ASSESSING FACTORS INFLUENCING FARMERS' WILLINGNESS TO PAY FOR INDEX-BASED INSURANCE PRODUCTS FOR COMMON BEAN IN HUYE DISTRICT, RWANDA

BY

JUSTIN TUYIRINGIRE

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Department of Agricultural Economics

Faculty of Agriculture

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DECLARATION

This thesis is my original work and has not been presented for the award of a degree in any other University.

Signature  Date: June 22, 2023

Justin Tuyiringire (A56/81150/2015)

This thesis has been submitted with our approval as University supervisors:

Signature  Date June 22, 2023

Prof. John Mburu

Department of Agricultural Economics

Signature  Date June 22, 2023

Prof. Richard N. Onwonga

Department of Land Resource Management and Agricultural Technology (LARMAT)

Signature  Date June 22, 2023

Dr Eliud Birachi

Research Scientist, Market Value Chains for Africa (CIAT Rwanda)

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LIST OF ACRONYMS

ACRA	Agriculture and Climate Risk enterprise
CA	Conjoint Analysis
CE	Choice Experiment
CGIAR	Consultative Group for International Agricultural Research
CIP	Crop Intensification Program
CVM	Contingent Valuation Method
EDPRS	Economic Development and Poverty Reduction Strategy
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IBI	Index-Based Insurance
IIAs	Irrelevance of Independent Alternatives
IPAR	Institute of Policy Analysis and Research
MINAGRI	Ministère de l'agriculture et de resources animales (Ministry of Agriculture and Animal Resources)
MINECOFIN	Ministère des Finances et de la Planification Economique (Ministry of Finance and Economic Planning)
NISR	National Institute of Statistics Rwanda
RP	Revealed Preference
RUT	Random Utility Theory
Frw	Francs Rwandais (Rwandan Francs)
SDGs	Sustainable Development Goals
SFSA	Syngenta Foundation for Sustainable Agriculture
SONARWA	Société Nationale d'Assurances du Rwanda
SORAS	Société Rwandaise d'Assurances
SP	Stated Preferences
SSA	Sub-Sahara Africa
USA	United State of America
WIBI	Weather Index-Based Insurance
WTO	World Trade Organization
WTP	Willingness to Pay

ABSTRACT

Common bean (Phaseolus vulgaris) is one of the most important food crops to Rwandese and cash crop for smallholder farmers in Rwanda. Due to the weather shocks that negatively affect bean productivity, index-based insurance has been identified as one of the most important coping mechanisms climate related risks for crop production. Most of the bean farmers are resource-poor farmers hence cannot afford to pay insurance premiums for the full coverage. Researchers are therefore promoting the adoption of insurance product that is based on critical bean growth stages. This study focused on farmers' WTP for index-based bean insurance for different bean growth stages. The study sought to understand farmers' perception towards index based crop insurance in Rwanda, their willingness to pay and the factors affecting their willingness to pay. The study was conducted in Huye district of Rwanda in Mbazi sector. Stratified random sampling method was utilized to select a representative sample of bean farmers in Mbazi sector, where 285 bean farmers who insure their crop were selected while 143 bean farmers who do not insure their beans were also selected. The study was anchored on the Random Utility Theory (RUT) and utilized the multivariate probit model to estimate the factors affecting willing to pay. Contingent Valuation Method (CVM) was used and bidding game to elicit the maximum amount that bean farmers were willing to pay for the products. Results showed that majority of the farmers were aware of the index based insurance product available in Rwanda (95.6%). However, the farmers had negative perception towards the insurance products and the providers of the same. Flowering stage was identified by 65% of the farmers as the most critical growth stage under drought conditions. Multivariate probit model showed that farmers bought insurance through inputs, on MAC44 climbing bean type no variable was significant to influence farmers' willingness to pay. RWR2245 bush bean type, age of the household head, education level, farming experience and extension service are the factors influencing farmers' willingness to pay and premium to pay to insure bean most critical growth stage. The findings have shown that farmers are aware of the index based insurance in Rwanda and are WTP for the product. The study recommends that product developers should target critical bean growth stages for insurance. Group membership and extension should also be emphasized to ensure increased willingness for farmers to pay for index based crop insurance products.

Key words: willingness to pay, critical growth stage, index-based insurance, bean, Rwanda.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Agriculture contributes 33 percent of Rwanda's GDP and employs approximately 72 percent of the active population. It provides 91% of the food commodities consumed in the country, as well as 70% of export revenue. Despite the agricultural sector's importance to the economy, it continues to face several challenges related to weather variability because of climate change (Ngabitsinze et al., 2011). Antón et al., 2013 states that weather variability and related risks are expected to increase globally leading to negative impacts on farm income.

