

Adoption of Crop Insurance in Kenya

A Case Study of Factors Influencing Farmers' Uptake of Maize Insurance in Othaya



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Course name

Interdisciplinary Land Use and Natural Resource Management

Word count

10892

Date 03/04/2020

Abstract

Agricultural index insurance has become an increasingly relevant mitigation tool in the Global South due to the growing threats of climate change. The Kenyan government has implemented a crop insurance program, however, uptake of crop insurance in the country has generally been low. Our report is based on fieldwork in Othaya, Nyeri County in the Kenyan highlands. With a focus on maize insurance, the aim of this report is to understand which external and internal factors influence farmers' decision to take up insurance.

To answer this question we carried out questionnaires, semi-structured interviews as well as a focus-group discussion with farmers and key informants involved in the program. Findings revealed that lack of information is a major contributing factor to the low uptake, since farmers have little knowledge about the insurance. Furthermore, we find that the attitude towards purchasing insurance is positively influenced by the membership in farmers groups and farmers' negative perception of climate change. Our suggestions focus on the institutional arrangements of the scheme which means that improving the flow of information between the insurance company, the local authorities of Othaya and the farmers should be the main priority if uptake of insurance is to be increased. More concretely we propose that formation of farmers' groups, the presence of representatives from insurance companies as well as more agricultural officers in the region would be beneficial in increasing uptake in the future.

Acknowledgements

The field-based part of the course was a collaboration between the Wangari Maathai Institute for Peace and Environmental Studies at University of Nairobi, Roskilde University and University of Copenhagen. The inputs and efforts of lecturers from the Wangari Maathai Institute, University of Copenhagen and Roskilde University are highly appreciated. This field work and design of the project was collaboratively done by students from University of Nairobi, University of Copenhagen and Roskilde University. Villagers of Othaya, Nyeri county hosted the students and freely contributed to the information in this report through several interviews and informal communications. Their contribution is acknowledged and much appreciated. We are grateful to the chief and the community leaders in Othaya for logistical support in the implementation of the training.

We want to thank our guides Maureen and Kuntah as well as our drivers James and George for helping us navigate the area so reliably during the field research, we would not have been able to accomplish our research without you.

We also want to thank all our host families for accommodating us so kindly, you have made our time in Kenya truly wonderful.

Work Distribution

All authors have contributed equally to each section of this report.

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Abbreviations

Methods and Framework					
FGD	Focus group discussion				
SLF	Sustainable livelihood framework				
SSI	Semi-structured interview				
People and Institutions					
AO	Agricultural officer				
ECMWF	European Center for Medium-Range Weather Forecast				
GoK	Government of Kenya				
ICE	Insurance company employee				
КАІР	Kenyan Agricultural Insurance Program				
Weather data and Insurance					
ΑΥΙ	Area-based yield insurance				
EWE	Extreme weather events				
JF	January, February				
МАМ	March, April, May				
JJAS	June, July, August, September				
OND	October, November, December				
WBI	Weather-based insurance				
WTP	Willingness to pay				

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1. Introduction

The impact of anthropogenic climate change and increase in climate variability is a growing challenge facing East African agriculture (Gasparatos et al. 2017; Capitani et al. 2019). This is also the case in Kenya where rising temperatures and changing precipitation patterns will have complex impacts in the future (Adhikari et al. 2015). Because of this, the government of Kenya has, in cooperation with 7 insurance companies, developed an insurance scheme for farmers to insure their crops (SSI2). Despite climate change negatively affecting farming, the uptake of insurance has been low (Njue et al. 2018). Past research has a limited examination of the extent to which farmers have necessary information to make a knowledgeable decision about purchasing crop insurance. This is what we seeked to cover in our fieldwork which was conducted in Othaya, Nyeri County in the highlands of Kenya, where uptake of insurance is low. Therefore, we planned to investigate which factors influence farmers' uptake of insurance. This has led us to the following research question is:

What are the main factors influencing farmers' decisions to uptake maize insurance in Othaya, Kenya?

We will study how socioeconomic and demographic factors as well as perception of climate change and the insurance scheme influence uptake of insurance. The report will begin with a background of the topic followed by a literature review. Thereafter, we will introduce the qualitative and quantitative methods used during fieldwork and describe our theoretical framework which combines the Decision-Making (Meijer et al. 2015) and Sustainable Livelihoods Framework (Ellis 2000). We will present our results of the data we gathered in the field, discuss our findings and lastly arrive at our recommendations on how uptake of maize insurance can be increased. We argue that lack of knowledge of the insurance scheme is a main factor influencing the low uptake, and that improved information is vital to increase purchase of insurance.

Literature Review

2. Literature Review

This chapter will examine existing literature on agricultural insurance and conclusively lead to our research gap.

Agricultural insurance protects farmers against losses to crops or livestock when a shock happens (Blampied 2016). In the case of natural hazards destroying a harvest, the farmer will be partially compensated for the experienced losses (ibid). In the 21st century, due to anthropogenic climate change, insurance schemes, have become more relevant than ever (CGIAR n.d.; Balzer and Ulrich 2010).

There are two types of agricultural insurance: traditional loss-based schemes and index-based schemes (Budhathoki et al. 2019). The former design compensates a farmer for experienced losses at the end of a growing season (Iturrioz 2009), while index-based insurance schemes compensate the policy-holder whenever the actual yield of the area (referred to as reference level) falls below the specified critical yield, regardless of the harvested yield on the farm (ibid.). The policy-holder of this insurance scheme receives the payment when a pre-established weather or crop yield-based event occurs (Blampied 2016). The most common index-based agricultural insurance schemes are weather-based insurance (WBI) and area-based yield insurance (AYI) schemes (Budhathoki et al. 2019).

Index-based insurance schemes have the potential of boosting farmers' productivity, allowing them to invest in more weather-sensitive crops that provide higher returns and could allow them to qualify for loans to purchase agricultural inputs and tools (Blampied 2016). Additionally, index-based insurance schemes have been associated with reduced administrative, distributive and transactive costs, making them more affordable for farmers (Microinsurance Network 2017; Sandmark et al. 2013; Chantarat et al. 2013). This specific type of insurance product also avoids problems relating to moral hazard and adverse selection (Jensen et al. 2018; Dercon et al. 2014; Sandmark et al. 2013; Chantarat et al. 2012), which both lead to higher costs for insurance providers (Fonta et al. 2018; Carter et al. 2014; Mahul and Stutley 2010). Index-based insurance has been proposed as a solution to reduce uncertainty and manage an array of risks for farmers (Blampied 2016; Binswanger-Mkhize 2012), thus having the potential to secure their livelihoods (Blampied et al. 2016; Mahul and Maher 2017; Sandmark et al. 2013). Despite its theorized economic benefits for farmers, the initial uptake of crop insurance seems low in developing

countries (Carter et al. 2014; Cole et al. 2013; Binswanger-Mkhize 2012; Mahul and Stutley 2010).

Credit, income and financial capital like savings accounts were found to have a positive correlation with insurance uptake in a number of empirical studies in Kenya (Njue et al. 2018), Burkina Faso (Fonta et al. 2018), Ethiopia (Amare et al. 2019) and India (Giné et al. 2008). Other socioeconomic characteristics found to have an impact on insurance include: gender, farming experience, occupation of household head (Sibiko et al. 2018), age (Amare et al. 2019; Sibiko et al. 2018; Njue et al. 2018), proportion of land allocated to maize, proximity to markets (Njue et al. 2018), education, off-farm activity and proximity to weather stations (Amare et al. 2019). Indepth reviews on the subject find that literacy, family size, land tenure and farm size also influence uptake (Ntukumazina et al. 2017).

There is a consensus in the empirical literature that most farmers in the Global South have been experiencing increased extreme weather events (EWE) in the past years (Amare et al. 2019; Budhathoki et al. 2019; Fonta et al. 2018; Akter et al. 2017; Bogale 2015). More relevant than farmers' actual experience of unusual weather events is their perception of the risks of EWEs on their crops and livelihoods. Results from past research has shown that farmers' increased perception of risk of unusual weather events positively and significantly correlates with an increased uptake of insurance (Amare et al. 2019; Fonta et al. 2018; Akter et al. 2017; Bogale 2015). Empirical studies in Ethiopia find that farmers who believe that weather-related risk poses a threat to their livelihoods tend to purchase insurance as a preventive measure (Amare et al. 2019; Bogale 2015). While increased experience with EWEs were not correlated with increased willingness to pay (WTP) in Nepal, Budhathoki et al. (2019) finds that increased education and training about climate change have a positive influence on insurance uptake.

Other literature cites different forms of climate adaptation strategies as a factor influencing the low uptake of insurance (Binswanger-Mkhize 2012; Budhatothoki et al. 2019; Carter et al. 2014). Better-off farmers rather rely on their own adaptation strategies such as income diversification, social networks and family instead of purchasing insurance which they do not fully understand or do not consider profitable for them (Binswanger-Mkhize 2012; Budhatothoki et al. 2012; Carter et al. 2019; Carter et al. 2014).

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Most of the empirical research investigating the role information and awareness play in increasing insurance uptake find that it is a highly significant factor (Budhathoki et al. 2019; Sibiko et al. 2018; Fonta et al. 2018; Njue et al. 2018; Dercon et al. 2014). Budhathoki et al.'s household level study in Nepal and Dercon et al.'s experimental study in Ethiopia find that more training on the respective insurance products resulted in substantially higher participation. Farmers' groups have also shown to help in informing farmers about complex products and have been associated with increased uptake (Sibiko et al. 2018; Dercon et al. 2014).

Through an experimental study in Northern Kenya, Kazushi Takahashi et al. (2016) did not observe evidence that increased understanding of the insurance product in question increased demand. In another qualitative experimental study in Kenya, poor comprehension of weatherbased index insurance products was found to reduce farmers' confidence and, consequently, demand in the scheme (Sibiko et al. 2018). Studying an existing WBI maize insurance scheme in the country, Njue et al. also found that lack of understanding hinders farmers' ability to make an informed decision about purchasing the product (Njue et al. 2018).

However, past research has shown its limitation in exploring the extent to which farmers have the necessary information to make a knowledgeable decision about purchasing a crop indexinsurance product. Examining the cause for the low acceptance and identifying the main factors influencing uptake of crop insurance by farmers constitutes the central research question for this study.

3. Research Question

From the previously stated research gap, the main research question can be derived:

What are the main factors influencing farmers' decisions to uptake maize insurance in Othaya, Kenya?

This question is purposely broad in order to cover different possible factors that influence the farmers' decision-making. Based on the information given above, four different sub-research questions were derived in order to cover various influencing factors:

1. How do socio-economic factors influence the uptake of insurance?

2. To what extent do farmers' perceptions of climate change and risk influence their decision to uptake crop insurance?

3. Which local practices and adaptation strategies to climate variability are present and what effects do they have on the adoption of the crop insurance schemes?

4. To what extent do farmers' perception of the institutional arrangements of the insurance schemes impact their decision-making?

4. Background

This chapter will present the locality in which our fieldwork took place, the climate change impacts the region is facing and the maize insurance that the region has been introduced to.

The research was conducted in Karima, one of four wards of the Othaya constituency (Nyeri county) located in the eastern part of the Kenyan highlands. The town of Othaya borders Karima ward to the west and is the main urban center in the region with an estimated population of approximately 5.300 people (County Government of Nyeri 2013).

The topography of Karima ward is shaped by soft hills and valleys with Karima Hill located in the northern half being the most dominant feature. Its prominence of approximately 200m affects local weather patterns, causing increased precipitation on the western side and therefore leading to diverse agricultural production in the area (ibid.). Agriculture in the region focuses on the production of cash crops, mainly tea and coffee (SSI1). Nevertheless, maize remains a pillar of food security in the region, though it has proven to be vulnerable to the effects of climate change in the region which will be briefly described in the next section.

4.1. Climatology

Climate change is predicted to have severe consequences on socio-ecological realities in eastern Africa, however, effects may vary widely within the region. The region currently exhibits strong seasonality, expressed by a bimodal annual rainfall cycle with two main precipitation periods. The largest share (circa 70 %) of annual precipitation falls in March, April and May (MAM) with an additional less intense season from October to December (OND) (Downing et al. 2009). In addition, parts of the highlands also encounter notable rainfall from June to September (JJAS) (Gebrechorkos et al. 2019).

