MFI: it protects the MFI against the risk of borrower’s death and it does not need to be sold. However, from the client’s point of view, the protection offered is limited. Indeed, in case of a borrower’s death, the family would most likely not reimburse the loan anyway, so the insurance does not make much of a difference. Additional guarantees can be proposed without increasing substantially the cost of the insurance. The insurance can cover the funeral’s expenses, and an additional capital can be paid to the policyholder’s family. Coverage can also be extended beyond the duration of the loan, in order to avoid protection gaps. Another way worth of investigating consists of linking insurance with savings. By doing so, MFIs make available to a larger number of clients, not only their borrowers. It also avoids issues of protection gaps for the periods between two loans.

3) Introduce new insurance business lines

Once death insurance products are well understood by both the MFI and the clients, it is possible to introduce other insurance business lines. At this stage, it is important for MFIs to identify which types of risks are the most likely to provoke payment defaults and which products are demanded by the clients. Health and accidents insurance are viewed by MFIs as the most pressing needs (ranked 3rd and 4th respectively).

Introducing new insurance business lines will most likely require a significant investment in marketing and client education. Indeed, in stage 1 and 2, insurance products were cheap and often compulsory. At stage 3, the value proposition must be clear to the client to provoke the purchasing decision.

Insurance products can also be linked to savings product. A savings account can be used to save for the premium payment for example. Capitalization insurance products can also complement existing savings options for the clients.

4) Exploit synergies between credit and insurance in agriculture

Insurance has the capacity to help MFIs control the risk and grow their agricultural loan portfolio. Different linkages mechanisms are available to MFIs. Despite a lot of interest from international donors, non-compulsory agricultural insurance schemes in the world have failed to reach scale and sustainability (Hess et al., 2016) and most of them remained at a pilot stage. Challenges for MFIs willing to develop combined services to smallholder farmers are many. Nevertheless, the potential benefits in terms of adoption of new technologies, improved risk management, better income-generating opportunities indicate that it is a path worth exploring.

6. Conclusion

Results from an online survey with 36 MFIs from Asia and Africa put in perspective the business case of microinsurance. Traditionally, development practitioners and donors sought to leverage the presence of MFIs within low-income communities to provide them insurance services. This paper brings the MFIs perspective in the discussion. Indeed, the delivery of insurance products through MFIs does not come without challenges. MFIs tend to prioritize insurance products that strengthen their core lending business, rather than multiplying products and offering a variety of risk coverages to their clients. Agricultural insurance is probably the most complex product to sell for MFIs. Despite technological innovations, it remains often very expensive. The complexity of such products not only hurts sales, it also means that MFIs need to develop significant insurance technical expertise to integrate agricultural insurance in their offer. More fundamentally, few MFIs have built sustainable business models in agricultural credit, which seems to be a prerequisite prior the launch of crop or livestock insurance. This fuels a vicious circle, in which MFIs do not lend to smallholder farmers because of the absence of insurance, and insurance is not developed because MFIs have no agricultural lending experience.

If the MFIs in the sample identify a business opportunity, they also express the need for support in technical areas (product design, technology, claims management) but also for customer education. MFIs will be able to reap the benefits of microinsurance only if they manage to enroll a significant portion of their client portfolio. To do so, this paper proposes a progression path for MFIs, starting with simple and compulsory products, before moving to more complex and

expensive coverages. Graduating from compulsory to voluntary products implies a significant investment for MFIs: clients' financial education, marketing, training, update of the management information system... Inclusive insurance policies must address these challenges, in order to integrate financial institutions within the insurance ecosystem (see Figure 13 – ACRE's role in the value chain for an example of the insurance partnerships in agriculture). Typically, financial education is a public good so private actors will be less inclined to make the necessary investments for market development as their competitors would also benefit from it, and the return on investment very uncertain. Moreover, insurance and banking regulations need to be consistent, as we have seen that low interest rate make insurance premiums appear more expensive in comparison, and therefore harder to sell. Both regulators and private actors (insurers, lenders) need to adopt a systemic perspective rather than thinking in silos. Market development will rely on cross-sector partnerships and comprehensive financial inclusion policies balancing credit, savings and insurance goals.