Agricultural insurance is an effective way of mitigating risks and hazards in agriculture. Agricultural insurance ensures that agricultural production is improved by lowering the level of risk, resulting in higher incomes among farming households (Nahvi et al., 2014).

1.1.1 Importance of Beans

The common bean (*Phaseolus Vulgaris*) is a vital crop for Rwanda's smallholder farmers. Most (97 percent) of farmers in Rwanda living in rural areas are bean farmers (Larochelle et al., 2015). Most Rwandan rural households consume beans from their own production, which ranges from 79 to 88 percent depending on the season, with the remaining small percentage purchased from the market (NISR, 2010).Beans provide the primary source of protein as well as other essential nutrients such as iron, zinc, and vitamins for Rwandans. Rwanda has the highest bean consumption rate in the world, with an estimated per capita consumption 164 grams per day (Birol et al., 2015; and Harvest Plus, 2015). According to the findings of the National Agricultural Survey (NISR, 2010), Rwandan households consume beans five days per week. Beans contribute 32 percent of calories and 65 percent of protein intake in Rwandan diets, which is higher than the 4 percent protein intake from animal sources (Birol et al., 2015).

Furthermore, almost all (97 percent) of Rwandans living in rural areas who work in agriculture are bean farmers (Larochelle et al., 2015). The majority of Rwandan rural households consume beans

from their own production, which ranges from 79 to 88 percent depending on the season, with the remaining small percentage purchased from the market (NISR, 2010).

1.1.2 Crop Insurance in Rwanda

Index based crop insurance scheme covers losses caused by unfavorable weather. The insurance premium payable is calculated using weather data collected and independently measured. Weather stations collect weather-related data such as rainfall, wind speed, and relative humidity, which is used to estimate insurance premiums. In Rwanda, the insurance program began with only four CIP crops: maize, rice, beans, and Irish potato, with other crops waiting for product appreciation and business improvement (MINAGRI, 2012).

In 2011, the Government of Rwanda launched a crop insurance scheme in collaboration with various insurance organizations including Micro-Ensure Company, Syngenta Foundation for Sustainable Agriculture (SFSA). The Kilimo Salama (KS) insurance scheme was later domesticated and renamed "Hinga urishingiwe" (Kinyarwanda for "Protected agriculture").

1.2 Statement of the Problem

Beans is one of Rwanda's staple foods and are consumed daily by the population, the changing climate patterns have detrimental effects on food security (Ngabitsinze et al., 2011). Bean farmers continue to experience income variability due to climate change. This is specifically, due to over reliance on rain-fed production (Hiwot and Ayalneh, 2015). However, no study has been done to determine the factors influencing the farmers' WTP for indexed-based Insurance (IBI).

Currently, bean farmers have access to crop insurance technology to manage weather-related risks affecting agricultural production (Chikaire et al., 2016). However, the available insurance options cover the entire growing season, making them unaffordable for smallholder bean farmers. Studies have shown that the impact of weather stresses on plant growth depends on the developmental stages of the plant, but farmers are unsure of which growth stage is the most vulnerable. In a study carried out in Rwanda, Ntukamazina et al. (2017) discovered that pod setting stage is the most susceptible to drought stress.

This study provides information on the factors influencing farmers' WTP for growth stage-specific insurance products.

1.3 Objectives of the study

The general objective of this study is to assess the factors influencing farmers' willingness to pay for index-based insurance products for common bean in Huye District of Rwanda.

The specific objectives are:

1. To assess farmers' perceptions on bean insurance products.
2. To assess willingness to pay for the various index-based insurance products by the smallholder bean farmers.
3. To identify factors influencing farmers' willingness to pay for the index-based insurance products by the smallholder bean farmers.

1.4 Research questions

1. What are the farmers' perceptions on current bean insurance products?
2. Are smallholder bean farmers willing to pay for the various index-based insurance products?
3. What are the factors influencing farmers' willingness to pay for the index-based insurance?

1.5 Justification of the Study

This study provides information on the factors influencing farmers' WTP for IBI products for bean production in Rwanda. It provides insights to insurance product developers such as One Acre Fund, SORAS, KS, and the Government of Rwanda on appropriate strategies and policies for promoting uptake of insurance schemes. Market players providing insurance products will obtain important insights on the factors influencing farmers' willingness to take up insurance.

This study adds to the scientific cycle by providing valuable literature on index-based insurance in the Rwandan context, particularly on the most sensitive growth stage, farmers' perceptions, and factors influencing farmers' willingness to pay. The study provides policy makers, decision-makers, and implementers with practical tools and knowledge for more effective product development and implementation in Rwanda.

