Final report

International Growth Centre

Managing agricultural risk in Mozambique

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February 2019

When citing this paper, please use the title and the following reference number:
F-36421-MOZ-1

DIRECTED BY LSE UNIVERSITY OF OXFORD

FUNDED BY UKaid from the British people

1-VCC-VMOZ-VXXXX-36421

Managing Agricultural Risk in Mozambique

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Acknowledgements

This report owes its success to many different people. Particularly, we acknowledge the inspiring support of IGC Mozambique, and especially of Alberto da Cruz and Jorrit Oppewal. Without their contribution, the success of this report would not have been possible.

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Abbreviations and acronyms

CIESIN	Center for International Earth Science Information Network
DNEA	National Directorate of Agrarian Extension
DPIC	National Directorate of Planning and International Cooperation
FGD	Focus Group Discussion
FNDS	Fundo Nacional de Desenvolvimento Sustentável
GDP	Gross Domestic Product
GIIF	Global Index Insurance Facility
GPW	Gridded Population of the World
IGC	International Growth Centre
INAM	National Institute of Meteorology
MASA	Ministério da Agricultura e Segurança Alimentar
MODIS	Moderate Resolution Imaging Spectroradiometer
MZN	Mozambican Metical
NCID	Navarra Center for International Development
SDAE	District Services for Economic Activities
SPOT	Satellite Pour l'Observation de la Terre
UNAV	University of Navarra
USD	United States Dollars

1 Introduction

Mozambique is primarily an agricultural economy with 81% of its population engaged in agriculture, which accounts for 32% of its GDP. “There are now 400 extreme weather events every year, four times as many as in 1970” (The Economist, 2017). The direct costs of these extreme events in the form of lost lives, assets, and habitat are evident. For farmers in agricultural-dependent developing countries such as Mozambique, these shocks lead to a loss of financial resources and productive assets with knock-on effects on investments and returns from their farms, trapping them into poverty. The resultant financial uncertainty has deep repercussions on both households' welfare and investments in productive activities. Such adverse shocks also force these individuals to divert resources from other priorities like nutrition, children’s education and healthcare, and lead to persistent damages to their lives and those around them.

The need for risk-mitigation instruments such as agricultural insurance under such situations cannot be overemphasized as they can provide a much-needed safety net to farmers who are vulnerable to climate shocks. However, there are very few insurance products or other risk mitigating instruments currently available to farmers. This lack of risk management instruments may contribute to the fact that only a fraction of Mozambique’s arable land is cultivated.

The primary objective of this report to provide a general overview of the agricultural sector in Mozambique, identify key policy challenges faced by the sector along with potential policy interventions related to agricultural insurance. To achieve this goal, we undertook a review of the current state of the agricultural sector in Mozambique with focus on agricultural insurance. Firstly, we collected data from a myriad of sources, including high-resolution satellite data, to identify the key agricultural risks Mozambique faces and understand its geographic segregation. Secondly, we analysed findings from the general literature on public policies for agricultural insurance in developing countries and linked it with the Mozambican context. Thirdly, an analysis of stakeholders through direct interviews and a focus group discussion provided unique insight on the experience and potential for agricultural insurance in Mozambique.

Mozambican farmers face a wide variety of weather-related risks, such as floods, droughts and hail storms. The most direct consequence of adverse climatic events is the destruction of production and a substantial loss of income. This reduces farmers’ quality of life and potentially leads to food insecurity. Weather-related risks are complemented by a large number of additional risks, such as limited technical know-how, lack of processing capacity, high exposure to pests and diseases, lack of access to finance and to markets and high risk of price volatility. Put together, the activity of farmers is characterized by a wide variety of risks, with heterogeneous frequency and potential damages, limiting significantly their productivity and their possibility to develop.

In this setting, there are potentially large benefits from the introduction of an agricultural insurance product. Climatic risks for agricultural production are present and spread throughout the country, and mitigation capacity is very limited by the high degree of poverty in a large share of Mozambique. However, there is currently no major product available in the market providing coverage for weather-related events. In the absence of a formal agricultural insurance, farmers depend on informal insurance, which also limits their possibility to access credit, which has already limited availability.

In this situation, it is not straightforward to introduce an insurance product in the market as several constraints need to be taken into account. First, liquidity constraints are an important reason for the generally low take-up of insurance in developing countries. Second, identifying ways to address the lack of trust is crucial for increasing the take-up of insurance products in a setting with no or little experience with the insurance market. Third, low levels of insurance awareness and literacy, and difficulty to understand and use insurance policies properly, should be addressed through intensive sensitization sessions among farmers. We discuss in detail each of these constraints in the report and we draw conclusions on the main points that should be addressed prior to the introduction of agricultural insurance.

The report is structured as follows. In section 2, we discuss in detail the context of Mozambique and the role of agriculture, as compared to neighbouring countries. In section 3, we analyse the climatic risk in Mozambique and how it relates with indicators of human development. In section 4, we describe the current state of agricultural insurance in Mozambique. In section 5, we discuss the lessons learned during meetings with stakeholders and during a focus group discussion with farmers. Finally, in section 6, we provide a discussion about the potential opportunities for Mozambique and we summarize the main policy recommendations.

2 Context

Agriculture continues to be one of the main drivers of growth in the African continent. It employs 70% of the workforce and it represents 30% of Africa's GDP. It follows that it is of paramount importance for the continent to maintain adequate conditions for optimal production. And, not surprisingly, governments and international organizations are underlining the importance of risk management and more specifically, agricultural insurance for sustainable growth of the sector. However, total insurance penetration in Africa is only 2.8%, well below the world's average, 6.3% (World Insurance in 2016: The China Growth Engine Steams Ahead, Swiss Re Institute).

Located in Southeast Africa, Mozambique is bordered by Malawi, Tanzania, Eswatini, South Africa and Zambia. Table 1 reports a comparison between these countries on a range of economic and climatic indicators. Among its neighbouring countries, it has the second lowest GDP per capita. It is highly reliant on agriculture, which represents more than a fifth of its economic output and employs 73.1% of its workforce. This is of special importance when considering that 97.5% of farmers are smallholders (PwC 2018). This dependence on agriculture is only matched by Malawi.

The Mozambican agricultural sector has a lot of room for improvement. Even though land with potential for agriculture represents 63.5% of total land area, total land under cultivation is only a 7% of total land area (PwC 2018). Moreover, its productivity is the lowest. This indicates that improvements along input usage, irrigation technology and risk management could go a long way in increasing agricultural production.