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CONCLUSION

Conclusion

This work analyzed the challenges hindering the growth of agricultural insurance, the disruptions that are affecting its business model and the public policies that can be implemented to support its development. The thesis is based on the assumption that agricultural insurance markets cannot develop beyond a niche segment without changing deeply its business model, and with no public support. Therefore, the research is structured around three research hypotheses:

(H1) For governments willing to reduce farmers' income volatility, agricultural insurance can be a substitute to disaster assistance programs.

(H2) Offering agricultural insurance to smallholder farmers requires a specific design of product features and business operations.

(H3) There is a business case for microfinance institutions to offer insurance to their clients

The research placed a strong emphasis on smallholder farmers living in developing countries, as they are the most likely to be excluded from agricultural insurance markets, while at the same time they are the more vulnerable to external shocks. The findings in this thesis are of interest for corporate and public decision-makers involved in agricultural insurance, and call for renewed partnerships between the public and the private sectors.

Chapter 2 is a reminder that government interventions in favor of agricultural insurance go beyond premium subsidies. Policy-makers can activate a variety of instruments, depending on the most pressing challenges in a specific market. An enabling legal and regulatory environment, as well as the availability of public goods such as data or financial education are pre-requisites for the introduction of agricultural insurance contracts. Subsidies and risk-sharing arrangements between public and private actors can further support market development. Too often, the debate around agricultural insurance is centered on premium subsidies and whether this is an optimal use of public resources. Phrasing the debate this way leaves out of the scope the fact that an agricultural insurance policy may pursue other goals than just "developing" agricultural insurance markets. Policy-makers are also interested in improving farmers' resilience to production shocks, in extending access to risk mitigation mechanisms to the most vulnerable farmers and ensure consumers protection. Therefore, policy-makers will use other instruments than simple premium subsidies to pursue these various goals. The definition of

political objectives as well as the growth stage of the local market will determine the right agricultural insurance policy mix.

The research hypothesis (H1) was addressed in chapter 3, and is based on a case study (C1) of drought risk insurance for grasslands in France. In this case, we demonstrate that an index-based insurance can be a viable alternative to a public disaster fund to compensate farmers for this risk. The level of protection of farmers will be enhanced while maintaining a similar level of public spending, the insurance premium subsidy replacing the public contribution to the disaster fund. Chapter 3 illustrates the importance of consistency within this policy mix. In particular, disaster relief programs and agricultural insurance should not compete and undermine each other. Both instruments can coexist if they handle different risk layers or types of farmers. In this case, they should adopt a common base for loss measurement in order to avoid coverage gaps.

In Chapter 4, the second research hypothesis (H2) is tested in an agricultural insurance scheme in Kenya (C2), specifically targeting smallholder farmers. The chapter shows that doing business-as-usual is not an option when targeting the Base of the Pyramid segment. In order to reach its market, ACRE Africa has brought substantial innovations to its products and its delivery channels. Chapter 4 outlines the importance to examine agricultural insurance under several dimensions and adopt a client-centric perspective. Price is not the only barrier limiting farmers' access to agricultural insurance. In accordance with the findings of chapters 2 and 3, it invites policy-makers to consider other levers of action than just premium subsidies. The case study of the Kenyan agricultural insurance program also shows the importance of considering not only the product characteristics (price and coverage), but also the processes surrounding it and the whole client experience in general. It also stresses the importance to evaluate client value in order to improve products and extend coverage to a larger number of clients. Though the case study focuses on smallholder farmers, the methodological approach and lessons are applicable to a larger number of farmers.

Finally, the chapter 5 addresses the third research hypothesis (H3) thanks to a survey of 36 microfinance institutions operating in Africa and Asia (S3). It examines the roles of financial institutions, for their role as potential distributors of insurance, but also under the perspective of synergies between credit and insurance. The survey illustrates the necessity to make the proof of the business case of insurance to lending institutions. The "bancassurance" model, offering a one-stop-shop for financial and insurance services, is popular in France, but few other countries have exploited the synergies between banking and insurance at that level. Chapter 5

shows that for the MFIs in the sample, the provision of insurance services is primarily seen as a way to strengthen their core lending activity. Furthermore, the delivery of other products beyond credit can seem appealing at first as MFIs already have the client base, but the broadening of the offer involves significant investments and is associated with risks, that may endanger their core business. This might explain why so few MFIs in the world are distributing insurance products.