The study provides policymakers with insights into the impact of farmers' willingness to pay for index-based insurance on household agricultural growth, thereby guiding the implementation of the Economic Development and Poverty Reduction Strategy 2 (EDPRS).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Weather Index-Based Insurance

Climate change presents significant risks to smallholder farmers especially in developing countries (Habimana, 2023). Agricultural insurance is an important climate change coping strategy for farmers (Smith and Glauber, 2012). According to Nnadi *et al*., 2013, crop insurance is defined as the allocation of a hazard from one unit to another in exchange for a payment. Crop insurance began in Europe over 200 years ago and later in the United States.

Crop insurance is stated as a protection that delivers monetary reimbursement to the farmers from their productivity losses (Delay et al., 2023). Apart from dropping the uncertainty that face the insured farmers, crop assurance also covers production shortfalls specifically of a large-size nature. In this case the risk is assigned to the insurance companies which in return pay the reimbursement to the farmers after the loss has occurred (Sibiko, 2016).

According to Hazell, (1992), Weather Index-Based Insurance (WIBI) resolves the problem of asymmetric information such as adverse selection and moral hazard where the way of paying the indemnities is uniform to all farmers and it reduces the transaction costs. Crop insurance is categorized into two main clusters; the first one is indemnity-based insurance and the second one is index-based insurance. The indemnity-based insurance is referred to as peril crop insurance which is also made up of the two categories which are damage-based indemnity assurance and harvest yield insurance (Iturrioz, 2009). Damage-based indemnity assurance is a form of coverage where the premiums are calculated based on the percentage damage in the field right (World Bank, 2011). This type of insurance is most used against hailstorms, frost and excessive rainfall. It is also the most familiar form of insurance practiced in the advanced countries.

Harvest-based crop insurance is also known as multiple peril crop assurance mainly practiced in the USA. It is an insurance cover that the premiums are calculated based on the records or the average of historical yield of a farmer. The range of insured yield ranges from Fifty percent to Seventy percentage of the ordinary production (World Bank, 2011). When the produce is below

the insured yield, the equivalent compensation is paid based on the difference between real and the insured multiplied by a predetermined value.

There are also two other categories of Index-based insurance; area-yield index insurance and weather-index insurance (Iturrioz, 2009). Area-yield index insurance is based on the actual normal yield of the area such as district, village among others. The insured harvest is calculated as a proportion of the usual yield for that specific area. The repayment is paid when the harvest for the area is below the insured harvest not considering the real yield of the specific insured farm. On the other hand, weather-index coverage, the compensation is calculated based on the understandings of particular climate parameter over a specific period of time at a specific weather place. The weather-index insurance use the historical data to measure the specific weather variable for a particular product. Moreover, weather-index insurance identifies minimum and maximum thresholds for premiums. Weather-index insurance is used to guard against excessive rainfall or drought.

Smallholder farmers in Rwanda commonly use weather index-based insurance. The indemnity is calculated based on the quantity of precipitation, water content and temperature in the area collected from nearby weather stations (Ashimwe, 2016).

2.2 Farmers' Perceptions Towards Crop Insurance

Farmers' perceptions towards the crop insurance depend on the mode of delivery of the insurance and also some farmers' attributes. Ngango et al., (2022) observed that farmers in India had negative perception towards crop insurance. The study also found that 80 percent of the farmers were not aware of insurance package provided and the procedure for enrollment. Mojarradi et al. (2008) found that farmers had positive perceptions about crop insurance and had trust in the private insurers. Chikaire *et al*. (2016) found that most of the farmers in Nigeria were not aware of crop insurance due to low level of education.

2.3 Factors Influencing Willingness to Pay

Farmer's willingness to pay is the maximum amount in terms of money that a bean farmer is WTP for an index-based insurance product. Several studies have been conducted on WTP for IBI in developed countries. Liesivaara and Myyra (2014) in their study conducted in Finland on farmers'

WTP for agricultural insurance found that age and soil characteristics influenced farmers to pay for the insurance where young farmers were more WTP for the insurance compared to their elderly counterparts.

Danso-abbeam *et al.,* (2014) analyzed the willingness to pay for cocoa price insurance in the cocoa industry in Ghana. The findings of the study showed that the farmers willingness to pay was significantly influenced by marital status, education background, ownership of farming land, farmers' awareness about the insurance scheme and income generated from the cocoa farming activities. The study by Ntukamazina *et al.,* (2017) on index-based agricultural insurance products: challenges, opportunities and prospects for uptake in sub-Sahara Africa found that index-based crop insurance and index-based livestock insurance have been piloted and implemented in the region. The study also found out that on-farm income/savings, literacy and family size had a positive correlation with these products. Age of the farmer, land tenure and farm size had negative correlation with these products.