Nevertheless, Mozambique's agricultural potential is hampered by its exposure to climate risk given its two topographical zones: coastal lowlands and rugged highlands. Its farmers often deal with drought, floods, uneven rain and cyclones. The Global Climate Risk Index, an index produced by German Watch that analyses to what extent countries have been affected by the impacts of weather-related loss events, places Mozambique at the top of the Southeast African region. There have been at least 26 large climatic shocks since 1990. For instance, during the floods of 2000-2001, approximately 800 people died, an

estimated 750 million USD worth of property were lost, and close to half a million families were affected (Climate Risk and Adaptation Country Profile). From 1990-2017, climatic events have resulted in an average yearly loss of 120.78 million USD (German Watch).

Table 1. Cross-country comparison of Southeast Africa

Indicator	Mozambique	Malawi	Tanzania	S. Africa	Zambia
GDP per capita *Current int. PPP adjusted*	1247.6	1202.2	2945.9	13497.6	4024.1
Incidence of rural poverty *% Rural population*	56.9	56.6	33.3	87.6	-
Employment in agriculture *% Total population*	73.1	84.6	66.0	5.5	53.0
Agricultural land *% Land area*	63.5	61.4	44.8	79.8	32.1
Agricultural value added per worker *Constant 2010 US$*	485.4	380.4	675.1	11546.1	626.1
Agriculture, value added *% GDP*	21.3	26.1	30.1	2.3	6.7
Cereal yield *Kg per hectare*	823.8	1347.4	1540.7	3809.5	2418.0
Global Climate Risk index (GCRI)	40.8	81.0	112.0	78.5	118.5

Note: Global Climate Risk Index (GCRI) includes fatalities, losses in PPP-adjusted US dollars, and percentage of loses per unit of GDP from 1990-2017. A lower value denotes higher climate risk. Sources: World Bank Development Indicators, German Watch.

For our analysis, to identify areas of higher versus lower climatic risk, we need to use objective measures of risk. To divide Mozambique into objective areas of different climatic risk, we build on the work of UNEP's Global Risk Platform. We consider the indicators built for the following climatic risks: drought, flood, and cyclones. We then map variation in risk across the districts of Mozambique based on these indicators.

Like elsewhere in the developing world, awareness of agricultural insurance, and, even more so, for index-based products, is low in Mozambique. Farmers have low purchasing power and are unfamiliar with financial practices. According to PricewaterhouseCoopers, the non-life insurance market represents a measly 0.69% of Mozambican GDP, which is below the African average of 1.11% (PwC 2018). As of the time of this writing, there are some companies looking into the possibility of implementing an index-based insurance product after a pilot by the World Bank Group.

The index-based insurance pilot covered cotton farmers and it marketed with very low premium costs. It was sold to an aggregator that would cover its farmers. This strategy is

cheaper than retail sales to individual farmers. Conclusions by the World Bank Group suggest that financial education for farmers and local skills to manage such a product are a necessary condition for its success.

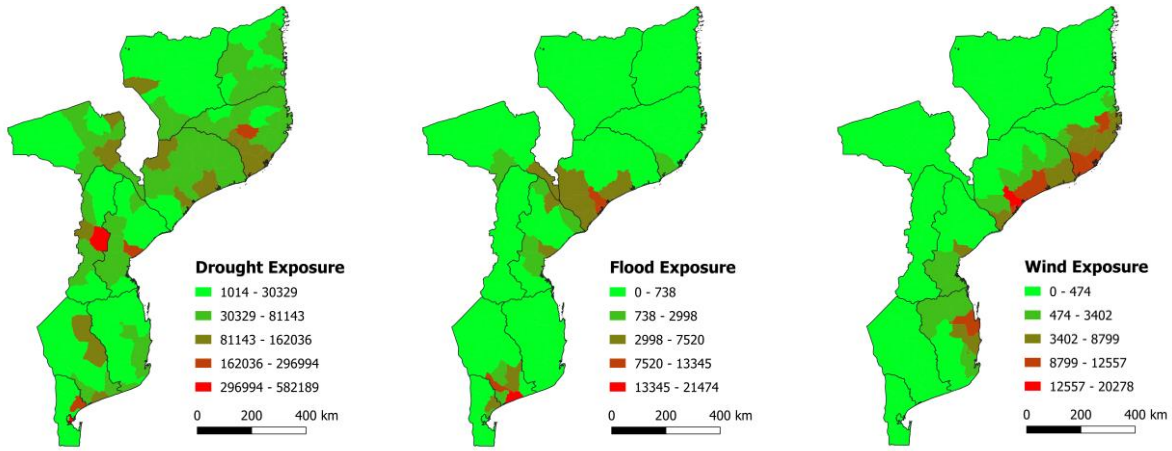
3 Climatic Risk in Mozambique

This Section discusses the geographical distribution of climatic risk and identify areas with higher exposure, and therefore potential higher benefit from agricultural insurance. To analyse these dimensions, we average different variables at the district administrative level and perform the analysis at the level of the province.

3.1 Physical Exposure to Adverse Climatic Events

To understand instead how climatic risk is distributed across the country, we focus on physical exposure to adverse climatic events. Information about physical exposure is obtained from the Global Risk Data Platform (UNEP/GRID-Europe) database. Data provides raster-level information about exposure to climatic events and about climate-related risk. For Mozambique, we identify and analyse three different types of adverse climatic events that could have negative impact for agriculture: droughts, floods, and extreme winds. Figure 1 presents the geographical distribution of physical exposure to drought, flood and extreme wind. Physical exposure is defined as the expected average annual population exposed to each event. Note that since each event type has a different relative importance, we use different scales to identify areas with higher risk. Therefore, these maps are not directly comparable by type of event.