This research provides elements to conceive an agricultural insurance development strategy. It also bears its own limits. In chapter 3, the grasslands production index and the disaster fund data were only available for 13 years, which is a short period of time for this kind of insurance products. It includes several bad years, and one exceptional drought (in 2003) which is a good thing when trying to estimate the probable maximum loss. It remains a small sample though and each year will likely improve the relevance of this analysis. The survey in chapter 5 faces the same kind of limit, with only 36 MFIs. It is a very qualitative sample though, as survey respondents were CEOs or top managers of their institutions. Still, this sample does not claim to be representative of the microfinance industry. Due to limitations in time and resources, it was not possible to conduct additional, qualitative interviews with these institutions. It is clearly an interesting path to explore, in order to assess the barriers and reservations of microfinance institution towards insurance.

This thesis would benefit from additional research taking into account the expectations of other actors in the agricultural value chains. Chapter 4 already mentioned the potential involvement of farm input suppliers. Other stakeholders such as off-takers and the food industry in general can also contribute to extend coverage to a larger number of farmers and support agricultural insurance markets development. More research is also needed to further explore complementarities between public and private actors, especially to design new risk-sharing agreements, and test new approaches of “risk layering”, to see more practically what levels of risks are bearable by private actors and when public intervention is actually required. The issue of governance of public-private partnerships is also a question that is worth investigating further, in order to not only involve the insurers and governments, but all stakeholders who have an interest in implementing better agricultural risk management, farmers being the most important of them.

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APPENDICES

Appendix 1 - Client value assessment approaches

Figure 20 - Client value approaches

	Key performance indicators ²⁶	PACE	Market study	Client satisfaction study	MILK client math ²⁷	Impact
Rationale	Raise red flags about current client value performance; Help set priorities for improvement	Identify value creation opportunities; Explore strengths and weaknesses of current design in relation to alternatives	Understand needs and preferences of target population	Understand client satisfaction, renewal behaviours and client loyalty	Understand the financial value at the time of a claim of products in comparison to alternatives	Assess outcomes/ impacts on indicators related to behaviour change or wellbeing of households / communities
Key audience	Practitioners and enablers	Practitioners and enablers	Practitioners and enablers	Practitioners	Practitioners and enablers	Enablers
Type	Ongoing monitoring	Ad-hoc audit	Ad-hoc study	Ad-hoc study, ongoing monitoring	Ad-hoc study	Ad-hoc, longitudinal study
Stage	Product monitoring	Product development or refinement	Product development	Product refinement	For more mature products	For more mature products
Data source	MIS	Secondary data on current design and clients	Primary and secondary data on current and prospective clients	Primary and secondary data on current clients, MIS	Primary client interviews and MIS data	Primary and secondary data, at least two rounds of data collection
Complexity / costs	Low	Low to medium	Medium to high	Medium	Medium	High

Reproduced from Sandmark (2013)

Appendix 2 - PACE scoring criteria

Figure 21 - PACE scoring criteria and sub-dimension weights

Dimension	Weight	Detailed criteria (<i>positive ranking if the product...</i>)
1. PRODUCT		
1.1 Coverage, quality of service, exclusions and waiting periods	0.35	<ul style="list-style-type: none"> • Covers appropriate risks from a client perspective • Integrates appropriate riders to main cover • Provides adequate service quality (for health) • Offers simple cover without many exclusions • Provides limited waiting period
1.2 Sum insured in relation to cost of risk	0.35	<ul style="list-style-type: none"> • Pays out adequate amount in relation to cost of risk • Does not put many sub-limits on specific covers
1.3 Eligibility criteria	0.15	<ul style="list-style-type: none"> • Is inclusive, does not exclude groups of people
1.4 Value-added services	0.15	<ul style="list-style-type: none"> • Offers non-insurance benefits • Offers preventive health services (for health) • Offers value-added agriculture services • Triggers positive behaviour changes
2. ACCESS		
2.1 Choice and enrolment	0.35	<ul style="list-style-type: none"> • Is voluntary • Offers choices in benefit levels or additional riders • Provides options to opt out • Has simple enrolment process