2.4 Review of Methods and Theories

The valuation of non-market goods, services or products is divided into two categories which are revealed preference (RP) and stated preferences (SP) methods. In few years ago different governments used this method of valuation of non-market goods or services to gain information about the peoples preferences on different programs with the aim of developing and designing the effective policies and improvement of programs (Bennett and Birol, 2010).

Revealed preference methods use data based on actual choices made. In this case the value of non-market goods or service by assessing the actual consumers' behavior on the market. Travel cost method and hedonic pricing are most known methods under revealed preferences methods. Valuation based on actual choices confers advantage in using RP, however it does not take care of non-use values such as altruistic and bequest values (Martinsson *et al*., 2001). The disadvantage led to the development of Stated Preference (SP) methods. The stated preference methods are used in hypothetical studies in valuing non-market goods and services by using stated behavior. Stated preference methods are divided into different three categories; conjoint analysis (CA), contingent valuation method and choice experiment.

2.4.1 Choice Experiment (CE)

The choice experiment method is a stated preference method that is mostly used in transport and marketing fields (Train, 2002). The econometric root of choice experiment is in random utility models (Manski, 1977). In CE method the goods, services or products are valued based on their attributes or level of the attributes. The CE is different from the typical conjoint methods where the farmers or individuals select the combinations of attributes which they believe maximize their utility rather than rating or ranking them. CE is dependable with random utility theory (RUT) and is very helpful method to elicit the passive use values (Owusu et al., 2022).

Majority of CE applications in non-market valuation studies came after the first application by Adamowicz *et al*., (1994), after this study a number of studies applying CE in valuing non-market goods and services increased in the environmental studies *(*Adamowicz *et al*., 1998; Birol *et al*, 2006 ; Ruto and Garrod, 2009). Choice modelling has the capability to embed a variety of possible alternative goods within the options from which respondents are inquired to choose (Bennett and Blamey, 2001). The choice modeling involves intricate survey designs where the number of choice settings can be huge and be likely to impact the outcome (Owusu et al., 2022).

2.4.2 Contingent Valuation Method (CVM)

The contingent valuation (CVM) technique has ability and capability to assess non-use values. It most popularly use practice for valuing economic values for various non-market resources. The CVM provides to the respondents one or sometimes two alternatives to value, and thus advanced rate (Owusu et al., 2022). CVM has the different elicitation method such as discrete choice (take-it-or-leave-it), open-ended CV format, the payment card, bidding game and the dichotomous question with some follow up have been used in prior studies to value private and the public goods.

Some of the studies have employed open-ended elicitation setup to elicit WTP (Owusu et al., 2022; Kwadzo *et al*., 2013; Abdinasir, 2005; Ogunniyi *et al*., 2011; Budak *et al*, 2010). The Compétition Commission (2010) found that the technique is informative because WTP can be recognized by each respondent and it needs the straight forward statistical practices and it is easy to formulate the questions.

It is difficult to the respondents to give a financial value or provide their true maximum amount they are WTP for a good in which they're not familiar with and never tried valuing just before without some kind of support (Arrow *et al*., 1993).Most open-ended CV formats normally generate huge number of non-responses to the WTP questions and outliers which generally give non-realistic large bids that lead to unreliable responses hence limiting the applicability of the method.

The dichotomous choice contingent valuation has been used to reveal WTP in different studies namely (Hubbell *et al*, 2000; Qaim and Janvry, 2003). This elicitation technique has shown to give respondents diverse market-like structure than the simple open-ended format (Hubbell *et al*., 2000). This technique has also simple and easy to deploy, as respondents are required to just answer "yes" or "no" to a given price and minimizes the non-responses and it avoids the outliers (Competition and Commission, 2010).

According to Competition Commission, (2010) the "yea-saying" is a limitations of the technique. The WTP values of this technique are significantly larger than the results of open-ended interrogations and it suffers from the initial point bias. The method itself is ineffective because it provides a non-sufficient information from each respondent and the analysts only knows that the WTP is higher or lower to a certain amount. Some studies have used this technique of double-bounded dichotomous choice model like (Kimenju and Groote, 2008) in their study used double-bounded dichotomous choice model to evaluate the consumer WTP for genetically modified food. The method is not able to reveal the actual WTP amount. The method is therefore limited as it only relies on market goods with actual value.