Figure 1. Physical Exposure to Adverse Climatic Events



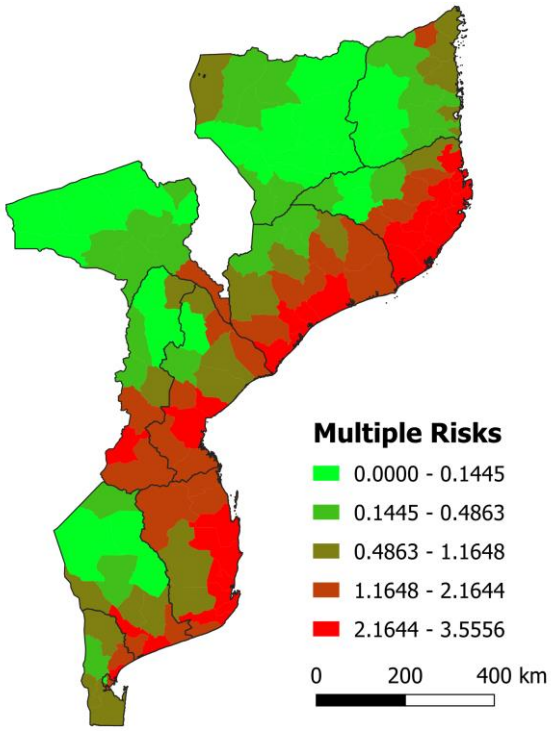
Note. Unit is the expected average annual population (2010 as the year of reference) exposed (inhabitants). Raster data is averaged at the district level. Source: Global Risk Data Platform, UNEP/GRID-Europe

Drought is the adverse climatic event to which Mozambique has the highest physical exposure. In some districts of the country, the expected average annual population exposed to this event is larger than 300,000 inhabitants. Higher exposure of drought is present in the central part of Manica and Sofala, and in most parts of Nampula and Zambezia. Other areas at risk are large part of Cabo Delgado and Tete. Mozambique presents a much lower physical exposure to flooding and extreme winds relative to drought. However, some areas of the country present a relatively large exposure to these events. Exposure to floods is mainly located in Zambezia, Sofala and the coastal part of

Gaza. Exposure to extreme winds is instead more localized, covering most of Nampula and Zambezia.

Summing up the risk from multiple events, we identify areas at higher risk by focusing on the UNEP global risk index. This estimate risk on a 1 (low) to 5 (extreme) scale considering the aggregate risk of extreme winds, flood and landslide induced by precipitations. Figure 2 shows the geographic distribution of the global risk induced by multiple hazards. The coastal area of Mozambique presents a significantly higher risk of adverse climatic events as compared the rest of the country. Nampula, Zambezia and Inhambane present the highest risk levels. The coastal area of Gaza and Sofala, and the southern part of Manica also show higher risk levels. Combined with information on economic development and agricultural land, this result indicates that efforts related to the introduction of agricultural insurance could have larger benefits in these areas since farmers could be more affected by adverse climatic events. On the other hand, these are also areas in which the introduction of insurance could be more costly, due to the higher physical incidence of adverse climatic events.

Figure 2. Risk of Multiple Adverse Events



Note. The figure shows the geographical distribution of the global risk induced by multiple hazards: extreme winds, flood and landslide induced by precipitations. Unit is the estimated risk index from 1 (low) to 5 (extreme). Raster data is averaged at the district level. Source: Global Risk Data Platform, UNEP/GRID-Europe.

3.2 Population, Agricultural Land and Economic Development

To understand which areas at risk of climatic event present larger potential consequences of an adverse event, we look at the geographical distribution of population, agricultural land and economic development. Population and agricultural land proxy for the potential of an adverse event to generate an economic cost for the population and damages to

productive agriculture. Economic development is instead proxying for the ability to adapt and mitigate risk, and for the ability to purchase insurance products. Similar to the geographical analysis presented in the previous section, we discuss in this section how these variables vary across Mozambique.

To measure *population distribution* in Mozambique, we make use of the Gridded Population of the World, Version 4 (GPWv4), provided by the Center for International Earth Science Information Network (CIESIN). This dataset provides estimates of human population (number of persons per pixel), consistent with national censuses and population registers, for the years 2000, 2005, 2010, 2015, and 2020, at 2.5 arc-minute, 15 arc-minute, 30 arc-minute and 1-degree resolutions. In this report, we make use of the data at the resolution of 2.5 arc-minute for the year 2015.

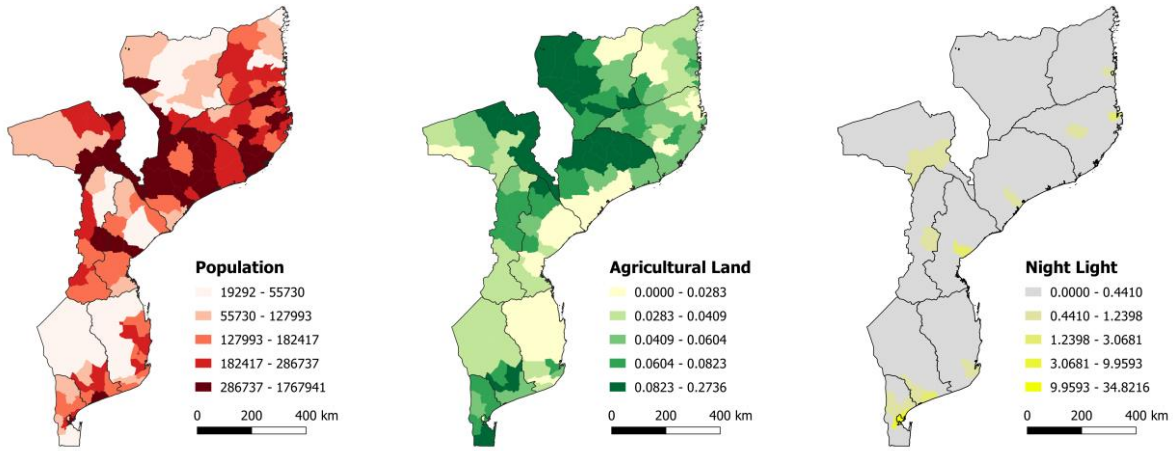
To measure *agricultural land*, we make use of the Global Agricultural Lands in the Year 2000 dataset (Ramankutty et al., 2010). It provides the proportion of land area used as cropland (land used for the cultivation of food) and pasture (land used for grazing). This is built using satellite imaging from the Moderate Resolution Imaging Spectroradiometer (MODIS) and Satellite Pour l'Observation de la Terre (SPOT) Image Vegetation sensors. Data is available at 0.05 degrees x 0.05 degrees spatial resolution in longitude by longitude (roughly 10 km per side at the Equator).

As a proxy for *economic development*, we look at night light from satellite imaging, which has been widely used in the literature to capture local variation in income. We make use of Version 4 DMSP-OLS Night-time Lights Time Series for the year 2013, provided by NASA. It provides cloud-free composites contains the lights from cities, towns, and other sites with persistent lighting, including gas flares. Areas with higher luminosity at night are assumed to be more developed and therefore to have, on average, higher per-capita income. Higher income indicates not only higher ability to save and to face adverse weather events, but also a less binding budget constraint when facing the decision to purchase an insurance product.