		<ul style="list-style-type: none"> • Does not require many documents • Provides enrolment in convenient times • Has efficient way to remind clients to renew policies
2.2 Information and understanding in relation to complexity	0.35	<ul style="list-style-type: none"> • Provides clear information about the product, its benefits and limitations • Establishes a channel to update the information • Does checks if clients understand the product • Educates clients on broader insurance issues
2.3 Premium payment method	0.15	<ul style="list-style-type: none"> • Makes it possible for clients to pay in small instalments • Offers premium financing options at fair price • Offers premium subsidies • Offers an option to automatically deduct premiums • Offers a way to pay from savings accounts
2.4 Proximity	0.15	<ul style="list-style-type: none"> • Offers a close PoS • Does not require frequent travels to PoS • Offers close network of health care providers
3. COST		
3.1 Premium in relation to benefit	0.35	<ul style="list-style-type: none"> • Offers good value for money coverage (calculated as a ratio of monthly premium per insured member divided by the score on 1.1 coverage and 1 all benefits)
3.2 Premium in relation to client income	0.35	<ul style="list-style-type: none"> • Offers affordable access, <2% of client income (calculated as a ratio of monthly premium for a household divided by average monthly household income)
3.3 Other costs	0.15	<ul style="list-style-type: none"> • Limits travel costs • Reduces opportunity costs • Limits co-payments • Does not have any additional fees
3.4 Cost structure and controls	0.15	<ul style="list-style-type: none"> • Prices fairly • Has claims ratio in a range of 40-90% • Has lean cost structure, explains use of intermediaries and other commissions • Has strong cost controls • Has mechanisms in place to control fraud, adverse selection and moral hazard
4. EXPERIENCE		
4.1 Claim processing procedures	0.35	<ul style="list-style-type: none"> • Has simple and easy claims procedures • Requires limited documentation to file a claim • Provides a cashless access to health services with a clear authorization process
4.2 Claim processing time and service quality	0.35	<ul style="list-style-type: none"> • Does not reject claims • Offers quick payments of primary benefits (eg<7 days) • Offers quick turnaround time on other payouts (eg<2 weeks) • Provides cashless access to quality health services
4.3 Policy administration and tangibility	0.15	<ul style="list-style-type: none"> • Issues policies on the spot or within 2 weeks • Offers a clear policy document • Provides a tangible insurance card
4.4 Customer care	0.15	<ul style="list-style-type: none"> • Has mechanisms to collect feedback from clients • Has clear first contact information • Provides access to call centre

Reproduced from PACE technical guide v1.0 2012

Appendix 3 - Online questionnaire filled by MFIs

Accueil / Welcome

* 1. Quelle est votre langue? / What is your language?

Respondent's information

* 2. Respondent's name

3. Position

* 4. Organization name

* 5. Email

6. Telephone number

* 7. Legally, can you offer insurance services/products directly to your clients?

 Yes I don't know No

Comment

* 8. Do you offer any insurance product(s) to your clients?

NB: This includes mandatory credit life policies offered to borrowers.

 Yes No

* 9. When did you start offering insurance?

* 10. What are your main reasons for offering insurance to your clients?

Please select up to 3 answers.

- | | |
|---|---|
| <input type="checkbox"/> Reduce credit risk | <input type="checkbox"/> Reinforce social mission |
| <input type="checkbox"/> Answer clients' demand | <input type="checkbox"/> Obtain additional income from commissions and fees |
| <input type="checkbox"/> Reach new clients | |
| <input type="checkbox"/> Other. Which? | |

11. Please give more details about the insurance product(s) you currently offer to your clients.

Please enter 2016 data, or 2017 data if your program started in 2017.

Name/type (product 1)	<input type="text"/>
Voluntary/mandatory	<input type="text"/>
Self-insured/Insurance company	<input type="text"/>
Risks covered	<input type="text"/>
No. of policies sold	<input type="text"/>
No. of lives covered	<input type="text"/>
Claims ratio	<input type="text"/>
Name/type (product 2)	<input type="text"/>
Voluntary/mandatory	<input type="text"/>
Self-insured/Insurance company	<input type="text"/>
Risks covered	<input type="text"/>
No. of policies sold	<input type="text"/>
No. of lives covered	<input type="text"/>
Claims ratio	<input type="text"/>

12. What were the main difficulties you faced when introducing insurance products to the market?

13. If you offer mandatory product(s), please continue to question below. If you only offer voluntary product(s), skip to question 14.