Alhassan et al. (2013) used payment card evocation format as a CVM to assess willingness to pay. The payment card gives a background to the bids therefore trying to prevent starting bias and it minimizes the amount of outliers compared to open-ended and iterative bidding approaches. The elicitation technique is prone to prejudices relating to the range of the numbers in the card and the position of the benchmarks and can't be used in phone interviews (Competition Commission, 2010). To present a set of mimic scenarios to respondents to make a choice is expected to create the anchoring prejudices (Arrow *et al*., 1993).

Some studies used bidding game to elicit WTP just like (Dror *et al*., 2007; Garming and Waibel, 2007; Sathya and Sekar, 2012). The respondents are encouraged by this method to take in consideration their preferences vigilantly just before affirming the amount of money they are really

willing to pay, and the respondents might be influenced by the initial values, and following bids used (Willis, 2002). This method also provides a big number of "yea-saying" bids and outliers.

This method uses face-to-face communications between the respondents and interviewer and it's not appropriate for mail surveys (Competition and Commission, 2010).

This study uses iterative bidding games. According to Boyle *et al*., (1988) the bidding, payment cards and dichotomous cards, have specific strengths and weaknesses and said that there is no superiority between the methods. The bidding method is has its advantage of capturing the highest price that the respondents are WTP therefore it computes the full consumer surplus (Cummings *et al*., 1986). This technique is easy to respond to questions and it is hard to free ride on to provide a continuous measure of WTP. This helps respondents with their typical market transaction knowledge where they don't face a "take it or leave they can afford and willing to pay (Wattage, 2001). Venkatachalam, (2004) has shown that bidding game proved that it can work securely in developing countries because it proposes reasonably better outcomes by offering "market-like" situation to the respondents by letting them examine their preferences of the product in question. The monotonous augmentation of the small constant amounts provides the respondents with opportunities to discard the bid amount, compared to a double-bounded dichotomous choice format where the bid sums are doubled or halved (Venkatachalam, 2004). Studies that have been conducted to compare the elicitation formats have also produced results showing that the bidding game is more dependable and consistent than the dichotomous choice methods (Dong *et al*., 2003).

2.5 Theoretical Framework

The current research is anchored on random utility concept. The hypothesis suggests that a farmer's judgement to pay for a new product is dependent on the point of usefulness s/he expects to obtain from paying for that product (U_p). As such, farmers pay for an insurance product scheme (specific growth stage) if the anticipated utility of buying the insurance (U_{ip}) is superior to the utility without buying the insurance (U_{in}) (Ali and Abdulai, 2010). Moreover, the decision to pay for the coverage is a dichotomous one such that farmers choose to pay for the structure based on individual preferences as well as specific farm characteristics. Willingness to pay is also dependent on farmer's oneself-choice behavior more readily than on a random task to treatment.

Meaning the variance amongst the net utility of willing and non-willing to pay as for every single farmer *i* gives:

$$I_i^* = (U_{ip}) - (U_{iN}) > 0 \quad (1)$$

Equation 1 indicate that farmer *i* will pay for the IBI scheme if the derived utility from the insurance surpasses that of not taking the insurance, *ceteris paribus* (other things held constant).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Framework

The problem under investigation is the farmers' willingness to pay for bean index-based insurance. Fig. 3.1 illustrates how the socio-economic factors influencing bean farmers' willingness to pay and their perceptions towards index based insurance. The framework also shows how the insurance attributes contribute to bean farmers' WTP for the IBI. Those who are willing to buy the insurance are expected to have improved agricultural productivity that leads to improved life with self-reliability.