Figure 3 shows the geographical distribution of population, agricultural land and night light. For ease of presentation, these measures have been averaged at the administrative level of the district. Areas with larger shares of agricultural land are scattered throughout the country, but mainly located in the north of the country, including Nampula, Zambezia, Niassa, and the northern part of Tete, Manica and Sofala. The coastal part of Gaza and Maputo also present larger shares of agricultural land. Niassa presents larger shares, but also lower population density, which reduces the impact of climatic events and the potential for an agricultural insurance market. Conditional on risk and population density, we can conclude that the highest potential for large economic impact of adverse climatic events on agriculture is present in Nampula, Zambezia, and the coastal part of Gaza.

Analysis of the geographic pattern of night light shows that mitigation capacity, as proxied by economic development, is very limited in areas at higher risk of adverse climatic events. Overall, most of the country is characterized by low levels of luminosity, at the only exclusion of Maputo in the south and few areas scattered around the main cities. This pattern also indicates that in these same areas the capacity of farmers to purchase an agricultural insurance product is limited.

Figure 3. Population, Agricultural Land and Economic Development



Note. Population is computed using the Gridded Population of the World, Version 4 (GPWv4), provided by Center for International Earth Science Information Network (CIESIN). Agricultural land is computed using the Global Agricultural Lands in the Year 2000 dataset (Ramankutty et al., 2010), which provides the proportion of land area used as cropland and pasture. Nigh light is computed from the Version 4 DMSP-OLS Night-time Lights Time Series for the year 2013, provided by NASA. Raster data is averaged at the district level.

4 Agricultural Insurance in Mozambique

Agricultural insurance is all but non-existent in Mozambique and not surprisingly there are very few resources providing insights about the agricultural insurance sector in Mozambique. The Mozambican insurance sector is miniscule with the non-life insurance market only representing 0.69% of GDP, which is much lower than the African average of 1.11%. While climatic calamities have affected the agriculture sector 26 times since 1990, losses due to these calamities were insured only 3 times (PwC 2018). Especially in the coverage of climatic risk, the development of index-based products in Mozambique has suffered from a lack of quality data with no primary sources of data[1] and the lack of historical data.

Given the high dependence on agriculture and frequent exposure to adverse climatic shocks, agricultural insurance offers an untapped opportunity to mitigate risk across the agriculture value chain. Available experiences and lessons in Mozambique are mainly limited to two sources. First, an in-depth study of the sector commissioned by the Government of Mozambique and performed by PricewaterhouseCoopers (PwC, 2018). Secondly, a pilot project to promote the development of markets for index-based weather and catastrophic risk insurance under the Global Index Insurance Facility (GIIF).[2]

PwC (2018) provides an in-depth study of the agricultural sector and the related opportunities for agricultural insurance by focussing on four commodities: beans, cashew, cotton, and maize. These products provide four value chains in which the bundling of index insurance products with services provided by stakeholders could be beneficial for farmers. We summarize the findings here:

1. *Beans*. Total production ranks 4th in sub-Saharan Africa by cultivated area, but they are mainly produced for self-consumption, with a negligible proportion of the produce being marketed, mainly for the domestic market (94% of the stakeholders procure

[1] Crop yield and rainfall data are generally available only from secondary sources. The National Institute of Meteorology (INAM) is responsible for weather and climate observation.
[2] At the time of the report, there is an on-going pilot managed by the insurance company Hollard, providing insurance linked to seeds.

beans from within their province, and 96% of them also sell their bean in their own province). Since beans are mainly sold to traders, it provides a good setting for introducing insurance products within the value chain. Specifically, stakeholders that could participate in the effort corresponds to aggregators, post-harvest contractors, commission agents, traders, wholesalers, processors, and retailers.

2. *Cotton*. It is one of the most important agricultural exports of Mozambique, contributing to approximately 20% of its total agricultural exports. At the same time, cotton is also primarily dominated by smallholder farmers, with 170,000 smallholders accounting for 90% of the country's total production (mainly concentrated in Cabo Delgado, Nampula and Tete). It copes well with weather variations, but it has a substantial dependence on water, especially in the flowering stage, making the production highly sensitive to droughts. The market is organized in the form of a monopsony, with ginning companies granted concession rights as exclusive buyers in particular regions of the country and assisting farmers in the domain of input provision and education on best practices. In this setting, ginnery associations and the Cotton Institute of Mozambique (IAM) are the main stakeholders to be involved for the introduction of agricultural insurance. However, in between, there are also aggregators, commission agents, and wholesalers.
3. *Cashew.* It is Mozambique's second most exported agricultural commodity (second only to tobacco) and it is produced in the northern part of the country (mainly in Nampula province). 95% of production is undertaken by smallholder farmers and the sector employs a substantial number of people (approx. a million households). Cashew, being a perennial tree crop, can survive dry spells; cyclones or storms can have an adverse impact on it. Main stakeholders in the cashew sector include aggregators, post-harvest contractors, commission agents, traders, wholesalers, processors and retailers.
4. *Maize*. It is a staple crop mainly cultivated by smallholder farmers for self-consumption with very small quantities being sold in the market. Maize is therefore of great importance for food security in Mozambique as two thirds of the rural households produce it and it is affected by variation in the weather pattern. Similar to beans, a large number of stakeholders in this sector could support efforts in providing infrastructure for insurance, including aggregators, post-harvest contractors, commission agents, traders, wholesalers, processors and retailers.

Another example of experience with agricultural insurance in Mozambique is related with the Global Index Insurance Facility (GIIF), which was developed by the World Bank as a pilot project to promote the development of markets for index-based weather and catastrophic risk insurance.[3] The pilot, implemented in 2012 among cotton farmers, offered a low (subsidized) premium for a weather-based index insurance and was implemented at the meso-level, rather than at the farmer-level. This occurred at an unfortunate time for the sector, since from 2005 to 2015, total land under cotton cultivation plummeted from 212.1 thousand hectares to 101.4 thousand hectares, due to both market volatility in the international market and adverse weather conditions. The key takeaways from the pilot are summarized here. First, financial education is a must for the success of agricultural insurance, with most farmers not being fully aware of how the insurance worked. Second, in absence of understanding, a 100% subsidy is not

[3] The Global Index Insurance Facility (GIIF) has been created as a tool to deliver financial knowledge, products and advisory to key stakeholders so that they can address their financial challenges. It relates to the broader objective of raising productivity and market access.

desirable. That is, outreach numbers from the fully subsidized program should not be used as basis for a partially subsidized one, since take-up could vary significantly.