The high climate variability is amongst the reasons why precise prognosis of climate change impacts are very challenging for the region. In the case of the Kenyan highlands, most models project a more pronounced dry season in January and February (JF) and increased precipitation during the main rain season (MAM) (Capitani et al. 2019). Furthermore, the duration and rainfall of short rain seasons will experience increasing variability (ibid.).

Rising temperatures and more precipitation might lead to increasing yields and upwards shifting cultivation areas, especially regarding tea and coffee cultivation (Adhikari et al. 2015). However, the aforementioned unpredictability of precipitation periods as well as more extreme weather events will certainly have negative impacts on agriculture (Capitani et al 2019). Much of the current research focuses on rising temperature in higher altitudes which could lead to the spreading of crop-pests such as the coffee berry borer (*Hypothenemus hampei*) (Jaramillo et al. 2011).

These substantial challenges require comprehensive mitigation strategies of which crop insurance schemes might play a significant part. How the studied scheme was set up will be outlined in the following section.

4.2. Maize Insurance Scheme in Karima Ward

As part of the Big 4 Development Agenda, the Government of Kenya implemented agricultural insurance schemes to promote food security in the country (SSI1). This animated the foundation of the Kenyan Agricultural Insurance Programme (KAIP), a Public-Private partnership between the Kenyan government and insurance companies with assistance from the World Bank. The program has taken the shape of a consortium between seven insurance companies (SSI2) and the Kenyan Ministry of Agriculture and is geared towards smallholder farmers and pastoralists (Microinsurance Network 2017). In Nyeri, the program exclusively targets maize farming, as it is a staple crop crucial for ensuring food security in the country. Through information received from the Othaya sub-county agricultural office of Nyeri county, it was verified that the insurance program in the region is a yield-index based insurance scheme (SSI1).

Figure 1 shows the process of implementing the insurance scheme in the county, where both the insurance companies and agricultural office were involved. Data was collected to set the yield-index/reference level at 8 bags per acre, meaning farmers would be compensated if the region's average reference level fell below that number. This information was communicated to farmers through public gatherings, or barazas, where farmers could also sign up for the insurance. Before the harvest, the agricultural office measured randomly selected plots of land to determine the reference level, which was found to be 7.3-12.9 bags per acre. According to this data, farmers could receive a compensation as the lower part of the reference level is below 8 bags/acre. However, as of the time of field research no compensations to farmers were reported.



Figure 1: Diagram depicting the flow of implementation and processes of the KAIP in Othaya in 2019

5. Analytical Framework

In this chapter we introduce the framework that we apply in our analysis of our data. Theories dealing with decision-making processes have mostly dealt with external factors such as characteristics of the adopter and the external environment (Meijer et al. 2015). However, recently researchers have started to focus more on the internal factors which include psychological and motivational factors influencing uptake of new technologies (ibid.). In order to answer our research questions, we will be using two theoretical frameworks; the Sustainable Livelihoods Framework (SLF) by Frank Ellis (2000) and the decision-making framework presented by Seline S. Meijer et al. (2015). Applying a framework offers us a tool to structure our analysis and interpret our data. By combining these two frameworks we hope to conduct a more comprehensive analysis of our data, in which we will include both internal and external factors influencing farmers' uptake of maize insurance. In our analysis, we will distinguish between internal factors and external factors in order to gain a better understanding of farmers' decision-making process.

We expect that the SLF will help us explain the external factors influencing farmers' uptake of insurance. The external factors will be inspired by the SLF and are defined as organizations, institutions and socioeconomic factors. Throughout our report, we will be examining the uptake of insurance as a livelihood strategy that has the potential to improve livelihood outcomes. According to Ellis (2000), livelihoods are "[...] comprised by the assets [...] the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by the household" (Ellis 2000:10). A households' livelihood assets allow them to develop different capabilities to cope with vulnerabilities, risk and uncertainties (Masanjala 2007; Ellis 2000) - like a climate-related shock that affects their crops. These assets are comprised of natural capital (land, water and biological resources), financial capital (savings, access to credit, cash and other financial resources), human capital (labor, skills and abilities), social capital (social networks) and physical capital (infrastructure, tools, machines) (Elizondo 2017; Ellis 2000). Access to assets is influenced by factors outside a household's control, like social relations, institutions and organizations that all operate in the context of certain trends and shocks (Ellis 2000). Institutions are defined as: "the humanly devised constraints that structure political,

economic and social interaction" (North 1991:1) while organizations are defined as "groups of individuals bound by some common purpose to achieve objectives" (North 1990:5).

However, the SLF framework is limited in its account of internal factors' influence on the uptake of agricultural innovations. Thus, to answer the research questions we will also use the decisionmaking framework proposed by Meijer et al. 2015. They argue that internal factors such as knowledge, perceptions and attitudes of the potential adopter play an important part in the decision-making process (Meijer et al. 2015).

Knowledge about the existence of the maize insurance, how to apply it and the outcomes of it is one of the internal factors influencing uptake of the insurance scheme. The information a farmer has about the insurance forms the basis for perceptions farmers develop towards it (ibid.). Thus, perception is closely related to knowledge, but whereas knowledge refers to factual information about the insurance scheme, perception relates to farmers' view about it and is based on their needs and prior experiences (ibid.). Together knowledge and perceptions determine farmers' attitudes towards the insurance scheme (ibid.). Attitude encompasses farmer's intentions and behavioral control and leads to actual behavioral outcomes (Ajzen 1991). A positive attitude towards the scheme is expected to result in an increased likelihood of the uptake of insurance, while a negative attitude towards the scheme will most likely result in no uptake (ibid.).



Figure 2: Framework developed and applied for this report: The Decision-Making Framework (Meijer et. al 2015) combined with the Sustainable Livelihoods Framework (Ellis 2000)

We have developed a diagram to illustrate our framework, which is presented in figure 2 above. The external factors contribute to and influence the internal factors; therefore it is important to understand how livelihood assets, organizations and institutions influence farmers' perception, knowledge and attitudes towards the maize insurance scheme. Only by incorporating both internal and external factors, it is possible to get a full understanding of farmers' decision-making process.

6. Methodology

Overview of methods used in our fieldwork						
44 questionnaires, 12 of them combined with interview questions	12 farmers with insurance and 32 farmers without insurance					
4 semi-structured interviews	The agricultural officer of Othaya, Chairman of Kihugiru, a county official in Nyeri County and a phone interview with an employee at APA insurance					
1 focus group discussion	10 farmers with and without insurance					
Geodata	From 38 of the 44 farmers who responded to our questionnaire					
Climate data	Observational data from Nyeri from 1968 to 2020 ERA5 climate reanalysis data from 1979 to 2019					

Table 1: Overview of applied methods

During fieldwork we used different social and natural science methods in order to gain both quantitative and qualitative data on our topic. These methods are shown in the table 1 above and will be explained in detail in the following. All informants are anonymous and are referred to by pseudonyms.

6.1. Questionnaires

By incorporating a questionnaire into our fieldwork, we gained a broader understanding of farmers' demographic and socioeconomic factors, since it was possible to administer more questionnaires than interviews in the short amount of time we had for the fieldwork. Furthermore, the quantitative data from questionnaires can be analyzed statistically which simplifies comparisons. We covered several socioeconomic factors in our questionnaire which we chose based on existing literature. Furthermore, we included questions on the perception of climate change and the insurance scheme. We revised the questionnaire several times and tested it resulting in several changes to the questionnaire.

Methodology

We planned our original sampling strategy on the assumption that we would receive a list of approx. 130 insured farmers from the agricultural office. We aimed at splitting our sample into equal parts between insured and non-insured farmers. Based on this we planned on selecting a study area and using a random sampling approach to select questionnaire respondents with insurance. Non-insured farmers would also have been randomly selected by approaching houses at a previously chosen interval. However, this plan could not be implemented as we received a list with only 16 names, many of which we later realized were not insured but were selected as samples for calculating the reference level. The farmers on the list were distributed all over Karima ward, significantly enlarging our research area.

The remodeled sampling strategy was centered on a purposive approach targeting farmers with maize insurance. We were additionally able to coincidentally meet insured respondents by interacting with bypassers. Given the large research area we tried spatially spreading out our questionnaire sample to non-insured farmers by randomly selecting households in the vicinity of interviewed insured farmers.

We approached different farmers and asked if we could conduct a questionnaire with them. The questionnaires were researcher-administered in English which meant that we needed our guides to interpret them into Kikuyu. Because we were meeting farmers face to face the answers to the questions were often elaborative. We utilized this to ask follow-up questions and had additional note takers when farmers were elaborating or if misunderstandings occurred.

Furthermore, this allowed us to combine questionnaires with in-depth interview questions with farmers who had purchased maize insurance. In practice we used our questionnaire as an interview guide by merging it with our interview questions. This combination of methods enabled us to gather both quantitative and qualitative data from farmers under the given time constraints.

We used the statistical software program SPSS to analyze the data from our questionnaire. We found the frequency of different factors and undertook chi-square tests that we will present in the result section.

6.2. Semi-structured Interviews

Apart from combining interview questions with our questionnaires, we conducted four semistructured interviews. The interviews were mainly meant to give us an understanding of how the insurance scheme worked, how each stakeholder was involved in the implementation of the insurance as well as what the ideas behind the insurance scheme were. We conducted the interviews with one main interviewer, another person helping to ask questions and introducing our project as well as notetakers. It was helpful to have several people carrying out the interview, since the language barrier sometimes made it difficult to understand what the informant was saying. We recorded all interviews after asking for permission and made it clear that the respondents would be anonymous.

6.3. Focus Group Discussion

We carried out a focus group discussion (FGD) to gain a better understanding of farmers' perception and knowledge about maize insurance, farming and climate change. Furthermore, we reasoned that a FGD could make farmers inspire and challenge each other which we expected would create a more in-depth discussion. During the FGD, we used an open set of questions and creative methods, which created room for the farmers to elaborate and take control of the interview. Creative methods used in the focus group discussion was a timeline, on which farmers were asked to indicate certain weather and political events that had affected their farming. Furthermore, we gave the farmers Post-its on which they could suggest improvements of the insurance scheme. We had met most of the farmers who participated in the FGD when administering the questionnaires, while a few had been brought there by other informants. To accommodate all the farmers that participated in the discussion we chose to keep it in their local language Kikuyu. By doing so, we hoped that everyone would feel included. One student, who spoke Kikuyu, was moderating the discussion, two students were helping the moderator with questions and other formalities and two students were taking notes based on translations from our two guides. The farmers had very different knowledge about the insurance scheme, since some had taken up insurance before while some had almost no knowledge about the insurance scheme. That meant that some farmers were speaking more than others because they could share their experiences and opinions on the scheme. Furthermore, one farmer was a former Agricultural Officer (AO) of Othaya, which meant that when the farmers criticized the agricultural office the criticism was often being directed towards him.

6.4. Geodata

In all maps in this report, the base map is Google Maps Satellite. Shapefiles containing Kenyan administrative boundaries and average annual rainfall in Kenya were obtained from the World Resources Institute. The coordinate reference system used for all maps is WGS 84/Pseudo Mercator. Further details will be displayed in the maps' description.

During our field research GPS points for questionnaire respondents were collected and subsequently mapped using QGIS 3.4 (figure 3). It was not possible to conduct all questionnaires at the respondent's home, therefore only 38 points are shown on the map.



Figure 3: Spatial distribution of questionnaire respondents in Othaya

6.5. Climate Data

Observational precipitation data from the Kenyan Meteorological department was at the center of this analysis. The data set features monthly total precipitation from 1968 to 2014 collected at Nyeri's meteorological station located approximately 15km away from the field site. This original data was later supplemented with weather cards containing data for the months up to January 2020 collected at the same station.