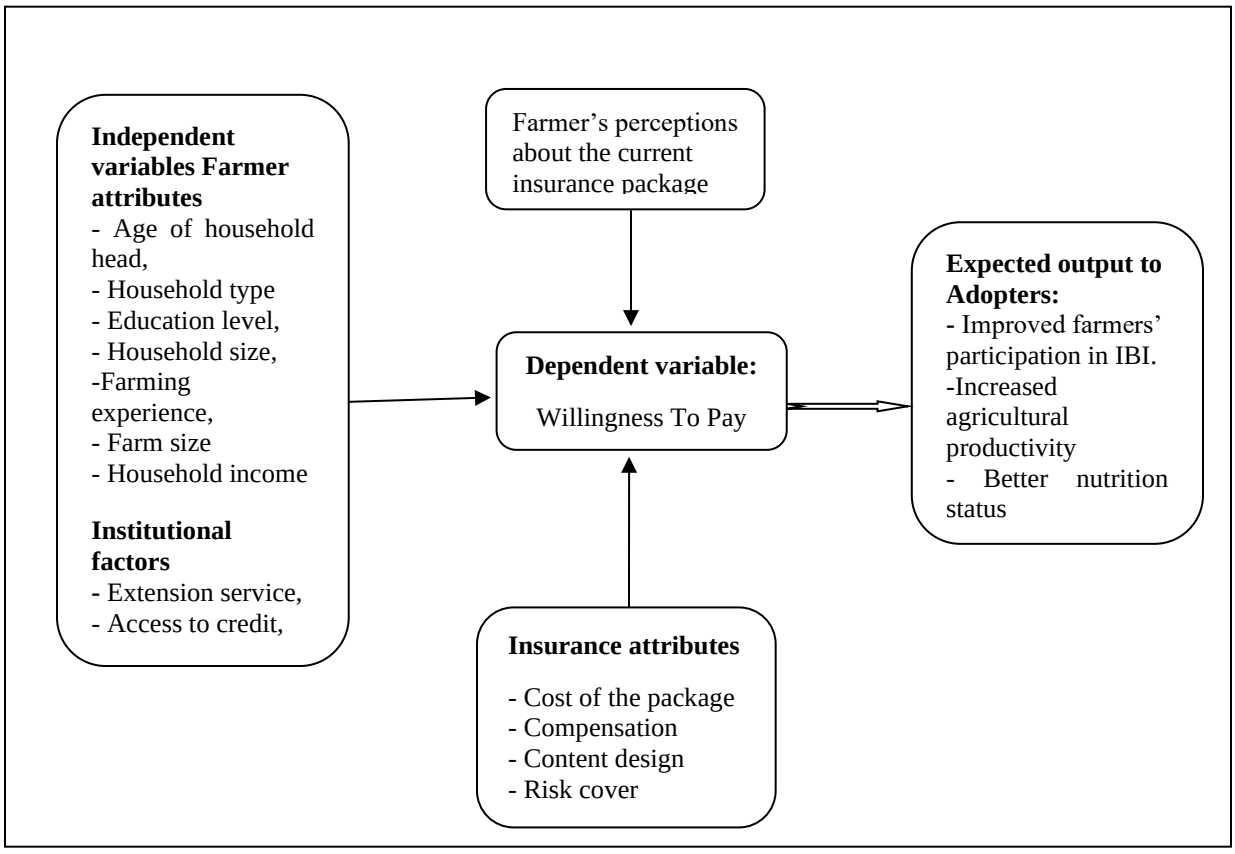

Figure 3.1: Relationship between farmers' willingness to pay and household specific variables.

The conceptual framework shows the endogenous and exogenous factors that influence farmers' WTP for the bean insurance product. The arrows show how the factors are interlinked and how they influence a farmer's willingness to pay.

Farmer specific attributes, institutional and product specific attributes influence farmers' willingness to pay for crop insurance products. Specifically, household income, farmers age, family size, farm size and farming experience affect the farmers' willingness to pay for bean insurance. Farmers with low income are more likely not adopt bean insurance, while wealthy and educated farmers are expected to be willing to pay for crop insurance. Institutional factors such as access to information, extension services and access to loans are likely to positively influence adoption of bean insurance. However, insurance specific attributes also influence willingnes to pay for the product. The study conceptualizes that the more willing farmers are to pay for the bean insurance product the more likely they will adopt bean insurance and hence increased crop productivity and eventually household income.

Independent Variables

Farmer attributes

Socio-economic factors such age, gender, education, farm size, household size, farming experience and natural incidence factor (drought, bush fire and flood) influence a farmer's decision to insure his/her farm. Farmer's perception towards insurance policies could stem from how frequent natural disasters such as flood, drought or bush fires do occur in and around his/her farming areas. Since beans are susceptible to natural disasters, farmers closer to disaster prone areas would be much likely to take insurance for their farms than their counterparts who are far from those areas. Socioeconomic characteristics of the households influence the farmers' WTP for the IBI (Hiwot and Ayalneh, 2015). This study also hypothesizes that socioeconomic characteristics of the households influence the bean farmers' WTP for IBI.

Institutional factors

Agricultural household with limited or no access to credit are more vulnerable and exposed to adverse weather causing the unexpected production loss and income shocks. These households choose to apply low risk mechanisms with low investments in order to reduce the income risk which also has low returns. Most of the agricultural households do not have access to credit due

to the low number of individuals interested in agricultural credit. This increases the financial transaction costs making it very difficult for the banks or financial institutions to operate on a commercially viable basis. Agricultural insurance facilitates the farmers to access the credit which also contribute to the financial stability of the entire agribusiness sector.