Overall, experience and sectoral development for the insurance market in the country is very limited, but potential is large. However, new attempts to introduce insurance products need to consider the diversity in crop production. In fact, crops farmed in Mozambique present different characteristics in terms of growing season, input requirements and value chains. Benefits of agricultural insurance are therefore heterogeneous across different crops, and all these features need to be considered while planning the introduction of an insurance product.[4] Table 2 provides estimates computed by PwC (2018) relative to the willingness to pay for index insurance. We can observe that even at a relatively low premium, the percentage of farmers willing to purchase is highly heterogeneous. This suggest that the introduction of an insurance product is strictly related to understanding the willingness to pay for the product and its determinants across different crops (see section 5.1 for a discussion of evidence in the literature on the causes for low take-up of insurance products among farmers).

Table 2. Willingness to pay for index insurance

Crop	**Willingness to pay** *(assumed premium)*	**Average net income** *(MZN/ha)*	**Average yield** *(kg/ha)*
Beans	39% (250 MZN/ha / 18.1% of income)	1383.6	369.8
Cashew	55% (500 MZN/ha / 7.4% of income)	6749.8	423.9
Cotton	45% (500 MZN/ha / 10.8% of income)	4625.6	770.2
Maize	29% (500 MZN/ha / 10.7% of income)	4660.6	1020.7

Source: PwC (2018).

5 Opportunities for Mozambique

5.1 Lessons from the literature

In this section, we discuss the lessons from previous experiences of adoption of agricultural insurance and underscore the learnings that can be leveraged for the Mozambican context.

The negative effects of climate change on weather shocks are now well documented in the literature (Rosenzweig and Parry, 1994; Guiteras, 2009).[5] In particular, adverse weather shocks and the subsequent severe loss of assets has been documented as a common reason for falling into a poverty trap for farmers (Carter et al. 2007; Barrett et al. 2007; Morduch, 1994). Firstly, adverse weather shocks lead to a direct loss of income and financial resources, which has immediate negative impacts on not only household finances, but also knock-on effects on investments and thus, returns from the following

[4] PwC (2018) provides simulated incomes conditional on the presence or the absence of insurance. These are based on strict assumption. For beans, simulations assume that once every three years, there is a failed crop due to climate conditions, the overall damage is assumed to be 50%, the payout is 50% of farmer's costs, and the premium is 250 MZN/ha. For cashew, cotton and maize, simulations assume that once every three years, there is a failed crop due to climate conditions, the overall damage is assumed to be 50%, the payout is 50% of farmer's costs, and the premium is 500 MZN/ha. For bean producers, net income equals 900 MZN/ha with insurance and 414.9 MZN/ha without insurance. For cashew producers, net income equals 5124.8 MZN/ha with insurance and 4066.2 MZN/ha without insurance. For cotton producers, net income equals 3354.7 MZN/ha and 1687.4 MZN/ha without insurance. For maize producers, net income equals 3383.9 MZN/ha with insurance and 3051.9 MZN/ha without insurance.

[5] More recently, Aragon et al. (2017) highlight the role of extreme weather events on agriculture.

season. Moreover, when a household receives an adverse shock it is also likely to divert resources from other priorities like nutrition, children's education and healthcare in order to smooth consumption, which leads to human capital costs (Jensen, 2000). These effects can often be persistent over time and children who face adverse weather shocks might be scarred for life (Maccini and Yang, 2009).

Clearly agricultural insurance, can provide a much-needed safety net to farmers, protecting them from the vagaries of nature, and climate change induced shocks (Barnett and Mahul, 2007; Dercon, and Christiaensen, 2011). However, take-up of agricultural micro-insurance has remained stubbornly low and increasing take-up has remained a notably difficult policy to achieve. The literature has identified various barriers to take-up including liquidity constraints, lack of understanding of insurance, trust, and previous experience with insurance, among others (Casaburi and Willis, 2017; Cole et al., 2013).

Among the different concerns, liquidity constraints are a particularly salient reason behind the low take-up of insurance. Households, despite standing to benefit from insurance, may struggle to rationalize paying a premium at the beginning of the growing season given that there is only pay-out in the case of a weather shock. Not surprisingly, farmers state "I don't have enough cash" (Casaburi and Willis, 2015) or non- purchasers cite "lack of funds" (Cole et al., 2013) most often as their most frequent reason for not buying insurance. Prices of insurance products are high relative to expected pay-outs when compared to retail insurance in developing countries discouraging take-up (Cole et al., 2013). Also, given the competing uses of the limited funds that households have at the start of the growing season, the opportunity cost of insurance is high (Cole et al., 2013, Rampini and Vishwanathan, 2010). Hence, there might be a case for subsidizing insurance premiums for small farmers, at least at the beginning.

While the liquidity constraint barrier is crucial, it is not the only barrier. Even under large price discounts and an expected return which are significantly better than what is actuarially fair, increasing take-up has remained a challenge (Cole et al., 2013). Hence, one needs to understand non-price frictions that limit insurance demand over and above liquidity constraints.[6] Lack of trust usually follows liquidity constraints, as the other major barrier to take-up (Casaburi and Willis, 2015). Households with little financial capital may be reluctant to invest resources in insurance if they are unsure that the insurer can be held accountable to indemnify losses when claims are made. The importance of trust is further borne by the fact previous experience with insurance products has been found to be important for take-up. (Karlan, et al., 2014). Hence, identifying ways to address the lack of trust is crucial for increasing the take up of insurance products.

Lack of trust often goes hand in hand with other non-price frictions such as low levels of insurance awareness and literacy, and difficulty to understand and use insurance policies properly (Churchill, 2013). More importantly, lack of insurance awareness among the poorer populations has been impeding take-up among these populations (Coydon and Véronique, 2011). Not surprisingly, intensive education campaigns have been found to improve insurance demand (Gaurav et al., 2011). Hence, there is a need for taking on this barrier head-on through intensive sensitization sessions among farmers.