In addition, due to data scarcity, atmospheric reanalysis data was used to model changes in temperatures. The data is part of the ERA5 climate reanalysis model developed by the European Centre for Medium-Range Weather Forecasts (ECMWF). The data features the monthly mean temperature for a 30km grid from which the cell containing the field site was selected. The data was available from January 1979 to August 2019.

7. Results

In the following we will present our findings for each sub-research question.

7.1. Socio-economic Factors

In this section we examine which socio-economic factors influence uptake of insurance to answer our first sub-research question. Descriptive statistics of demographic characteristics were used for our sampled farmers and can be found in figure 4. Sampled farmers are smallholders that on average farm on 2.15 acres of land and allocate 0.59 acres of land to maize farming. The mean age of farmers is 56.16 years.



Figure 4: Descriptive statistics of sampled farmers

External factors like natural, financial and human capital, as well as age and gender, were not found to have a statistically significant correlation with insurance uptake (table 2). Only one of our variables reflected statistical significance with insurance uptake: members of farmers' groups (*P*=0.0009). The results from our questionnaire showed that all farmers who had taken up insurance belonged to a farmer's group or cooperation like horticulture or livestock groups (figure 5). Our qualitative data shows that farmers were exposed to the insurance scheme in gatherings with other members from their group (SSI3, 4, 5). During our FGD, when asked what approaches farmers could take in relation to farming and insurance, there was a consensus that they should organize themselves in groups to optimize their agricultural production. Social capital, therefore, seems to be important to farmers and, according to our data, can influence insurance uptake. This is an example of how external factors influence the internal ones like knowledge.

	Age	Gender	Education Level of Household Head	Farm Size	Size of Farm Allocated to Maize	Income	Maize Yield	Member of Farmers' group
Insurance	P =	P =	P =	<i>P</i> =	<i>P</i> = 0.453	P =	<i>P</i> =	P =
Uptake	0.692	0.343	0.229	0.641		0.683	0.907	0.0009

Table 2: Pearson correlation between socioeconomic and demographic factors and insurance uptake



Membership in farmers groups and uptake of insurance

Figure 5: Spatial distribution of uptake of insurance and membership of farmers' groups

Farmers need to grow maize in order to take part in the insurance scheme. Natural capital is therefore closely related to underlying characteristics that determine farmers' ability to take up insurance or not. On more than one occasion farmers mentioned that they produce too little maize to be interested in insurance (SSI6, 7, 8). Despite the lack of statistical correlation between natural capital variables and insurance uptake (table 2), we still argue that natural capital can influence farmers' decision towards purchasing insurance. However, the extent to which it influences uptake cannot be verified due to insufficient data.

Although we found no significant statistical correlation between income and insurance uptake (table 2), farmers need financial capital to purchase the insurance premium. Through our semistructured interviews, we heard diverging answers relating to farmers' conception of how expensive the insurance scheme is (SSI4, SSI10, SSI11). Two individuals present in our FGD disagree with the insurance scheme being expensive. However, one farmer, Henry, mentioned that many farmers did not sign up because of how expensive the scheme is (SSI10). After asking farmers what would make them take up insurance in the future, almost 41% of our sample answered that a lower cost of the premium would factor into their consideration. Although the AO did not recommend a lower cost of the premium to make it more accessible to farmers, he did recommend the insurance program starting earlier in the year so farmers have more time to come up with the necessary funds to purchase the scheme. In conclusion, financial capital is a factor that influences farmers' decision to take up insurance, since they need income to pay for it. However, due to contradictory data, we cannot say to what extent it influences farmers' attitudes towards uptake.

We found no significant relationship between human capital, like level of education of household head and insurance uptake (table 2). When analyzing traditional forms of human capital, like formal education, we argue that it does not influence insurance uptake. However, in the FGD and interviews, farmers expressed a need for more education and awareness about insurance and proper agricultural practices (SSI5, 11, 14). The importance of knowledge about these topics will be elaborated in the following sections.

When we analyze our findings, it seems like natural capital plays some role in farmers' decisionmaking process, despite the lack of statistically significant correlation between this variable and uptake. We cannot say to what extent financial capital influences uptake due to contradictory data. The only factor that had a statistically significant influence on uptake was membership of a farmer's group or organization. Social capital in the form of farmers' groups like horticultural and livestock groups in Karima ward can be a valuable information source. This reflects how an external factor (social capital) influences an internal factor (knowledge, information), which influences farmers' attitude towards insurance and, consequently, the decision-making process regarding uptake. The importance of information acquired through social knowledge will be further analyzed in the fourth subsection of this chapter.

7.2. Perception on Climate Change

In the following, we will examine internal factors influencing the uptake of insurance. The focus of this part will be farmers' perception of climate change and how worries about unusual weather events shape their attitudes towards maize insurance.

The unequivocal finding presented in this section is the overwhelming consensus of farmers experiencing unusual weather and environmental events in the last ten years. With a positive response rate of 100 %, changes to rainfall seasons is most prevalently experienced by farmers (figure 7). According to them, long- and short rain-seasons have become increasingly unpredictable with especially pronounced changes in the last two years. In particular the current season (during the field research) showed continuous rains since September without the regular

dry season in January and February. This makes it increasingly difficult for farmers to determine planting times and select the best crop varieties including maize. A lot of the interviewed farmers experienced last season that changing rainfall patterns were causing their maize to rot due to increased precipitation during a Figure 6: Rotting maize cobs natural dry period. One farmer



called Patrick showed us how water was able to enter the open maize cobs causing them to rot (figure 6). He told us that he worries a lot about weather changes and thinks about it every morning when he wakes up (SSI11). A potential relationship between this unpredictability and uptake of insurance will be examined more closely in the next part. We will look closer at farmers' worries on climate change and how it influences their attitude towards maize insurance.



Figure 7: Answers to multiple choice question 3.1 "Have you experienced any of the following unusual weather or environmental events in the last 10 years?"

As summarized in figure 7, farmers experience a wide variety of unusual weather events which further strengthens the case that the region exhibits severe climate change impacts. Notable is also the strong response rate for environmental problems which were often specifically mentioned in the context of maize and coffee production. How these perceptions match with climatological data will be discussed in the following.

Climate change data

The findings presented above show a generally high awareness of farmers towards climate change impacts. However, it might prove insightful at this point to compare farmer's perception to actual meteorological data in order to review the results and contextualize the relevance of the maize insurance scheme in the region.

Farmers' perception of increasing rainfall matches well with the observational weather data. Average annual rainfall increased significantly in the inquired period (figure 8). This fits in with the broader trend in the region which shows increased precipitation in the last 30 years (figure 9). Similar results can be presented regarding farmers' perception of rising temperature (figure 11). Average daily temperature increased by approximately 1°C between 1979 and 2019 with unusual high temperatures in 2018 and 2019, a fact frequently mentioned by farmers.

Regarding changing seasonality, the data shows a major increase in rainfall during the OND and MAM seasons in the studied period. Furthermore, the last five years show a high volatility in precipitation during OND and MAM. In particular, concerns about high rainfalls during OND season in 2019 were raised by the respondents (figure 10)

This brief analysis shows that farmers' perceptions of climate change impacts correspond with the presented climatological data, strengthening the relevance of crop insurance schemes as a form of climate change mitigation in the region.



Figure 8: Monthly precipitation in Nyeri between 2010 and January 2020. (Kenyan Meteorological Department, 2020)



Monthly precipitation Nyeri





Figure 10: Seasonal precipitation in Nyeri between 2009 and January 2019 (Kenyan Meteorological Department, 2020)



Figure 11: Mean monthly temperature in Othaya between 1979 to August 2019. (Copernicus Climate Change Service, 2020)

One insured farmer (SSI3) specifically mentioned that he took up the maize insurance because he worries about the weather and that it has become more unpredictable. However, to what extent farmers' perception of climate change is influencing the uptake of maize insurance will be discussed in the next part.

Worries about climate change

As mentioned earlier famers do experience and worry about unusual weather events affecting their crops production. Therefore, we asked them to what extent they worry about the unusual weather patterns affecting their crops. Their answers were, as can be seen in figure 12: 37 (84%) either strongly agree or agree with the statement. These findings indicate that climate change impacts are of major concern to farmers, something most likely related to the fact that 38 (86.3%) of the farmers have experienced negative impacts on their crop production the last 10 years due to unusual weather events (figure 13)



Figure 12: Answers to question 3.2 "I worry about unusual weather patterns affecting my crops"



Figure 13: Answers to question 3.3 "Unusual weather event have negatively impacted my crop production in the last 10 years"

Additionally, we asked them to what extent they think that maize insurance would be beneficial for their household. 29 (65.9%) think that it might be beneficial while 11 (25%) did not think so. A majority of farmers (70%) who expressed concerns about unusual weather events do also strongly agree or agree that their household would benefit from the maize insurance (P=0.350) (table 3). We found a significant correlation between farmers who think their crop production has been negatively impacted by unusual weather events and that maize insurance could be beneficial for their household (P=0.015) (table 4). Thus, it seems like former experiences with unusual weather events have influenced their perception of climate change, which in turn creates a positive attitude towards maize insurance.

		Unusual weather events have negatively impacted my crop production in the last 10 years							
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total		
	Strongly agree	16	5	0	0	1	22		
		57.1%	50%	0%	0%	50%	50%		
	Agroo	3	3	0	1	0	7		
	Agree	10.7%	30%	0%	33.3%	0%	15.9%		
The maize	Neutral	2	0	1	1	0	4		
insurance would be beneficial for my household		7.1%	0%	100%	33.3%	0%	9.1%		
	Disagree	2	1	0	1	0	4		
	Disagree	7.1%	10%	0%	33.3%	0%	9.1%		
	Strongly disagree	5	1	0	0	1	7		
		17.9%	10%	0%	0%	50%	15.9%		
	Total	28	10	1	3	2	44		
	Iotai	100%	100%	100%	100%	100%	100%		

Table 3: Cross-tabulation between question 3.2 "I worry about unusual weather patterns affecting my crops" and 4.6 "The maize insurance schemes would be beneficial for my household"

		I worry about unusual weather patterns affecting my crops						
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total	
	Strongly	15	4	1	1	1	22	
	Agree	57.7%	36.4%	7.7%	100%	33.3%	50%	
	Agree	4	3	0	0	0	7	
		15.4%	27.3%	0%	0%	0%	15.9%	
	Neutral	2	0	1	0	1	4	
The maize insurance scheme		7.70%	0%	33.3%	0%	33.3%	9.1%	
for my household	Disagree	2	1	1	0	0	4	
	Disagree	7.7%	9.1%	33.3%	0%	0%	9.1%	
	Strongly	3	3	0	0	1	7	
	Disagree	11.5%	27.3%	0%	0%	33.3%	15.9%	
	Total	26	11	3	1	3	44	
	TOtal	100%	100%	100%	100%	100%	100%	

Table 4: Cross-tabulation between question 3.3 "Unusual weather events have negatively impacted my crop production in the last 10 years?" and 4.6 "The maize insurance schemes would be beneficial for my household"

At this point however, it might be relevant to briefly discuss farmers that, despite experiencing unusual weather or environmental events, were not concerned about climate change affecting their crop production in a negative way. Reasons for this expressed by the farmers were assurance in their own farming skills as well as religious motives. An older woman in Kihugiru, who did not worry at all since *"she is well prepared for everything"* and she believes that God is watching over her (SSI13). This belief and the subsistence characteristic of maize deter her from purchasing insurance as she does not consider it to be beneficial. In these instances, the perception of climate change does not impact their decision on the uptake of insurance in a positive way. Instead, they do not consider it a major risk to their crops and hence, they establish a negative attitude towards the insurance scheme.