Agricultural insurance can assist governments in transferring these agricultural risks to third parties, such as insurance companies (Nnadi *et al*., 2013). Extension services update the farmers on the new technologies such as agricultural insurance and how the service is offered to them. This helps the farmers to be aware of the new technology and increases their financial ability to pay the loan or reduce the cost of insurance which leads to high rate of participation in insurance scheme (Sadati *et al*., 2010). Group membership helps farmers to easily adopt the new agricultural technologies such as crop insurance because the decision are made in groups and some farmers influenced by the group decisions (Wairimu *et al*, 2016).

Insurance attributes

Reducing the risks faced by farmers is essential for improving their welfare. Contrary to the past crop insurance formed through a top-down approach that deprives farmers an opportunity of being involved in the design of the product they pay. Empirical studies have shown that stakeholder engagement in intervention programs that they ought to pay for is crucial for adoption and high participation of the farmers in taking insurance of their crops (Feder *et al.*,1981; Batz *et al.*, 2003). The consequences of failing to consult farmers as low percentage uptake of the crop, low productivity in the agricultural sector despite its major contribution to economic development and poor market participation resulting in poverty cycles among farmers. This approach also improves the farmers' perceptions about the program on how the product is delivered and the agency providing the products.

Dependent variable

In this study, willingness to pay is the extreme amount of money a smallholder bean farmer is ready to spend, sacrifice or pay in order to insure a bean crop for unpredictable climatic conditions.

3.2 Study Area

The study was conducted in Rwanda, Southern province in Huye district. Huye district is among the eight districts that make up Rwanda's Southern Province. It's headquarters located in Ngoma

sector. It comprises 14 sectors which are Gishamvu, Karama, Kigoma, Kinazi, Maraba, Mbazi, Mukura, Ngoma, Ruhashya, Huye, Rusatira, Rwaniro, Simbi and Tumba. The total area of Huye district is 581.5 km^2 with the population of 314,022 with the density of 540/km^2. The district receives 1,200mm regular rainfall and 19^0 C average temperatures yearly. The district has four seasons, long rain which starts as of mid-February to end May; the long dry that starts from June to early September; the third one is short rains starting from mid-September to mid-December and the last one is a short dry-season, which is experienced between January and mid-February.