The benefits of increasing take-up of agricultural insurance for Mozambican farmers and farming households are manifold. For instance, there is a clear potential for welfare improvements due to adoption of insurance. Insurance can improve welfare through

[6] The reader is directed to Cole et al., 2013; Giné, Townsend and Vickery, 2008; and Giné et al., 2012, for a more detailed discussion of these non-price frictions.

behavioural channels, driven by the transfer of risk from the household to an external party. Risk aversion is a central barrier preventing farmers from investing more and increasing profits. In fact, simply mitigating risk, without any infusion of capital can have significant positive effects on investment (Karlan, et al., 2014). This might lead to households' smoothing of consumption and assets, which normally begins with the growing season, to become less frequent and severe. Asset and consumption smoothing in anticipation of bad harvest due to adverse weather is a crucial factor in the context of smallholder farmers (Karlan, et al. 2013). Such farmers usually undertake anticipatory smoothing, preferring to adapt current consumption and/or assets to a level in line with a poor harvest/weather shock. Slightly wealthier households prefer to reduce assets, while slightly poorer households prefer to reduce consumption. This is described in Karlan et al. (2013) and identified as a central mechanism in human capital losses, through poor nutrition, school attendance, and medical care.

As insurance can potentially mitigate weather risks and provide a minimum return at the end of the season, households with insurance are less likely to cut food consumption, and other investments, such as education and health. At the end of a poor growing season (driven by adverse weather), while uninsured families might be forced to either continue reducing consumption or liquidating assets, insured families should be able to maintain comparatively higher level of consumption and assets. This means that in the short and medium-term, welfare among insured households remains stable, measured in terms of school attendance, food expenditure, healthcare expenditure, and other key indicators that are closely related to later life outcomes for children, as well as the health of adult household members.

The second major effect of being insured could be in the shift in investment strategies. In the presence of financial constraints and uncertainty, households under-invest in potentially productivity-boosting changes. However, insurance has the potential to increase a household's ability to invest in productivity improvements significantly. As insurance allows households to externalize and reduce risk, productivity investments, such as planting a wider area or new crops, are more likely to have positive returns. In the medium-term insurance should significantly improve the financial situation of households and allow them to make greater investments in revenue generating activities, as well as essential household goods. This is driven by insured households being more likely to be able to sustain productivity levels year over year. Even in the case of an adverse shock, such households are expected to end the growing season with enough capital to purchase seed and inputs for the following season, as they do not have to siphon off resources from the following year's investment allocation, therein avoiding a common poverty trap. Finally, improvements in each growing cycle driven by risk transferring will then lead to long-run welfare improvements. Households would accumulate better investments over time, which would lead to better income and improvements in human capital.

5.2 Lessons from Stakeholder Meetings and Focus Group Discussion

During the scoping visit in December 2018, we completed a series of meetings with stakeholders involved in or related to the agricultural sector. During these meeting, we discussed about the risks associated to adverse climatic events, about the experience and the potential interest on agricultural insurance in Mozambique. On December 10th, 2018, we participated in a collaborative meeting at the Ministry of Agriculture and Food Security (Ministério da Agricultura e Segurança Alimentar - MASA). This meeting included 11 participants from MASA, the National Directorate of Agrarian Extension

(DNEA), the National Directorate of Planning and International Cooperation (DPIC) and IGC Mozambique. On December 11th, 2018, we met with Ercílio Zimba, Head of the Rural Finance Department at the National Directorate of Rural Development - Ministry of Land, Environment and Rural Development, and with the representatives of the National Institute for the Supervision of the Insurance Market (Instituto de Supervisao de Seguros de Moçambique). On December 12th, 2018, we met with the team at Sustenta - Fundo Nacional de Desenvolvimento Sustentável (FNDS) to discuss about their experience relative to the implementation of agricultural insurance in Mozambique and the state of current pilots, and with José Jese of Banco Terra Mozambique to discuss about the role of insurance in the provision of loans for agriculture.

Meetings with stakeholders were supplemented with a focus group discussion (FGD) with farmers and other stakeholders in the town of Moamba, Moamba district. This was implemented on December 13th, 2018. The focus group was composed by 9 participants, including local farmers, representatives and technicians from the District Services for Economic Activities (SDAE) and Ms. Anina Manganhele from DPIC at the Ministry of Agriculture and Food Security. Figure 4 shows a moment from the discussion in Moamba.

Figure 4. A moment during the FGD

Note. The picture shows the FGD in the town of Moamba, Moamba District. Source: NCID.

The dialogue within the FGD was designed to gather information about the knowledge and experiences with agricultural insurance. In the Appendix "*Structure of FGD*", we present the instructions followed during the meeting. The main objective of the focus group was to collect information about the main climatic threats to crops and their consequences for farmers, their perception of agricultural risk, the usefulness of agricultural insurance while trying to deal with the damage caused by these threats, and, finally, the expectations they had about the possibility of accessing agricultural insurance. Under these parameters, the execution of the focus group was mainly directed towards documenting risk perceptions of producers and identify the positive and negative experiences of farmers in their daily lives, especially the ones related to climate risks. Specifically, the following points were addressed during the meeting:

1. What are the main threats crops face?
2. How do farmers protect against them?
3. How do these threats affect farmers?

4. How do farmers plan for expenses and/or investments?
5. Do farmers know what an agricultural insurance is?
6. How would farmers prefer to pay for a product that might cover losses under certain situations?
7. Would farmers be willing to participate in informative sessions regarding the consequences of climate risks for agricultural production?
8. Would farmers be interested to receive information on how to manage income, expenses, investments, and to sell their products?

Here we discuss the main results of the stakeholder meetings and the FGD. Table 3 summarizes the results.

5.2.1 Main threats to crops

To collect this information, we discussed what are the main weather-related threats to the crops, and how are crops protected against them? How do these threats affect the daily life activities of farmers?

Farmers face a wide variety of risks, especially floods, droughts and hail storms. In relation to floods, one noticeable fact among participants is the large number of producers who have their crops on the verges of a river. It is understood that this facilitates the possibility of irrigating their crops but considering the latent risk of floods and the risk of dam mismanagement in neighbouring countries, it highlights the lack of risk management practices among producers.