Looking more specifically at farmers that took up maize insurance, all of them either strongly agree (10) or agree (2) that they worry about unusual weather patterns affecting their crops (P=0.210) (figure 14). Likewise, they all either strongly agree (11) or agree (1) that unusual weather events have negatively impacted their crop production in the last 10 years (P=0.272) (figure 15). Even though this might indicate that perception of climate change is a contributing factor for uptake of insurance, the chi-square tests do not show a significant correlation. Nevertheless, by supplementing these findings with our qualitative data presented above, we are able to state that farmers' perception of climate change does influence their attitudes towards maize insurance



Figure 14: Answers from insured and uninsured farmers to question 3.2 "I worry about unusual weather patterns affecting my crops"



Figure 15: Answers from insured and uninsured farmers to question 3.3 "Unusual weather patterns have negatively impacted my crop production in the last 10 years"

We found that farmers' perceptions of climate change do translate into worries about negative impacts on crop production in the vast majority of cases. These worries in turn translate into a positive attitude towards the maize insurance, as it could help them cope with their losses. This is a strong indication that farmers' uptake of insurance is at least partly impacted by their perception of climate change. Therefore, we argue that their worries about climate change is a contributing factor in the decision-making process to take up maize insurance.

7.3. Local Practices and Adaptation Strategies

Climate change creates many agricultural challenges and insurance is only one way for farmers to try to handle the impacts. This section aims to analyze whether knowledge and application of alternative adaptation strategies influences farmers' decision-making about purchasing insurance.

From our questionnaire we found that farmers in Karima apply a number of agricultural practices as protection against maize losses (figure 16). Testing the data with a chi-square test, we found no statistically significant correlations between any adaptation strategies and insurance uptake (table 5). However, the collected qualitative data might still provide valuable insights. We classified adaptation strategies into two categories.

Firstly, a general diversification approach is that farmers apply supplementary agricultural practices such as livestock (68%) or planting other crops (63%). In addition, some respondents established non-farming income sources.

The expansion of agroforestry as a tool to diversify farmers' income and as part of a comprehensive environmental policy (increasing tree coverage) was also practiced in the region (SSI12).

Compared to this, the second approach is more focused on climate change adaptation, specifically on the protection of maize. Our findings indicate that farmers modify their production inputs by applying pesticides (68%) as the most prominent technique, followed by planting drought resistant varieties of maize (47.7%). Both methods are specifically targeted to mitigate climate change impacts. Despite pesticides and maize varieties being the two most highly applied methods for climate change adaptation, farmers in the FGD mentioned a deep dissatisfaction with the government's role in providing them with inputs for better farming practices. This might

again reflect how organizations (the government) can influence farmers' agricultural practices and adaptation strategies.



Figure 16: Answers from insured and uninsured farmers to question 4.7 "How do you protect yourself against crop (maize) losses?"

	Drought Resistant Varieties of Maize	Intercropping	Livestock	Non- Farming Income Sources	Pesticides	Other Adaptation Strategies
Uptake of Insurance	<i>P</i> = 0.124	<i>P</i> = 0.645	<i>P</i> = 0.895	<i>P</i> = 0.252	<i>P</i> = 0.552	<i>P</i> = 0.873

Table 5: Pearson correlation between insurance uptake and adaptation strategies from quantitative data

We further identified climate change adaptation strategies that do not require inputs. One example mentioned by the AO and farmers alike was intercropping of maize and beans as a protection against pests. The lower growing bean plants become infested first, giving developing maize plants more time in critical early growth stages. Knowledge about this method seemed to be widespread and enabled farmers to increase their maize yields through a more accessible method.

Given all surveyed farmers in Karima ward experienced changes to rainfall season, an important climate change adaptation method mentioned by a farmer's association chairman (Henry) was
adopting timing for planting crops. He suggested farmers should increasingly incorporate weather awareness into their selection of the most suitable planting time (e.g. as it starts raining and not when the seasons are supposed to start or end) (SSI10). However, knowledge about this approach did not seem to be widespread amongst the surveyed farmers and most interviewees expressed great insecurity towards planting for the next season.

What became clear during the research and was also highlighted by the AO, was limited climate change adaptation training for farmers due to scarce county government resources. However, the AO mentioned that farmers were generally aware of climate change but unable or unwilling to apply adequate climate change adaptation strategies SSI1). Improving climate change education was indeed suggested by farmers in the FGD, hinting at a possible demand for such programs (FGD).

Although the maize insurance program was created to improve food security due to the growing threats of climate change, farmers revealed an interest in purchasing insurance for cash crops like coffee and tea (9 interested in coffee; 3 interested in tea). The AO confirmed this trend during our interview (SSI1).

We were unable to assess a relationship between adaptation practices and insurance uptake. However, we got an insight into the different adaptation strategies dealing with both livelihood diversification and climate change. We will elaborate on our shortcomings in data collection in the discussion section.

7.4. Perceptions of the Institutional Arrangements

In this section we will investigate how farmers' perception and knowledge about institutional arrangements form a main part of the process to decide whether to purchase insurance or not. The following organizations form and influence the institutional setup of the maize insurance scheme: national and local government agencies, such as the ministry of agriculture and agricultural officers and private insurance companies (SSI1).

Knowledge about the insurance scheme

Agricultural officer and government

The questionnaires and semi-structured interviews with farmers, as well as the interview with the AO showed the importance of the AO in communicating the insurance scheme. Over a third

(36.4%) of our respondents answered that the AO was their main informant about the insurance scheme. Other important information sources were public barazas where the AO informed farmers about the maize insurance scheme (figure 17). An insured farmer from Ichambugi, Joseph, told us that his farmers' group received information about maize insurance because they invited the AO for education purposes to their farms and at the end of the meeting he informed the farmers about the maize insurance scheme (SSI3). This method of spreading information could explain why the distribution of uptake is so unequal across the study area (figure 18) and why farmers located close to insured farmers are not aware of the scheme



Figure 17: Answers to multiple choice question 4.2 "What is your main source of information about the insurance scheme?"



Uptake of insurance and main source of information

Figure 18: Map - Location of uninsured and insured farmers in the research area

Furthermore, the AO pointed out that selling maize insurance should not be a government issue but rather a transaction between the insurance companies and farmers (SSI1). The FGD showed that some farmers think the government should be involved in the scheme. However, the extent of the involvement was not discussed by the farmers and insured farmers stated in the SSIs that they would prefer to interact with the insurance companies directly (SSI3, SSI4). In addition, while farmers discussed possible improvements of the insurance scheme, they argued that there is need for improved policies and a higher number of AOs in the area who visit the farmers to inform and educate them (FGD). This was also mentioned by the AO. The reduced number of AOs that can inform and visit farms could be one aspect that led to misinformation about the insurance scheme which can be further linked to a lack of resources given by the government to implement it. In addition, data from the questionnaire revealed that the majority of farmers (56.8%) would take up insurance in the future if they would receive more information about it and 38.6% answered that an improved institutional setup is necessary. This data also indicates the need for more information and the flaws in the institutional setup of the insurance.

Insurance companies

Our findings show that the insurance companies involved in the maize insurance scheme were not active in communicating the insurance scheme. The lack of information from the insurance companies is presented in figure 17 as it shows that only 2.3% answered that insurance companies are their main source of information. One farmer, Beth, told us she thinks it would be better to be in contact with the insurance company to receive information, but she does not know how to contact them (SSI4). This data coincides with information derived from the interview with the AO. He proposed that insurance companies should deal with the farmers directly to improve the transparency of the scheme. When asked what his impression about the transparency of the scheme was, he replied: "minus 90%". Further, he argued that the lack of transparency is due to the fact that he does not know how the insurance company set the yield index for Karima ward at 8 bags/acre (SSI1). The employee from the insurance company we interviewed also acknowledged that the farmers' lack of understanding of the scheme was one of the challenges that the program was facing. However, he opined that the structure of the scheme was adequate (SSI2). The lack of transparency further indicates the flaws of the design of the insurance scheme. With the AO as the only representative of the insurance scheme and his limited knowledge about it, it is difficult for him to pass on the necessary information to the farmers. We argue that this lack of information and transparency of the scheme negatively impacts the farmers' attitudes towards the scheme, which in turn influences the decision-making process.

Furthermore, the data shows a lack of awareness about the insurance scheme among the farmers in the area. Half of the surveyed farmers had no knowledge about the insurance scheme, a third (32.8%) explained that they had little knowledge while only 9.1% of the farmers described themselves as knowledgeable about the insurance (figure 19). This reflects that farmers did not receive enough or no information about the insurance scheme. The lack of awareness about insurance might be one of the main factors influencing the low uptake in the research area as farmers with little or no knowledge about the insurance are unable to decide to purchase it. In addition, the data shows that most insured farmers did not receive sufficient information about the insurance scheme. This reflects that 66.7% of the insured farmers did not have sufficient knowledge about the scheme which can further lead to misunderstandings and wrong expectations about when the farmers should receive compensation.



Figure 19: Answers from insured and non-insured farmers to question 4.1 "What is your level of knowledge about the maize insurance scheme?"

These findings show that external factors like organizations and institutions strongly influence the internal factor knowledge. The AO, as an organization, is the only source of information farmers can depend on to gain knowledge about the insurance scheme. Thus, the impact on how this organization communicates information is significant. Knowledge and information form the basis of the decision-making process as decisions without information are not possible. It can be seen from the analysis above that transmission information was not sufficient which further resulted in the low adoption rate of maize insurance.

Trust in the insurance scheme

Another central finding of our research about the institutional arrangement of maize insurance is that doubts about its effectiveness and benefits are present amongst both non-insured and insured farmers. A common issue raised by respondents was insecurity about compensation being paid out to farmers. One insured farmer, Henry, is not convinced that eligible farmers will receive compensation. When asked if he thinks more people will sign up for insurance in the future he answered: "no, they won't be interested because there was no compensation" (SSI10). This uncertainty in the insurance scheme discourages him from extending maize insurance into the following season. This is not an isolated case as many farmers only specifically agreed to the advantageousness of maize insurance under the condition that compensation will be paid (SSI3, 4, 10). These findings indicate that a relevant number of farmers expressed sufficient uncertainty for them to question the fundamental workings of the insurance schemes itself. Hence, farmers' previous experiences with the insurance seem to have affected their perception of it, which in turn creates a negative attitude towards the maize insurance scheme.

According to the AO, a high number of farmers, potentially eligible to participate in the maize insurance scheme, decided to await the outcomes of the first insurance period. He further mentioned that some farmers generally have a distrustful stance towards him and his role in selling maize insurance. It can be difficult for farmers to figure out his precise role in the institutional arrangements and what his responsibilities are (SSI1). Hence, we argue that the insurance scheme is, on the part of farmers, surrounded by distrust and suspicion which can be further linked to the intransparency of the institutional setup of the insurance scheme.

Despite the uncertainty and lack of trust in the insurance scheme some farmers still wish to purchase insurance this year. Patrick argues that he cannot judge the effect of maize insurance before he has tried it: "if you do not try it out, there is no way of knowing whether it works or not" (SSI11). Therefore, he wishes to give the maize insurance a fair chance before judging it. Patrick is not the only insured farmer with this attitude towards the insurance scheme. Maria also wishes to sign up again, as she has trust in the AO (SSI5). She expressed the conviction that if other farmers would receive the same information about the scheme as she did, more of them would choose to take up maize insurance in the future.

At this point, it becomes important to return to the deficient dissemination of information since it is directly related to farmers' trust in the scheme. Knowledge is of major importance in the decision-making process. If farmers, due to the lack of transparency, do not receive sufficient information about the insurance they do not perceive it as credible. This, in turn, creates a negative attitude towards the insurance scheme. Thus, the lack of transparency makes the maize insurance vulnerable to personal perceptions of trust which in turn influences the uptake of the maize insurance scheme.

The lack of information and knowledge about the insurance scheme together with the lack of trust in the institutional arrangements are important internal factors influencing farmers' attitudes and, consequently, their decision-making process.

The fact that most farmers in Karima ward did not receive sufficient information about the maize insurance scheme can be one factor explaining the low uptake of insurance in the area. The lack

of trust in the insurance scheme may be another important factor influencing the uptake of insurance - and may turn out to be even more crucial when it comes to the sustainability of the insurance scheme. If farmers' perception of the institutional arrangement lacks trust and they do not believe that they will receive compensation, they will develop a negative attitude towards the scheme and most likely not take up maize insurance.

8. Discussion

In this chapter we will discuss how ethical concerns, positioning in the field and the use of our methods and framework has affected our results. Furthermore, we will compare our findings to those of other studies.