Why did you choose to make your product(s) mandatory?

14. If you offer voluntary product(s), please continue to question below. Otherwise, skip to question 15.

How does your voluntary product(s) affect(s) your lending methodology? Select more than one if needed.

- | | |
|---|--|
| <input type="checkbox"/> It lowers the interest rate | <input type="checkbox"/> Insurance is accepted as collateral |
| <input type="checkbox"/> It loosens requirements to obtain credit | <input type="checkbox"/> No impact on lending methodology |
| <input type="checkbox"/> Other. Which? | |

* 15. Have you ever had to remove an insurance product from the market?

- Yes
- No

16. Please explain why your insurance product(s) had to be removed from the market.

* 17. Do you have any current or future plans to expand your insurance offering?

- | | |
|---|---|
| <input type="radio"/> Yes, we are already investing in it | <input type="radio"/> Yes, in the long term (more than 3 years) |
| <input type="radio"/> Yes, in the short term (1-3 years) | <input type="radio"/> No |

18. Please provide more details about your plans, including the type of product(s) that you plan to offer, the target market for your product(s), if you have conducted any market research, if you have already partnered with an insurance company, who is working on this product(s) internally, and anything else you might have you done so far.

19. Please provide your reasons for not planning to expand your insurance offering to your clients.

20. Please provide your reasons for not offering insurance to your clients.

* 21. Have you ever offered insurance before, but had to remove your product(s) from the market?

Yes

No

22. Please explain why your insurance product(s) had to be removed from the market.

* 23. Do you have any current or future plans to start offering insurance to your clients?

Yes, we are already investing in it

Yes, in the long term (more than 3 years)

Yes, in the short term (1-3 years)

No

24. Please provide more details about your plans, including the type of product(s) that you plan to offer, the target market for your product(s), if you have conducted any market research, if you have already partnered with an insurance company, who is working on this product(s) internally, and anything else you might have you done so far.

25. Please provide your reasons for not planning to offer insurance to your clients.

26. In your opinion, what are the biggest challenges faced by organizations trying to offer insurance to their clients?

* 27. Based on what you know about your clients, what would you say are the risks they would be most interested in covering through insurance? Please select up to 3 answers.

- | | |
|--|--|
| <input type="checkbox"/> Death | <input type="checkbox"/> Livestock loss |
| <input type="checkbox"/> Accidents | <input type="checkbox"/> Property loss |
| <input type="checkbox"/> Health problems | <input type="checkbox"/> Natural disasters |
| <input type="checkbox"/> Crop loss | |
| <input type="checkbox"/> Other. Which? | |

* 28. What kind of support does your organization need to effectively engage in the insurance business? Please select up to 3 answers.

- | | |
|---|---|
| <input type="checkbox"/> Training | <input type="checkbox"/> Funding |
| <input type="checkbox"/> Mentoring | <input type="checkbox"/> Technical assistance |
| <input type="checkbox"/> Learning from peers who have been successful | |
| <input type="checkbox"/> Other. Which? | |

* 29. In which areas do you think your organization needs more support? Please select up to 3 answers.

- | | |
|---|--|
| <input type="checkbox"/> Product design | <input type="checkbox"/> Improving client value |
| <input type="checkbox"/> Sales | <input type="checkbox"/> Claims management |
| <input type="checkbox"/> Customer education | <input type="checkbox"/> IT systems and technology |
| <input type="checkbox"/> Other. Which? | |

Information sur le répondant

* 30. Nom du répondant au questionnaire

31. Fonction / Poste:

* 32. Organisation

33. Numéro de téléphone

* 34. Email

* 35. Légalement pouvez-vous offrir des services/produits d'assurance en direct?

Oui

Je ne sais pas

Non

Commentaire

* 36. Proposez-vous actuellement des produits d'assurance à vos clients?

NB: Ceci inclut les assurances vie obligatoires liées au crédit.

Oui

Non

* 37. Quand avez-vous commencé à distribuer des produits d'assurance?

* 38. Quelles sont les principales raisons pour lesquelles vous proposez de l'assurance à vos clients? Choisissez jusqu'à 3 réponses.