Climate-related threats are a big limitation to productivity among farmers, but this is not the only constraint they face. When thinking about insurance products, the following additional constraints needs to be considered:

1. *Technical know-how* is limited and farmers lack capacity to process their output. For different crops, farming is lacking the use of advanced and improved seed material, harvesting is mainly performed manually, and farmers are unaware of the benefits of using fertilizers. This limits the capacity of farmers to access markets beyond local markets.
2. *Pests and diseases* in animals are also considered significant threats in their agricultural and livestock activity. However, no steps are generally taken to prevent them, generally because farmers lack access to protection chemicals. This is due to financial constraints or to distance from input suppliers.
3. *Access to finance among farmers* is a big issue. Commercial banks and development banks are financing value chains of different crops (e.g. cotton, sugarcane, cashew, sesame, soya, beans, maize, etc.), but, due to high operation costs and lack of infrastructure, loans are almost exclusively targeted at large-scale farmers, those who can at the least offer some collaterals, and to crops with export potential. Access to finance among smallholder farmers is therefore highly limited, with a very low uptake of financial products. According to PwC (2018), among bean farmers, only 9% of have access to credit, of these, only 27% take credit from formal financial institutions, which translates in extremely high interest rates of up to 30-48% per annum (PwC, 2018).

4. Access to markets is limited and high fluctuation in the international market creates uncertainty among farmers. This situation generally translates into disadvantageous prices paid to the farmers. Access to markets is also affected by distance, creating additional risks associated to robbery during the transportation of products.

5.2.2 Preventive actions and consequences of adverse climatic events

After describing the main threats faced by producers, participants identified the direct consequences of these threats for their daily lives, and the strategies they use to deal with the damage caused by climatic adversities.

Since agriculture is the main or even sole source of income for many of the producers, the most direct consequence of adverse weather events is a substantial loss of income. This dynamic reduces their quality of life since they do not have enough money for daily sustenance. Farmers also stress the lack of food security as a consequence of adverse climatic events.

Generally, no preventive action is taken to face the risk of adverse weather events. Undoubtedly, capacity to diversify agricultural production, as well as income sources, increase the preparedness to face losses from adverse climatic events. However, diversification is not widespread, suggesting risk management practices are very limited among farmers.

In the absence of a formal agricultural insurance, farmers depend on informal insurance from friends and relatives. In the face of any calamity, they would ask friends and relatives for income support. As a consequence, farmers tend to limit the size of production with lower investments, as precautionary savings are the first protection against calamities.

5.2.3 Producer's perceptions of risk and crop insurance

An open debate was held to understand the producer's perceptions about insurance access, as well as how they conceive agricultural risk. The biggest concern that came out of the meeting was the unavailability of insurance products. Farmers report that insurers don't want to insure the whole productive process, which is what is more demanded by farmers for commercialization of their products. Participants acknowledged that insurance is a way of recovering damages, and it is another form of income that can help with household expenses in the case of adverse events.

Participants expressed that, while they did not have the opportunity to access insurance before, they had experience with credit. Lack of access to insurance also limits the access to finance. Banks demand insurance for giving loans, therefore without the insurance component it is hard for farmers to receive credit from the banks. In the absence of insurance, banks demand instead collaterals before providing money. In addition, participants report that obtaining credit in absence of collaterals is extremely expensive, reporting monthly interests rates of up to 25%. Especially among farmers with larger productions, access to insurance would facilitate access to credit, allowing for higher investments and for wider market access. However, it is not clear whether access to insurance would facilitate access to credit for farmers with very small productions or subsistence production, as demand for credit would be lower.

In terms of design of agricultural insurance, it is important to note that farmers produce different types of crops, each have their specific growing periods. This highlights the need

for a multi-risk insurance product and a payment system that has to be tailor-made for each crop depending on the time required to realize production.

Clearly the main attention in terms of design is driven by the premium. A large share of farmers produce at subsistence level and cannot afford paying a large share of its production as a premium. This suggest subsidies should be considered in order to achieve higher take-up of insurance products, especially at the beginning since there is less familiarity with insurances. Similarly, given the dispersion of productions and of climatic risk (see Section 3) and the lack of infrastructure, insurance premium are expected to be high due to the high cost of managing it and the general low take-up. It is also expected that introducing a standard agricultural insurance based on observation of damages is not feasible for insurance companies due to the high cost. For this reason, feasibility of the product demand for innovative and cost-reducing solutions (such as weather index-based insurance) and for the integration of insurance along the value chain of products.

5.2.4 Awareness and knowledge

Among the people we interviewed, there was high awareness about insurance. They all knew what insurance was and that it existed in other countries. However, they mentioned that while they knew about insurance, a vast majority of farmers do not know about insurance or how insurance works. Apart from the partial understanding of public insurance, there is little knowledge about private crop insurance. Producers have a very vague idea of what crop insurance implies, as well as what is the meaning and repercussions of crop risks. In addition to a prevalent lack of financial education among most producers, their understanding of risk is also basic. Nevertheless, among participants, there was a great expectation for accessing crop insurance, because they think it can transform their living conditions in a positive way.

This issue is in line with previous evidence provided by PwC (2018). A large percentage of farmers reports being interested in purchasing index insurance products, but very few are fully aware of the characteristics of the product. Among bean producers, only 20% know about insurance at all, and only 14% being aware of index insurance products (PwC 2018). For maize producers, awareness of insurance products presents similar levels, with 26% knowing about insurance in general, and only 13% being aware of index insurance products. Among cotton producers, only 27% knows about insurance and only 19% is aware of index insurance products. Among cashew producer, insurance awareness is strikingly low, standing at only 13%, with only 8% aware of index insurance products. In all cases, more than 75% would opt for an index insurance if given the opportunity.

In face of the need for improved knowledge among a large number of farmers, a demand for training is present, especially on the different types of insurances and on the general risk management. Specifically, the following topics have been highlighted to be of interest:

- Information about how an insurance work;
- Technical support to understand what type of insurance to buy and to understand what type of insurance is best for them;
- Technical training and assistance;
- Risk management.

Table 3. Summary of lessons from the FGD

TOPIC	MAIN LESSON
MAIN CLIMATIC THREATS	Drought, flood, hail storms, plagues
PROTECTION AGAINST CLIMATIC THREATS	Limited understanding of risk management Limited or no method of protection
IMPACT OF ADVERSE WEATHER	Significant losses in income Food security compromised Need for diversification of production and sources of income Demand of support from family members and friends
KNOWLEDGE OF CROP INSURANCE	Limited knowledge about the operation of insurance Limited application of risk management
EFFECT OF INSURANCE ON DECISIONS	Incentive to diversify their sources of income Food security and consumption smoothing
DESIRED CHARACTERISTICS OF INSURANCE	Multi-risk coverage Coverage of the whole productive process Payments linked to crop-specific growing season
INTEREST IN TRAINING	Willingness to participate exists. Themes of interest: financial education; risk management; agricultural insurance.