Lack of knowledge about the insurance scheme appears to be a defining factor pertaining to farmers' insurance uptake. The absence of transparency significantly influences their perception of trust and their level of knowledge, which, consequently, contributes to a negative attitude and leads to low uptake. Our results show that insured farmers received crucial knowledge about the insurance scheme through farmers groups. This reflects how social capital plays a key role in the decision to purchase insurance.

All sampled farmers are experiencing climate change and most of them worry about their agricultural production due to the phenomena. More importantly, almost all insured farmers perceive negative impacts on weather changes and worry about future agricultural production prospects, indicating that these factors contribute to their positive attitude towards the scheme, leading to uptake. Despite a majority of our sample perceiving climate change as a threat to their livelihoods, we did not find differences in how insured and non-insured farmers implement adaptation strategies.

8.1. Ethics and Positioning

Going to Kenya to conduct fieldwork leaves us in a special position as outsiders in the community. Our presence as mzungus (white people) was perceived differently by farmers as some seemed privileged to have us visiting their farms, whilst others seemed more suspicious. Being outsiders gave us an opportunity to see social patterns that the residents might not see or take for granted. On the other hand, it also left us with disadvantages. Firstly, we are culturally biased and strangers in the surroundings. Secondly, due to our limited knowledge about the field site we had certain expectations and predispositions about our research that most certainly influenced our study. Thus, it is important to be aware of our bias and our position in the field.

A position as not only outsiders but also university students required us to be aware of how it might affect the way farmers responded to us and our questions. When visiting their farms, some farmers thought that we worked for the AO or insurance company and that we came to inform them on compensation or farming. Thus, they seemed reluctant to answer some of the questions, as they were not sure about why we were doing the research. We were cautious about not appearing as if we were there to educate the farmers but there to learn from them. Furthermore, it was important for us to make sure that farmers knew that we were only in the area for a short time and that our presence in their community would not make any significant changes to their problems.

8.2. Reflection on Framework and Methods

Reflecting on our framework and our methods as a tool for our analysis has exposed a number of limitations and biases that will be discussed in this section.

The framework helped us in our analysis by giving us an overview of the decision-making process among farmers who were exposed to the insurance. However, it did not help us accounting for the farmers who had no knowledge about the scheme and hence having no decision-making process.

The major shortcoming of our study is that we did not collect sufficient data to answer our third research question. This is due to the fact that our question (4.7) in the survey was often perceived as a general inquiry on diversification of livelihoods and rarely specifically about climate change adaptation strategies. Additionally, we later realized that the intent of the question was poorly communicated to the interpreters. Furthermore, trying to collect data on this complex topic in only one question of our survey proved to be insufficient. Our analysis therefore relies mostly on qualitative data; however, climate change adaptation strategies were rarely discussed by respondents. Therefore, the validity of findings presented in this section is subject to significant limitations.

An issue that has been prominent across all methods has been the language barrier. In the field we were relying on interpretation. Even though the focus group was conducted in Kikuyu, language difficulties were still existent since one farmer decided to only speak in English. This created an imbalance in the discussion since not all farmers were able to understand him. Furthermore, while we tried to limit the use of academic language, certain terms might have been misinterpreted or entail a different understanding. This point applies to the entire field work. Issues concerning gender were also part of the field work but were especially pronounced during the FGD. The four women present in the discussion overall had much shorter speaking time, though we tried to include them by asking them more directly on their opinions. Furthermore, during interviews in which husband and wife were present, the male respondent often dominated the conversation. These experiences could imply loss of information and can limit the validity of our findings. This can result in gender biased data.

Our collected data on average monthly income is also subject to limitations as many farmers were indecisive due to strong seasonal differences in their income. This limits the validity of our statistical analysis regarding income and uptake of insurance.

Another limitation concerns farmers' perception of climate change. During the fieldwork we observed only few farmers talking about unusual weather or environmental events in the inquired time span (last 10 years). We specifically noticed that recent extreme weather events dominated the answers, therefore possibly distorting respondents' long-term perspectives.

This leads over to another limitation resulting from our decision to avoid climatological terminology in our fieldwork. This was done on purpose to keep questions comprehensible for all actors involved. However, there is a clear distinction between weather and climate and it is vital to acknowledge that most qualitative data regarding climate change is based on statements about weather. This is not per se problematic, as one effect of climate change is the increasing frequency of extreme weather events. The use of climate data to depict long term trends is therefore used to strengthen the validity of our study.

The used climate data is also subject to limitations. Firstly, the precipitation data originating from the Kenyan Meteorological Department has significant data gaps. Data for the years 2004, 2006 and 2014 is almost entirely missing. The possibility of filling these gaps with climate reanalysis data proved to be infeasible as the error rate between the observational and modeled data was too large. Due to unavailability of observational data, climate reanalysis data needed to be applied for changes in temperature. However, accuracy for temperature data is reportedly higher compared to precipitation (Lorenz and Kunstmann 2012; Zwiers et al. 2013). Therefore, despite remaining limitations, the use of climate reanalysis data is still suitable for this specific use.

The uneven distribution of data over the large research area prevented us from using geospatial analysis tools and hence we used maps to visualize simple spatial relationships in our data.

We also acknowledge that a sample of 44 farmers is too small to adequately represent Karima ward, however because of time constraints and significant challenges of finding insured farmers we were not able to conduct more questionnaires. This also applies to our small sub-population of 12 insured farmers. Our analysis might be distorted as possible correlations remain undetected due to the dominance trends among non-insured farmers.

8.3. Reflection on Findings

Based on the results presented in the previous chapters, this section aims to discuss the functionality of the maize insurance scheme and contextualize our findings.

Considering that out of the 44 farmers we talked to 29 (65.9%) of them agree that the maize insurance would be beneficial for their household. However, 13 (44%) of them also say that they have no knowledge about the scheme. This could indicate that even without direct exposure or specific information about the scheme, some farmers are aware of potential benefits of insuring their maize. However, answers to this question could have been distorted as our inquiry could have influenced their opinion about the scheme. This might suggest that there is a need among farmers to secure their maize against losses. But without any information on the insurance scheme farmers cannot make a knowledgeable decision on uptake of insurance.

It is interesting to consider whether maize insurance is the best option for farmers when it comes to mitigating maize losses, given they apply other adaptation strategies. Based on our findings of mistrust, we argue that farmers could prefer strategies with less dependence on government entities. Furthermore, it should be questioned whether maize insurance can significantly improve farmers' livelihoods in the region. As mentioned, insurance products targeted at major cash crops could be more relevant in the region. This suggests that there are additional factors to investigate in order to understand low uptake of maize insurance in the area.

Connected to the lack of information is also the perceived intransparency of the scheme. As mentioned earlier, it is difficult for stakeholders and even directly involved officials to obtain knowledge about the inner workings and responsibilities of organizations in the scheme. The intransparency and inadequate communications indicate a mismanagement of the entire scheme. Hence, the weak design of the scheme makes the implementation at the local level difficult to succeed.

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8.4. Comparison to Literature

The following section will compare our results to literature on insurance.

Our statistical findings on financial capital oppose much of the literature that finds that higher income and increased access to other financial capital are positively correlated with index insurance uptake (Amare et al. 2019; Njue et al. 2018; Fonta et al. 2018; Giné et al. 2008). Results from other demographic variables and natural and human capital were also not found to be statistically significant with uptake, contradicting the research on the topic (Amare et al. 2019; Sibiko et al. 2018; Njue et al. 2018; Ntukumazina et al. 2017). However, our qualitative data on natural capital suggests that, to some extent, size of land dedicated to maize can influence farmers' decision to take up insurance, thus going in accordance with past studies (Amare et al. 2019; Njue et al. 2018). Lacking qualitative data on financial capital does not allow similar conclusions on this factor. The only variable we found a statistically significant relationship with uptake was membership of a farmers' group, corroborating Sibiko et al.'s (2018) findings in Kenya and both Dercon et al.'s (2014) and Amare et al.'s (2019) respective studies in Ethiopia.

Our findings reflect that worries about climate change influence farmers' attitudes towards insurance. This is in accordance with previous studies conducted in developing countries that also find a correlation between concerns about climate change and weather related risks and insurance uptake (Amare et al. 2019; Fonta et al. 2018; Akter et al. 2017; Bogale 2015). Akter et al. (2017) found that farmers in Bangladesh who displayed fatalistic views about the impacts of climate change were less likely to adopt crop insurance of any kind. We also encountered farmers who, despite having experienced unusual weather or environmental events, felt no concern about its impacts on their crops due to religiously motivated beliefs. Budhathoki et al. (2019) finds that training and information on the threats of climate change can lead to increased insurance uptake. Similarly, farmers in our FGD and the AO expressed a need for education pertaining to climate change to improve agricultural practices in the region.

Our results show that local practices and strategies to adapt to climate change are present in the research area. We were unable to find a negative influence of the engagement of farmers in risk management strategies and the uptake of insurance. However, Budhathoki et al. (2019) argue that crop insurance is only one of many different strategies to risk management strategies. Therefore, the uptake of insurance competes with other risk management strategies and the

decision for one strategy will influence the engagement in other strategies (Binswanger-Mkihize 2012; Budhathoki et al. 2019). When comparing our findings, it is important to keep in mind that the majority of our sample had no knowledge about the insurance scheme. Therefore, a reasoned choice for purchasing insurance or the engagement in a different risk management strategy was not possible for the majority of our sample.

The major impediment for farmers' decision to purchase maize insurance is the lack of knowledge about the scheme. As the majority of the farmers are not aware of the scheme an informed choice is not possible for them. Our findings state that lack of knowledge negatively impacts the uptake of insurance, which coincides with other studies (Budhathoki et al. 2019; Fonta et al. 2018; Amare et. al 2019; Patt et al. 2010; Sbiko et al. 2018; Njue et al. 2018; Dercon et al. 2014). Further, our results show a lack of knowledge and understanding of the insurance scheme among insured farmers that can result in uncertainties about compensations. Sibiko et al.'s (2019) study from Kenya shows similar findings. They argue that the uncertainty from farmers about when and how payouts are triggered undermines farmers' confidence and therefore leads to a decreased uptake of insurance. This line of argument matches our findings as there is a high number of farmers that did not purchase insurance because they want to await the results before they sign up themselves. In addition, the importance of farmers' groups in terms of informing their members and helping to understand the scheme was reported in other studies (Dercon et al. 2014; Sibiko et al. 2018). These findings match our results as there is a correlation in the uptake of insurance and the membership in farmers' groups.

The lack of trust in the insurance scheme and the organizations behind the scheme is another main factor explaining the low uptake of crop insurance. The distrust of farmers that a compensation will eventually be paid out to them is also described in previous studies (Budhathoki et al. 2019, Cole et al. 2013). Anthony Patt et al. (2009) and Shawn Cole et al. (2013) argue that trust increases with time and when farmers actually experience the payout of compensations either to themselves or to members of their social network. However, as the studied insurance scheme has only been in practice for one year at this point distrust in the insurance scheme and the involved organizations remains a factor that negatively impacts the uptake of insurance. Changes in trust over time should be examined in future studies.

9. Conclusion

As stated in the research question the purpose of this study was to understand how external and internal factors influence farmers' attitude towards purchasing maize insurance in Othaya, Kenya. Results revealed that farmers' main reason for not purchasing the maize insurance is due to insufficient knowledge, intransparency of the system and lack of trust in the institutional arrangements. Furthermore, we found that the attitude towards purchasing insurance is positively influenced by the membership in farmers groups and farmers' negative perception of climate change. Based on our findings our main argument is that knowledge is vital in order to increase uptake of maize insurance. Therefore, we have several suggestions to how this can be achieved.

Farmers proposed to create groups in which they could share information about farming and insurance. Creating farmers groups could strengthen farmers' say in relation to the insurance companies. Furthermore, problems like lack of compensation could be handled by the farmers as a group. Farmer's groups could also be a way to receive education on insurance and climate protection strategies, something that farmers also expressed a demand for.