- Réduire le risque de crédit
- Répondre à la demande des clients
- Toucher de nouveaux clients
- Autre (préciser)
- Renforcer la mission sociale
- Augmenter les revenus de l'institution grâce aux commissions

39. Merci de donner plus de détails sur le(s) produit(s) d'assurance que vous offrez actuellement à vos clients (chiffres 2016).

Nom / type (produit 1)	<input style="width: 100%; height: 20px;" type="text"/>
Volontaire/Obligatoire	<input style="width: 100%; height: 20px;" type="text"/>
Auto-assuré/Compagnie d'assurance	<input style="width: 100%; height: 20px;" type="text"/>
Risques couverts	<input style="width: 100%; height: 20px;" type="text"/>
Nb de polices vendues	<input style="width: 100%; height: 20px;" type="text"/>
Nb de clients couverts	<input style="width: 100%; height: 20px;" type="text"/>
Taux de sinistralité	<input style="width: 100%; height: 20px;" type="text"/>
Nom / type (produit 2)	<input style="width: 100%; height: 20px;" type="text"/>
Volontaire/Obligatoire	<input style="width: 100%; height: 20px;" type="text"/>
Auto-assuré/Compagnie d'assurance	<input style="width: 100%; height: 20px;" type="text"/>
Risques couverts	<input style="width: 100%; height: 20px;" type="text"/>
Nb de polices vendues	<input style="width: 100%; height: 20px;" type="text"/>
Nb de clients couverts	<input style="width: 100%; height: 20px;" type="text"/>
Taux de sinistralité	<input style="width: 100%; height: 20px;" type="text"/>

40. Quelles ont été les principales difficultés rencontrées au moment d'introduire des produits d'assurance sur le marché?

41. Si vous offrez des produits obligatoires, merci de répondre à la question ci-dessous. Si vous proposez exclusivement des produits à adhésion volontaire, merci de passer à la question 14.

Pourquoi avez-vous choisi de rendre votre (vos) produit(s) obligatoire(s)?

42. Si vous proposez des produits à adhésion volontaire, merci de répondre à la question ci-dessous. Sinon, merci de passer à la question 15.

Comment votre (vos) produits volontaires affecte(nt)-il(s) votre méthodologie de prêt? Plusieurs réponses possibles:

- L'assurance réduit le taux d'intérêt L'assurance est acceptée comme garantie
 L'assurance assouplit les critères d'obtentions d'un prêt Pas d'impact sur la méthodologie de crédit
 Autre (préciser)

* 43. Avez-vous déjà dû retirer un produit d'assurance du marché?

- Oui
 Non

44. Merci d'expliquer pourquoi votre(vos) produit(s) d'assurance a (ont) été retiré(s) du marché.

* 45. Avez-vous des projets, actuels ou futurs, d'étendre votre offre d'assurance?

- Oui, nous avons déjà des projets en cours. Oui, à long terme (plus de 3 ans)
 Oui, à court-terme (1-3 ans) Non

46. Merci de fournir plus de détails sur ces projets, en précisant le type de produit(s) que vous comptez offrir, la clientèle visée, si vous avez conduit une étude de marché, si vous avez déjà conclu un partenariat avec une compagnie d'assurance, qui travaille sur ce(s) produit(s) en interne, et tout autre activité que vous auriez menée à ce jour.

47. Pour quelles raisons ne souhaitez-vous pas étendre votre offre d'assurance à destination de vos clients?

48. Pour quelles raisons n'offrez-vous pas d'assurance à vos clients?

* 49. Avez-vous proposé de l'assurance dans le passé, mais avez été contraint de retirer le(s) produit(s) du marché?

Oui

Non

50. Pour quelles raisons avez-vous du retirer votre(vos) produit(s) du marché?

* 51. Avez-vous des projets, actuels ou futurs, d'étendre votre offre d'assurance?

Oui, nous travaillons déjà sur le sujet

Oui, à long terme (plus de 3 ans)

Oui, à court-terme (1-3 ans)

Non

52. Merci de fournir plus de détails sur ces projets, en précisant le type de produit(s) que vous comptez offrir, la clientèle visée, si vous avez conduit une étude de marché, si vous avez déjà conclu un partenariat avec une compagnie d'assurance, qui travaille sur ce(s) produit(s) en interne, et tout autre activité que vous auriez menée à ce jour.