6 Conclusions and Policy Recommendations

Natural phenomena such as drought, flood and hail have become the main threats to farmers. They can cause irreversible damage, often leaving producers completely

defenceless. Given the analysis performed in this report, we highlight the following policy recommendations:

- There are potentially **large benefits** from the introduction of an agricultural insurance product. Climatic risks for agricultural production are present, but mitigation capacity is very limited. There is currently no major product available in the market, which requires increasing investments to support insurance companies interested in the introduction of such product and build their capacity.
- The **design of new agricultural products** should consider the lessons from the existing literature.
  - First, **liquidity constraints** are a particularly salient reason behind the low take-up of insurance, suggesting that subsidizing insurance premiums for small farmers, at least to start with, should be considered. Nevertheless, the introduction of a product requires careful assessment of the capacity of farmers to purchase the product, and conclusions should not be taken from piloting of fully-subsidized products.
  - Identifying ways to address the **lack of trust** is crucial for increasing the take up of insurance products. Since trust is expected to be low, it is important that, in case of loss, the indemnity should not take too long to reach the producers.
  - Non-price frictions such as low levels of insurance awareness and literacy, and difficulty to understand and use insurance policies properly, should be addressed through intensive sensitization sessions among farmers. There is a strong **need for financial education**, as well as training programs on agricultural risks and resilience. This would likely be the main obstacle for crop insurance to become a priority in agricultural production strategies. Training should cover various topics, such as agricultural technology and risk management. There is demand among farmers to participate in these meetings, if these would enable them to gain a better understanding of agricultural risks and strategies to deal with them.
- **Dispersion of farmers** in large distances and lack of infrastructure among insurance companies impose two features for future insurance products.
  - Innovative solutions to reduce insurers' operation costs and provide an affordable premium to small-holder farmers should be sought. Weather index-based insurance provides a superior solution as compared to standard insurance products based on damage.
  - Insurance products should be introduced within the value chain, as suppliers have extensive reach to farmers, and have already earned their trust (see for instance the case of seed suppliers).
- Since the range of adverse climatic events is sizable and the variety of crops is large, **crop insurance should cover a broader range of risks** in order to become an effective and preferred alternative for producers. Producers also consider that insurance can become an attractive option if it can protect most of the costs of production, or at least the most significant ones. An insurance that can respond in a comprehensive way to the needs of producers will certainly become a priority for the farmers that can afford the purchase of the insurance product. Premium should be designed in a flexible manner to allow farmers to pay in periods with higher income flows.

- Conditional on risk of adverse climatic events and the relative importance of agriculture, the **areas of Mozambique with a potentially higher impact** of climate events are located in Nampula, Zambezia and the coastal part of Gaza. At the same time, economic development is very limited in these areas, suggesting lower mitigation capacity, and therefore larger benefits for insurance, but lower capacity to purchase insurance, and therefore higher costs for insurers.

- The Mozambican setting not only provides the opportunity for the introduction of innovative products, but also provides a unique opportunity to **evaluate the benefits** of these products in absence of an alternative insurance product. Low levels of insurance awareness and literacy along with difficulty to understand and use insurance policies properly have been recurrent themes in the literature as main drivers of the low take-up of insurance products among farmers, particularly among poorer populations (Churchill, 2013; Coydon and Molitor, 2011). Previous attempts at providing financial literacy have proved futile (Cole et. al., 2012). Therefore, the introduction of new products should be complemented with an evaluation in terms of take-up and in terms of benefits for farmers that become insured against adverse climatic events. In addition, the introduction of new products linked to an evaluation design allows testing for different versions of the same product or for the introduction of the product in combination with an alternative product and/or service. Understanding impact in the context of Mozambique is not only useful for the development of the agricultural sector in the country, but also for the region.

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Appendix. Structure of FGD

The project's qualitative research was complemented by a focus group gathering agricultural producers and stakeholders outside of Maputo. The dialogue is designed to capture awareness and experiences with risk and agricultural insurance. The following structure was designed specifically for the FGD.

INSTRUCTIONS FOR MODERATORS

1. Moderators must know, in detail, how an average agricultural insurance product works.

2. Moderators should capture the participants' risk perceptions bearing in mind that there are differences in the concept of risk across producers.

OBJECTIVES

1. Determining risk perception.

2. Understanding limitations that reduce willingness to enrol.

3. Understanding positive and negative events farmers experience in their day to day, and how these impact investment decisions within the household contingent on being insured or not.

4. Understanding how farmers would expect to be compensated to losses resulting from adverse climate.

ENGAGEMENT QUESTIONS

1. What are the main threats your crops face?

   The goal is to capture farmers' risk perceptions. The threats discussed are likely to drive enrolment into an agricultural insurance program.

2. How do you protect against them?

   The importance of available risk mitigation instruments is to be discussed. Uninsured farmers are likely reliant on informal sources to mitigate shocks and/or prevent them. These include relatives or other rudimentary techniques.

3. How do these threats affect your household?

   Discuss with farmers past crop failures and their origin to understand how adverse situations impact decision-making.

4. How do you plan for expenses and/or investments?

5. Do you have records of previous expenses and/or investments towards your agricultural production?

EXPLORATION QUESTIONS

6. Do you know what an agricultural insurance is? How would you describe it?

   The objective is to establish whether farmers fully understand the objective of agricultural insurance products. Disinformation could have a decisive influence on their perceptions and thus, their willingness to enrol.

   a. In your opinion, how does an agricultural insurance policy work?

   The objective is to further understand if farmers are aware of the procedural steps needed to enrol, file a claim and/or cancel a policy.

   b. Why would you buy or not an agricultural insurance product?

   This question will give qualitative evidence about participants' perceptions of the agricultural insurance products.

   c. Do you believe your daily productive decisions might change if you were insured?

   We'd like to understand how farmers perceive the would-be impact of an agricultural insurance in their lives in terms of lowering risk expectations and changing investment decisions.

7. How would you prefer to pay for a product that might cover your losses under certain situations?

8. Would you be willing to participate in informative sessions regarding the consequences of climate risks such as low temperature, pests, drought and floods for your agricultural production?

9. In these sessions, would you be interested to receive information on how to manage your income, your expenses, your investment, and to sell your products?

10. What other subjects would you be interested in receiving during these sessions?

11. These questions aim to reveal participants' willingness and expected content to further their current understanding of financial products.

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