The results show the need to improve the institutional setup of the scheme. For this purpose, communication between the insurance companies, the AO and farmers should be expanded to positively influence uptake. A solution could be to have a representative from the insurance companies present in the region in order to close the gap between farmers and the insurance companies to make sure that knowledge and transparency of the insurance scheme increases.

Furthermore, to improve knowledge and education of farmers in the maize insurance scheme, an increase in the number of AO is imperative. This would help farmers become more aware of climate mitigation strategies, allowing them to make a more informed decision between taking up insurance or alternative practices.

These suggestions could be a starting point for increasing uptake of insurance in Othaya, however, further institutional reforms of the scheme are required in order to be an accessible and effective tool for farmers.

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Appendices

Appendix 1: Overview of Respondents

Alias	Number
Agricultural Officer (AO)	SSI 1
Insurance Company Executive (ICE)	SSI 2
Joseph	SSI 3
Beth	SSI 4
Maria	SSI 5
Simon	SSI 6
Paul	SSI 7
Erik	SSI 8
Adam	SSI 9
Henry	SSI 10
Patrick	SSI 11
County Government Official (CGO)	SSI 12
Stella	SSI 13
Isabel & Andrew	SSI 14

Appendix 2: Overview of Applied Methods

Overview of methods used in ou	r fieldwork
44 questionnaires, 12 of them combined with interview questions	12 farmers with insurance and 32 farmers without insurance
4 semi-structured interviews	The agricultural officer of Othaya, Chairman of Kihugiru, a county official in Nyeri County and a phone interview with an employee at APA insurance
1 focus group discussion	10 farmers with and without insurance
Geodata	From 38 of the 44 farmers who responded to our questionnaire
Climate data	Observational data from Nyeri from 1968 to 2020 ERA5 climate reanalysis data from 1979 to 2019

Appendix 3: Questionnaire

GPS coordinates:	Interviewer:
Sub-Location:	Note Taker:
Date and Time:	Translator:

We are students from the University of Nairobi and University of Copenhagen. We are conducting research on sustainable land use management systems. The research will focus on perception of climate change and uptake of agriculture insurance. Our topic was identified by the community and we will present our findings to local representatives so it can benefit farmers in the area. The information collected will only be used in our report and it will be kept confidential.

Contact information of group: 0721455866 or +4915775074257 (only Whatsapp)

Section 1: Personal background

1.1 What is your gender?

- (1) 🗖 Male
- (2) 🛛 🗖 Female
- (3) 🛛 Other

1.2 How old are you?

1.3 For how long have you resided in the given area?

1.4 How many people make up your household?

- (1) 🛛 🗖 1-3
- (2) 🗖 4-6
- (3) 🛛 🗖 7-9
- (4) **D** More than 10

1.5 Your highest level of education?

- (1) 🔲 None
- (2) Primary school
- (3) Secondary school
- (4) Tertiary school (diploma, certificate)
- (5) 🛛 Bachelor's degree
- (6) 🔲 Master's degree
- (7) 🛛 🗖 Other

1.6 Highest level of education of the household head, if not you?

- (1) 🔲 None
- (2) Primary school
- (3) Secondary school
- (4) Tertiary school (diploma, certificate)
- (5) 🗖 Bachelor's degree
- (6) 🔲 Master's degree
- (7) \Box None of the above
- (8) 🛛 I don't know

1.7 Most of my household's income comes from:

- (1) **D** Farming
- (2) Employment
- (3) 🛛 Business
- (4) Any other (please specify) _____

1.8 How much does your household earn per month from all income source?

- (1) Less than 1,000 KSH
- (2) 1,000 KSH to 4,999 KSH
- (3) **5,000** KSH to 9,999 KSH
- (4) 🛛 10,000 KSH to 14,999 KSH
- (5) 🛛 15,000 KSH to 19,999 KSH
- (6) **D** More than 20,000 KSH
- (7) 🛛 I don't know

Section 2: Farming

2.1 How do you describe your land ownership of the land you farm on?

- (1) Owner
- (2) Joint owner
- (3) 🗖 Leased
- (4) Other (please specify)

2.2 What size of land do you farm on? (in acres)

2.3 What size of land is under Maize farming? (in acres)

2.4 How many bags of maize did you produce last harvest?

- (1) **D** None
- (2) 🛛 🗖 0-4 bags
- (3) **4**-8 bags
- (4) 🛛 🖬 8-12 bags
- (5) 🛛 12-16 bags
- (6) 🛛 16-20 bags
- (7) More than 20 bags
- (8) 🛛 I don't know

2.5 Do you grow any of the following crops? (select all that apply)

Crops

	Coffee	Tea	Beans	Maize	Vegetables	lrish potatoes	Other (please specify)	
To sell	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
To eat	(1)	(2)	(3)	(4)	(5)	(6)	(7)	

2.6 Do you belong to any farmer's group including co-operative?

(2) 🗖 No

Section 3: Weather

3.1 Have you experienced any of the following unusual weather or

environmental events in the last 10 years? (select all that apply)

- (1) Increased temperatures
- (2) \Box Changes to rainfall seasons
- (3) 🛛 Increased rainfall
- (4) 🔲 Increased drought
- (5) \Box Increased presence of pests
- (6) \Box Increased presence of plant diseases
- (7) Increased flooding
- (8) \Box Increased soil erosion
- (9) Other:_____
- (10) 🗖 None

3.2 How much do you agree with the following: I worry about unusual weather

patterns affecting my crops.



- (2) 🛛 🗖 Agree
- (3) 🛛 Neutral
- (4) Disagree
- (5) Strongly disagree

3.3 How much do you agree with the following: Unusual weather events have

negatively impacted my crop production in the last 10 years?

- (1) Strongly Agree
- (2) 🗖 Agree
- (3) 🛛 Neutral
- (4) 🛛 Disagree
- (5) Strongly Disagree

Section 4: Uptake of crop insurance

4.1 What is your level of knowledge about the maize insurance schemes?

- (1) **Highly knowledgeable**
- (2) **D** Knowledgeable
- (3) 🛛 Average
- (4) Little knowledge
- (5) 🛛 No knowledge

If your answer was (5) in the previous question you can skip 4.2, 4.3, 4.4, 4.8, 4.9

4.2 What is your main source of information about the maize insurance scheme?

(select all that apply)

- (1) **□** From a neighbor
- (2) 🗖 TV
- (3) 🛛 🗖 Radio
- (4) 🔲 Internet
- (5) Dublic baraza
- (6) 🔲 Insurance agents
- (7) Agricultural officer
- (8) Other (please specify) _____
- (9) \Box I have never heard of it

4.3 Do you have maize insurance at the moment? (select all that apply)

- (1) **U** Yes
- (2) 🗖 No
- (3) \Box No, but I have considered it

(4) \Box No, but I have purchased it in the past (number of times)

4.4 If your answer was 2, 3, 4 or 5 to the previous question, why have you not

purchased maize insurance? (select all that apply)

- (1) 🔲 I do not consider it important
- (2) **D** Too expensive
- (3) \Box I don't mind taking the risk
- (4) \Box Lack of information on insurance
- (5) Other (please specify)

4.5 What would make you take up maize insurance in the future? (select all that

apply)

- (1) \Box More information about the insurance schemes
- (2) \Box Lower cost of insurance
- (3) Increasing risk to losses
- (4) \Box Better institutional setup of the insurance scheme
- (5) 🛛 🗖 Nothing
- (6) 🛛 I don't know

4.6 How much do you agree to this statement: The maize insurance schemes

would be beneficial for my household.

- (1) Strongly Agree
- (2) 🗖 Agree
- (3) 🔲 Neutral
- (4) Disagree
- (5) **D** Strongly disagree

4.7 How do you protect yourself against crop (maize) losses?

- (1) Drought resistant varieties of maize
- (2) Other crops
- (3) 🛛 Livestock
- (4) **D** Non-farming income sources
- (5) Desticides
- (6) Other (please specify)

4.8 Who makes the decision to purchase crop insurance in your household?

- (1) 🔲 I do
- (2) D My partner does
- (3) 🛛 🖬 We both do
- (4) Others (please specify)

4.9 Who takes the initiative to pay for the crop insurance cover?

- (1) 🛛 🗖 I do
- (2) Dy partner does
- (3) 🛛 We both do
- (4) Others (please specify)

4.10 Are there other agricultural insurance products you wanted to purchase

but you did not?

- (2) 🗖 No

4.11 How often does a representative of the maize insurance scheme visit your

Frequency

farm about the insurance?

				110400			
	Once	Twice a month	Monthly	Quarterly	Annually	Never	l don't know
Agricultural Officer	(1)	(2)	(3)	(4)	(5) 🗖	(6) 🗖	(7)
Insurance agent	(1)	(2)	(3)	(4)	(5)	(6)	(7)

If you want to meet us for an interview you can provide your contact

mormation.

Name

Email

Phone

Thank you for helping us with our project!

Appendix 4: Interview-guides

Interview Farmers

Background

We are students from the University of Nairobi and University of Copenhagen. We are conducting research on sustainable land use management systems. The research will focus on the perception of climate change and uptake of agriculture insurance. The information collected will only be used in our report and it will be kept confidential. Is it OK if we record this conversation? Ask for consent.

Tell us a little bit about yourself?

- Basic formalities (Name, age, details on household)
- What is your position in the household?
- What do you do for a living?
- What kind of crops do you have?
- Farm size (do you own the land yourself)

Have you experienced any specific change in the weather?

- rainfall? warm temperatures?
- Make a timeline
 - If yes how did that affect your crops/your farming?
 - More extreme events/Pests?
- Do you consider it a normal hazard or a long term change of climate/weather?

How do you prepare for or handle risky weather? (in regards to farming)

- any specific protection strategies?
- do you use weather forecasts?
- How do other farmers prepare/handle the weather?
- Do you feel well prepared for risky weather? (how would you like to be prepared?)
- Reliance on social networks?

What challenges do you think you will meet in the future?

- Would you be able to change your farming practices?
- Would you be willing to?
- Is it something you worry about?

Do you have crop insurance? Please elaborate.

- If no why not?
- if yes why? What made you purchase insurance?

If you have crop insurance, what are your experience with it?

- For how long have you had the crop insurance?
- What is your experience with the crop insurance?
- Do you think the crop insurance is living up to your expectations?
- Are you satisfied with the crop insurance? Why?
- What could make it better?

If you don't would it make sense for you to have the crop insurance?

- why/why not?
- How could the crop insurance schemes be designed to fit your needs?

What do you know about the different crop insurance schemes?

- how do you get information about the schemes?
- do you think the crop insurance schemes are transparent enough?

Do you know of any good or bad experiences with crop insurance from other farmers?

- Do you trust that you or other farmers who are insured will receive your payment?
- Is it something you talk about a lot?

Interview Agricultural officer:

We are students from the University of Nairobi and University of Copenhagen. We are conducting research on sustainable land use management system (SLUSE). The research focuses on the perception of climate change and uptake of crop insurance. The information collected will only be used for our report and it will be kept confidential. Is it OK if we record this conversation? Ask for consent.

We have some questions we want to ask you but feel free to lead the conversation and talk about issues you think are important.

Background

- What is your role as an agricultural officer?
- Are you in charge of the maize insurance schemes and if not, who is?
- What region do you cover?
- Since when do you do this job?
- What are your comments on Maize production trends in this area?

Crop Insurance scheme

- What were the reasons behind implementing the 2019 maize insurance schemes?
 - Do you know the reasons for choosing this specific region?
 - Are there similar programs in Othaya?
- How does the maize insurance schemes work?
- Who are the actors involved in the insurance schemes?
- How did farmers get information about the maize insurance schemes? (meetings)
- Were specific farmers or areas targeted? (e.g. criteria, meetings)
- Which of the following is covered by the maize insurance schemes:
 - Loss resulting from weather related events?
 - Loss resulting from plant diseases or pests?
 - Other losses?

- Do farmers receive a written contract?
- What agricultural practices are expected for farmers to qualify for compensation?
- What do farmers have to do to get compensated for crop losses?
- How many farmers were compensated for their losses?
 - If rejected: What were the reasons for rejecting farmers insurance payouts?
- How long does it take for the compensation to be paid?
- How was the reference level (8 bags per acre) calculated?
 - Do you think the 8 bag average is adequate for this area?

Uptake of insurance

- How many farmers initially took part in the insurance schemes? (List)
- Do farmers volunteer to take part in it?
- Why do you think some farmers chose not to take part in the schemes?
- How many farmers continued with insurance after the first season?
- Do you notice certain characteristics among farmers who take part in it?
 - (farm size, wealth, crop diversity, subsistence or cash crops)
 - Why do you think that is the case?

Benefits of crop insurance

- Do you think the schemes actually help the farmers?
- If you were a maize farmer, would you have signed up for the insurance?
- Based on the current and past agricultural insurance schemes, what is your opinion on the impacts (e.g. on improving livelihoods, on crop productivity)

Climate change

- How aware are farmers of the impacts of climate change?
- Are farmers preparing for climate change impacts?
 - If yes how?
 - If no, why not?
 - Are they worried?
 - Adaption strategies?
- Do you think insurance will help farmers to cope with climate change impacts?

Additional questions/further request

- List of insured farmers
- Contact to insurance representative
- Notes of meeting with farmers group

Appendix 5: Final synopsis

Adoption of crop insurance by smallholder farmers in Othaya

Synopsis

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Course: Interdisciplinary Land Use and Natural Resource Management

Academic year: 2020

Word count: 2474

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Introduction

Agricultural insurance protects farmers against loss or damage to crops or livestock when a shock happens (Blampied 2016). In the case of natural hazards destroying a harvest, the farmer will be (partially) compensated for the experienced losses (Blampied 2016). In the 21st century, due to anthropogenic climate change, these insurance schemes, particularly index-based insurance schemes, have become more relevant than ever (CGIAR; Balzer & Ulrich 2010).

When certain climate-related disasters occur, a household without insurance can be coerced to adopt negative coping mechanisms that can push them deeper into poverty, like selling livelihood assets or taking their children out of school for them to find work (Blampied 2016; Sandmark et al. 2013). Index-based insurance schemes act as a risk-transfer mechanism where the policyholder receives the payment when a pre-established weather or crop yield-based event occurs (Blampied 2016).

This type of insurance product has the potential of boosting farmers' productivity, since it allows them to invest in more weather-sensitive crops that provide higher returns and could allow them to qualify for loans to purchase agricultural inputs and tools (Blampied 2016). Additionally, this type of insurance scheme is preferable to traditional indemnity-based insurance schemes due to their reduced administrative, distributive and transactive costs, making them more affordable for farmers (Microinsurance Network 2017; Sandmark et al. 2013; Chantarat et al. 2012). Finally, index-based insurance schemes avoid problems relating to moral hazard and adverse selection (Sandmark et al. 2013; Chantarat et al. 2012).

This research will study the uptake of crop insurance in Othaya, Kenya. Agriculture is a pillar of the Kenyan economy, employing 57.5% of its population (World Bank 2020). The sector is dominated by smallholder farmers contributing to 63% of food production in the country (Rapsomanikis 2015), indicating the relevance of crop insurance to cope with the increasing unpredictability of climate change.

Kenya will experience rising temperatures and changing precipitation patterns which might have complex impacts (Adhikari et al. 2015). In the highlands it might lead to higher yields and upwards shifting of cultivation areas (Adhikari et al. 2015). Contrarily, climate models also predict uncertainty in precipitation periods and more extreme weather events (e.g. droughts and flooding) with severe negative impacts on agriculture in the highlands (Capitani et al. 2019). Current research focuses on the impacts of unstable precipitation on rain-fed agriculture as well as spreading of pests into higher altitudes due to rising temperatures (Jaramillo et al. 2011). Historically, Kenyan farmers have always faced significant climate variability, however, due to climate change, future generations will face even more unpredictable and uncertain climatic conditions (Cooper et al. 2008).

In order to mitigate these impacts, crop insurance is frequently proposed as it constitutes a possible means to reduce uncertainty and manage an array of risks for farmers (Blampied 2016; Binswanger-Mkhize 2012), thus having a potential to secure farmers' livelihoods (Blampied et al. 2016; Mahul & Maher 2016; Sandmark et al. 2013). Given agriculture is one of the fields most susceptible to climate change, securing farmers' livelihoods is a priority in Kenya (GoK 2018).

Despite its theorized economic benefits for farmers, the initial uptake of crop insurance seems to be low in Kenya (Njue et al. 2018; Kenneth et al. 2018). Empirical studies from Embu and Laikipa county showed that the following were among the characteristics influencing farming households in the uptake of insurance contracts: age and education level of the head, income levels, and size of land owned (Njue et al. 2018).

The low uptake of crop insurance could also be influenced by self-insurance strategies often employed by better-off farmers. (Binswanger-Mkhize 2012). Examples of self-insurance strategies are income diversification, ownership of different assets and the reliance on social networks. Farmers who can afford these self-insurance strategies are therefore not interested in the uptake of insurance contracts as it is not profitable for them (ibid.) Poor farmers, on the other hand, would benefit from well-designed insurance contracts, however, they often lack the possibility of advancing money for insurance contracts (ibid.) Examining the cause for the low acceptance and identifying the main factors influencing the uptake of crop insurance by farmers constitutes the central research gap for this study.

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Research Question

From the previously stated research gap, the main research question can be derived:

What are the main factors influencing farmers' decisions to uptake crop insurance in Othaya?

This question is purposely broad in order to cover different possible factors that influence the farmers' decision making. Based on the information given above four different sub-research questions derived in order to cover the various influencing factors:

- 1. How do socio-economic factors influence the uptake of insurance?
- 2. To what extent do farmers' perceptions of climate change and risk influence their decision to uptake crop insurance?
- 3. Which local practices and adaptation strategies to climate variability are present and what effects do they have on the adoption of the crop insurance schemes?
- 4. To what extent do farmers' perception of the institutional arrangements of the insurance schemes impact their decision-making?

Frameworks

In order to answer the research question and to gain a better understanding of the collected data we will use two theoretical frameworks. One, will be the Sustainable Livelihood Framework (SLF) which will help us answer our first sub-question and explain the external factors that might influence farmers' uptake of insurance. According to Ellis (2000), livelihoods are "[...] comprised by the assets [...] the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by the household" (Ellis 2000:10). A households' livelihood assets allow them to develop different capabilities to cope with vulnerabilities, risk and uncertainties (Masanjala 2007; Ellis 2000) - like a climate-related shock that affects their crops. Access to assets are influenced by factors outside a households' control, like social relations, institutions and organizations which all operate in the context of certain trends and shocks (Ellis 2000). We will be examining the issue with insurance as a livelihood strategy that has the potential to improve livelihood outcomes.

However, the SLF framework is limited in its account of internal factors such as farmers' perception and knowledge about insurance schemes and climate change. Thus, to answer the last three sub-questions we will use the decision-making framework proposed by Meijer et al. (2015). They argue that it is not enough to only look at the external factors as SLF does but also consider the internal factors, since two farmers that have access to the same assets can make different decisions regarding their uptake of insurance. According to Meijer et al. (2015) the external factors all influence the internal factors; hence it is important to understand both to get a full understanding of farmers' decisions to adopt new agricultural technologies. We will merge the two frameworks in order to encompass all external and internal factors. By examining people's knowledge and attitudes relating to agricultural innovations and how they are shaped by the extrinsic factors we hope to get a better understanding of farmers' decision to take up insurance.

Methods

Natural science methods

Geospatial analysis

Firstly, we will collect GPS location data of surveyed households by Garmin using etrex 10 devices with a reported accuracy of up to 3m (depending on satellite constellation). We will map the household locations using QGIS (ESRI) to provide an overview of conducted research and to serve as a basis for further spatial analysis. This will help to answer the first sub-research question by analyzing spatial patterns in the uptake of insurance or socio-economic factors. Furthermore, we will use the GPS devices to measure agricultural land area of interviewed households in order to verify data from interviews or questionnaires.

Finally, by using directly gathered geodata, farmers testimony as well as satellite imagery we will create maps of spatial changes in natural hazards (e.g. landslide) or the altitudinal distribution of pests in recent years (Jaramillo et al. 2011). This data will help us to answer the second subquestion as it can visualize farmers' perception of climate change.

Climate data analysis

In order to evaluate farmers' perception of climate change we will compare their statements to climate data. Due to data scarcity we will use an atmospheric reanalysis model *Climate Forecast System Reanalysis* (CFSR) from the National Centers for Environmental Prediction. The CFSR is a global coupled atmosphere-ocean-land surface-sea ice system frequently used in contexts with lacking observational weather data (Fuka et al. 2014). Data is available from 1979 until 2014 at a 38-km resolution (ibid.) and with it we will conduct a detailed evaluation of climate trends in the study area. However, there are certain limitations associated with climate reanalysis models, especially regarding precipitation, climate extremes or local micro-climates, therefore we will compare data to available local observational weather data (Dee et al. 2016 and Lorenz & Kunstmann 2012 and Zwiers et al 2013). These data sets will help us to understand farmers' climate sensitivity and their climate change experiences as well as provide meaningful background knowledge, thus contributing to answering the second sub-question.

Social science methods

Questionnaire

A questionnaire constitutes a crucial part of a research study as it collects information regarding the focus of the study with a series of more structured and closed questions (Rea & Parker 2005), while also being used for some more open questions (ibid.). This type of survey is widely used for providing an overview of the research topic, as well as accounting for demographic and socioeconomic information on subjects. Additionally, questionnaires can also gather data on subjects' opinions, attitudes, and behaviors, through scale-based answers (ibid.), although these will be further explored through more open-ended methods like interviews and focus groups.

We will use the questionnaire to sample socioeconomic and demographic data such as age, gender, economic resources and assets of farmers, thereby allowing us to collect information pertaining to our first sub-research question. Additionally, we will likely ask more open-ended questions to capture subjects' perceptions on climate change/risk and on the insurance schemes in general, which speak to our second and fourth sub-research questions.

Questionnaires are useful to quantify collected data, particularly among close-ended questions, and show initial correlations between certain variables (Rea & Parker 2005). Additionally, a large number of people can be reached with this method. However, questionnaires are subject to certain limitations such as potential misunderstandings that respondents might experience, which can lead to potential unrelated answers (Bernard 2011). To account for these errors in the questionnaire design, wording and structure, we intend to test it before collecting the information.

Participant observation

Participant observation allows researchers to experience activities directly, to get an understanding of events, and to record the researcher's own perception (Spradley 1980). The active participant seeks to participate in what people are doing not merely to gain acceptance, but to fully learn the cultural rules for behavior (ibid.).

Appendices

We hope that by participating actively in farmers' daily life and chores, we will gain a better understanding of how they experience climate change and what strategies they use to adapt to increasing climate variability in the area. In our fieldwork we wish to conduct passive (observing), as well as active participant observation. We will approach the daily life of the farmers with a wide-angle lens, in order to see the things that other people might not notice (ibid.). The participant observer will experience being both an outsider as well as an insider. Thus, doing ethnographic fieldwork involves alternating between the insider and outsider experiences, and having both simultaneously (Spradley 1980). As we will be using ourselves as a research instrument, we will have to increase our introspectiveness and reflect upon (be aware of) our position in the field. This we will do by keeping a detailed record of both our objective observations as well as our subjective feelings (ibid.).

Semi-structured interview

We wish to conduct 10-12 semi-structured interviews with farmers with and without insurance, the agricultural officer, as well as county officials. We plan that two students take part in interviewing – one asking the questions and the other taking notes and recording the interview.

In semi-structured interviews, the interviewer has formulated a number of questions in order to guide the interview in a certain direction. The questions are often open-ended and makes room for the respondent to elaborate when answering questions. The interviewer, therefore, knows what needs to be answered but also gives the respondent opportunity to influence the interview (Bernard 2011).

The semi-structured interview has the strength that interviewer can gain a better understanding of the respondent's perception of the topic and vocabulary about the topic. Thereby, the interviewer avoids the pitfall of misunderstanding the informant (ibid.).

The semi-structured interview can give us an understanding of the farmers' perception of insurance uptake as well as the institutional arrangements of the insurance schemes. Furthermore, we can get a better understanding of their view on climate change, it's effect on their production, and what other weather-adaption strategies they make use of. The interview with the agricultural officer can give us knowledge on how the insurance scheme is

communicated and what the (dis)advantages of the insurance is. The agricultural officer will also function as gatekeeper, who can introduce us to farmers both with and without insurance.

Grand Tour

When encountering our field, a *grand tour* will be a helpful method to gain a better understanding of the area (Spradley 1980). A grand tour is a tour around the places that are important for the locals. While walking with the locals they can illustrate what their relation to the area is. A grand tour will often consist of several places that a local introduces. Later – for instance during the semi-structured interview – we will be able to ask questions about these places and their meaning to the locals. With a grand tour we can therefore acquire a knowledge of which places are important to the locals and how they are being used.

Focus group discussion

Focus group discussions are useful tools to collect group-level data on perceptions and norms. The main goal is to collect data of different perspectives and experiences which are not accessible through individual interviews. Interactive group discussion aims at getting participants to question, answer, and challenge one another. The moderator keeps the discussion focused but minimizes the self-involvement (Jakobsen 2012; Hennink 2014).

We plan on conducting two focus group discussions, one with insured and the other with uninsured farmers. The aim will be to collect data of different perceptions of these farmers about climate change and crop insurance, and how they experience the implementation and institutional arrangements of the insurance schemes. We plan to use creative methods to start the conversation, such as pile sorting and word association. Further, we wish to use ranking methods during the discussion. First the farmers will discuss and identify different criteria on how they perceive climate change. These criteria will be used in a ranking exercise which will show us how the different farming households perceive or experience climate change.

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Appendix

Data Matrix

Overall Objective: In	fluence on adoption o	f crop insurance		
Research questions/themes	Sub-questions	What? (Data required)	Who? (Respondents)	How? (Methods)
What are the main factors influencing farmers' decisions to uptake crop insurance in Othaya?	How do socio- economic factors influence the uptake of insurance? (background data required)	Demographic data: Gender, age, education, position in the HH Household data: # of people in the HH; farm size; HH income; crop production; yield data	Heads of Household Farmers	Questionnaire GPS Semi-structured interviews with farmers
	To what extent do farmers' perceptions of climate change and risk influence their decision to uptake maize insurance?	Knowledge on their perception Do the farmers experience any climatic/weathe r complications? How do farmers explain the changes in weather or the possible climatic problems they are facing with farming?	Farmers Agricultural officer	Semi-structured interviews with farmers Semi-structured interviews with ag. officer Focus group interviews (Participant) observation Questionnaire (approx. 2 questions)

	Do farmers see climate change as a risk to their crop production?		GPS - map of climatic problems in the area
Which local adaptation strategies to climate variability are present and what effects do they have on the adoption of the crop insurance schemes?	Identification of adaptation strategies Presence of self- insurance or informal methods of risk reduction Impact of adaptation strategies on crop insurance uptake	Farmers Agricultural officer	Focus group interviews (Participant) observation Semi-structured interviews with the agricultural officer Semi-structured interviews with the farmers Grand Tour
To what extent do farmers' perception of the institutional arrangements of the insurance schemes impact their decision- making?	Farmers' knowledge about insurance. Transparency of insurance schemes (do they legally and technologically have access to information) Farmers' access to information about insurance	Farmers Agricultural officer Insurance aggregator	Semi-structured interviews with farmers Semi-structured interviews with insurance aggregator Semi-structured interview with the agricultural officer Focus group interviews

demands of the farmers? How are the insurance schemes communicated? Effectiveness of insurance- 8 bag yield perspective		Are the insurance schemes meeting the demands of the farmers? How are the insurance schemes communicated? Effectiveness of insurance- 8 bag yield perspective		
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Interview guide farmers

Introduction & Background

We are students from the University of Nairobi and University of Copenhagen. We are conducting research on sustainable land use management systems. The research will focus on the perception of climate change and uptake of agriculture insurance. The information collected will only be used in our report and it will be kept confidential. Is it OK if we record this conversation? Ask for consent.

Tell us a little bit about yourself?

- Basic formalities (Name, age, details on household)
- What is your position in the household?
- What do you do for a living?
- What kind of crops do you have?
- Farm size (do you own the land yourself)

Have you experienced any specific change in the weather?

- rainfall? warm temperatures?
- Make a timeline (use of printed timeline where interviewee can mark events)
 - If yes how did that affect your crops/your farming?
 - More extreme events/Pests?
- Do you consider it a normal hazard or a long-term change of climate/weather?

How do you prepare for or handle risky weather? (in regard to farming)

- any specific protection strategies?
- do you use weather forecasts?
- How do other farmers prepare/handle the weather?
- Do you feel well prepared for risky weather? (how would you like to be prepared?)
- Reliance on social networks?

What challenges do you think you will meet in the future?

- Would you be able to change your farming practices?
- Would you be willing to?
- Is it something you worry about?

Do you have crop insurance? Please elaborate.

- If no why not?
- if yes why? What made you purchase insurance?

If you have crop insurance, what are your experience with it?

- For how long have you had the crop insurance?
- What is your experience with the crop insurance?
- Do you think the crop insurance is living up to your expectations?
- Are you satisfied with the crop insurance? Why?
- What could make it better?

If you don't, would it make sense for you to have the crop insurance?

- why/why not?
- How could the crop insurance schemes be designed to fit your needs?

What do you know about the different crop insurance schemes?

- how do you get information about the schemes?
- do you think the crop insurance schemes are transparent enough?

Do you know of any good or bad experiences with crop insurance from other farmers?

- Do you trust that you or other farmers who are insured will receive your payment?
- Is it something you talk about a lot?

Interview guide Agricultural officer

We are students from the University of Nairobi and University of Copenhagen. We are conducting research on sustainable land use management system (SLUSE). The research focuses on the perception of climate change and uptake of agriculture insurance. The information collected will only be used for our report and it will be kept confidential. Is it OK if we record this conversation? Ask for consent.

Background

- What is your role as an agricultural officer?
- What area do you cover?
- Since when do you do this job?
- How is agriculture developing in the region/in the town?

Climate change

How is climate change going to impact the region?

- How aware are farmers of the impacts of climate change?
- Are farmers preparing for climate change?
 - If yes, how?
 - If no, why not?

Crop Insurance scheme

Can you summarize the crop insurance schemes?

- How do farmers get information about the crop insurance schemes?
- How many companies are involved?
- What is actually covered? Does it differ between companies?
- How do the insurance companies get information on the weather and what needs to be covered?
- How is the reference level (8 bags per acre) calculated?

What is the uptake of insurance in the region?

- What famers typically take part in it?
- Why do you think that is the case?

How do you think the schemes could be designed to fit more farmers?

- Do you think the schemes actually help the farmers?
- What is your opinion on the impacts of the schemes (e.g. on improving livelihoods; on crop productivity)?

Draft Questionnaire farmers

GPS coordinates:	Interviewer:
Sub-location:	Note taker:
Date and time:	Translator:

We are students from the University of Nairobi and University of Copenhagen. We are conducting research on sustainable land use management systems. The research will focus on perception of climate change and uptake of agriculture insurance. The information collected will only be used in our report and it will be kept confidential.

1. What is your gender?

- (1) 🛛 Male
- (3) Other

2. How old are you?

- (1) 🛛 18-25
- (2) 🛛 26-35
- (3) 🛛 36-45
- (4) 🛛 46-55
- (5) 🛛 56-65
- (6) **G** 66 and above

3. Civil Status?

- (1) Single
- (2) Aarried
- (3) Uidowed
- (4) Separated
- (5) **D** None of the above

4. Are you the household head?

- (1) 🖵 Yes
- (2) 🖵 No

5. Your highest level of education?

- (1) 🛛 None
- (2) Primary school
- (3) Secondary school
- (4) Tertiary school (diploma, certificate)
- (5) **D** Bachelor degree
- (6) 🛛 Master degree
- (7) 🛛 Other

6. Highest level of education of the Household head?

- (1) 🖵 None
- (2) Primary school
- (3) Secondary school
- (4) Tertiary school (diploma, certificate)
- (5) 🛛 Bachelor degree
- (6) **D** Master degree
- (7) \Box None of the above
- (8) 🛛 I don't know

7. How many people make up your household?

- (1) 🛛 1-3
- (2) 🛛 4-6
- (3) 🛛 7-9

8. How large is your farm in acres (both rented and owned)

- (1) **O**-0.5 acres
- (2) **Q** 0.5-1.0 acres
- (3) **1**.0-1.5 acres
- (4) 1.5-2.0 acres
- (5) **Q** 2.0-2.5 acres
- (6) 2.5-3.0 acres
- (7) above 3.0 acres
- (8) 🛛 I don't know

9. How much does your household earn per month from all income source?

- (1) Less than 1,000 KSH
- (2) 🛛 1,000 KSH to 4,999 KSH
- (3) **5**,000 KSH to 9,999 KSH
- (4) 🛛 10,000 KSH to 14,999 KSH
- (5) 🛛 15,000 KSH to 19,999 KSH
- (6) Give than 20,000 KSH
- (7) I don't know

10. Do you have other sources of income apart from farming?

- (1) Yes; please specify the sources
- (2) 🛛 No

11. Do you grow any of the following crops? (select all that apply)

								Crops			
	Coffee	Tea	Beans	Maize	Banana	Cabbage	Kale	Sweet potatoes	Irish potatoes	Arrow root	Other (please specify)
To sell							\Box				
To eat											

12. If yes, how many bags of maize did you produce per acre?

- (7) **D** None
- (1) **Q** 0-4 bags
- (2) **4**-8 bags
- (3) **3** 8-12 bags
- (4) **1**2-16 bags
- (5) 🛛 16-20 bags
- (6) More than 20 bags
- (8) 🛛 I don't know

13. Have you experienced weather change in the last 10 years?

- (1) 🖵 Yes
- (2) 🛛 No

14. If yes, which of the following weather phenomena did you experience in the last 10 years?

- (1) \Box I have not experienced any change in the weather
- (2) Increased rainfall
- (3) Increased drought
- (4) Increased presence of pests
- (5) Increased flooding
- (6) Increased soil erosion
- (7) Other:_____

15. Do you worry about weather change affecting your crops?

- (1) 🖵 Yes
- (2) 🖵 No
- (3) I don't know (I don't think the weather has changed)

16. How much do you agree with the following: Weather change has impacted my crop production in the last 10 years?

- (1) Strongly Agree
- (2) Agree
- (3) **D** Neutral
- (4) Disagree
- (5) Strongly Disagree

17. Do you have crop insurance at the moment?

- (1) 🛛 1. Yes
- (2) 🗖 2. No
- (5) 3. No but I have considered it
- (3) 4. No, but I have purchased it in the past

18. If your answer was 2, 3 or 4 to the previous question, why have you not purchased insurance? (select all that apply)

- (1) **D** Not interested
- (2) Too expensive
- (3) Lack of information on insurance
- (4) Reasons based on income
- (5) Reasons based on gender
- (6) Reasons based on community relation
- (7) Other (please specify)

19. If you have had an insurance - for which crops? (select all that apply)

- (1) Coffee
- (2) 🖵 Tea
- (3) 🛛 Beans
- (4) 🛛 Maize
- (5) 🗖 Banana
- (6) 🛛 Cabbage
- (7) 🛛 Kale
- (8) Sweet potatoes
- (9) Irish Potatoes
- (10) 🗖 Arrow Root
- (11) Other (please specify)

20. How much do you agree to this statement: Crop insurance would be beneficial for my household

- (1) Strongly Agree
- (2) 🛛 Agree
- (3) 🖵 Neutral
- (4) Disagree
- (5) Strongly disagree

21. Which of the following factors impact the uptake of crop insurance? (select all that apply)

- (1) 🖵 Gender
- (2) 🖵 Income
- (3) Community relations
- (4) \Box Access to information about the insurance schemes
- (5) \Box Impacts of weather change on crop production
- (6) I don't know

If you want to meet us for an interview you can provide your contact information

Email

Phone

Thank you for helping us with our project!