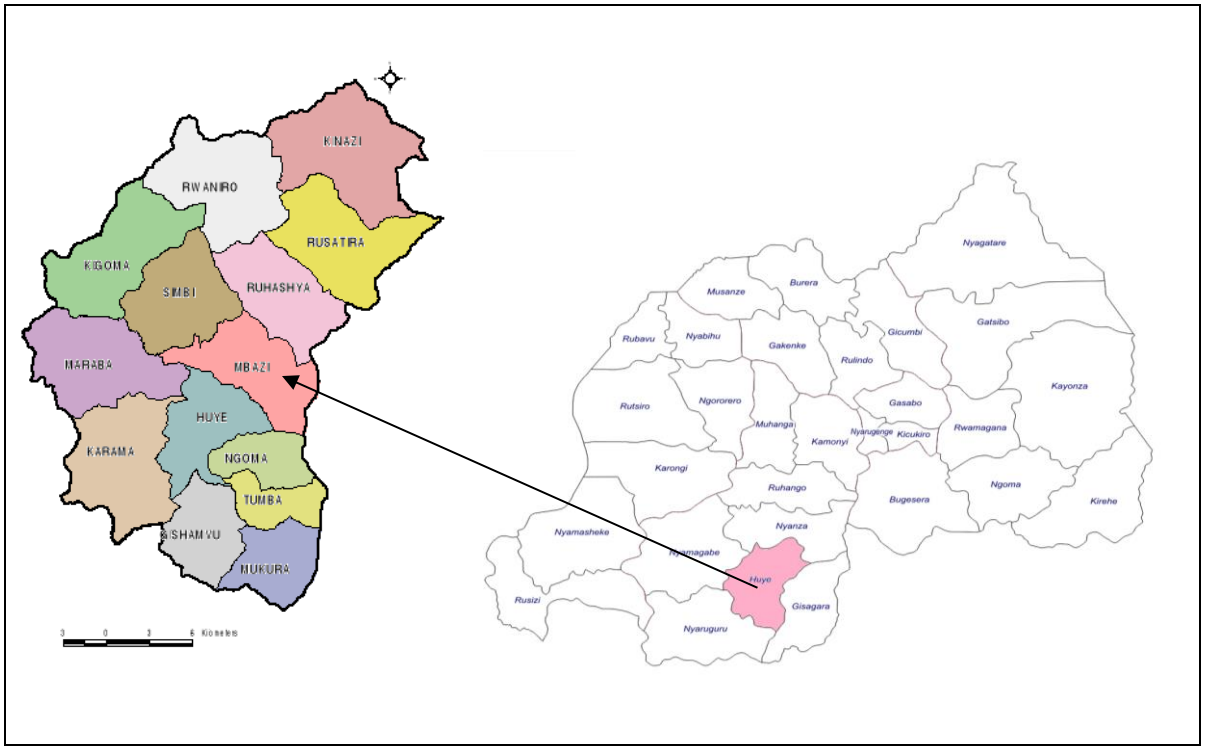

Figure 3. 2: Administrative map of Rwanda and the study site

3.3 Sample Size Selection

Determining sample size and dealing with non-response bias is essential in sampling design. The question is how large a sample can be in order to infer research findings back to a population. The study population was categorized into two, adopters and non-adopters of the insurance product. Using random sampling a total of 428 bean farmers in Mbazi sector were interviewed to cover all types of the bean farmers with different socio-economic factors and the sample size represented the targeted population. From the sampled farmers, 285 were bean farmers ensuring their bean crop and 143 bean farmers who do not insure their bean crop.

3.4 Data Collection

A focus group discussion (FGD) was conducted to gain insights on the uptake of insurance in Rwanda before the survey. FGD also helped in validating the survey tool before conducting the face to face interview survey. Key informant interviews were also conducted to get views and insights about crop insurance in the area. The key informants interviewed included One Acre Fund personnel, Agronomist at sector level in charge of agricultural activities in sector, Rwanda Agriculture Board (RAB) personnel in charge of extension services and a village leader in the study area.

Primary data was collected using semi-structured questionnaires. The data collected included demographic, institutional, economic, perceptions, and willingness to pay for the specific plant growth stage insurance products among smallholder bean farmers. Eight (8) enumerators were recruited to implement the survey data collection. Training of enumerators on methods of data collection and interviewing techniques were done prior to data collection. To measure knowledge and awareness of respondent's with regard to the current insurance product, farmers were asked if they had ever heard or taken insurance of their crop and source of information. Respondents' perceptions were captured through responses to a five-point likert scale that ranged from strongly disagree to strongly agree. A neutral was included to allow possibility of respondents with lack of opinion.

3.5 Empirical Analysis

3.5.1 Consumers' Utility and Willingness to pay

Willingness to pay can be analyzed as a consumer choice problem. According to Cranfield *et al*., (2003), if there is no increase in utility, then a farmer will be less willing to pay, as an increase in the price leads to the reduction of utility level compared to the base level of utility. Also if the utility raises, then the farmer may be more willing to pay for the insurance product, on the basis that even if the price increases, it can't lower the utility beyond the base level (Cranfield *et al.*, 2003). The farmers' willingness to pay is therefore a function of the change in utility arising from the consumption choice (equation 2).

$$WTP = f(\Delta U), \quad (2)$$

Where,

ΔU is the change in utility and $f'>0$.

Since the choice of one product over another is a discrete one, it is convenient to look at farmers' choice problem in a random utility setting. Random utility models have been used extensively in the valuation literature in the analysis of consumer valuation and assessment of consumer response to new (or different) products (Ohnson, 2000). Following the random utility framework proposed by (Cranfield *et al*., 2003), it is assumed that a farmer faces a choice between buying the insurance product or not buying.

The utility derived from buying an insurance product by a farmer is given as:

$$U_i = X'i\beta + \varepsilon_i \quad (3)$$

Where,

U_i is the utility arising from choosing the *i*th alternative; $X'i\beta$ is the deterministic component of the utility function,

X_i is a vector of observable alternative specific factors that influence utility. β is a vector of variables and ε_i is the stochastic component. The farmer chooses alternative *i* if and only if $\mu_i > \mu_j$ for all $j \neq i$ (or that $\Delta U = U_i - U_j > 0$). Without loss of generality, willingness to pay can be expressed as:

$$WTP = X_i\beta + \varepsilon_i \quad (4)$$

Where, $X = X_i - X_j$ and $\varepsilon = \varepsilon_i - \varepsilon_j$. As (Cranfield *et al*., 2003) pointed out, farmer or household characteristics could be included in the matrix *X* since WTP is likely to vary among farmers. Given that ε is unobservable and stochastic, the farmer's choice is not deterministic and cannot be predicted.

Based on Kimenju *et al*. (2005), WTP is affected by farmer's understanding and perception, in addition to price and socio-monetary factors. Moreover, consumer's WTP may be affected by person's preferences, income and opinions on the products, in adding up to household and socio-economic traits (Cranfield *et al*., 2003).

3.5.2 Measurement of Willingness to Pay

There are three techniques of measuring willingness to pay; the Contingent Valuation Method, the Choice Experiment and Conjoint Analysis method. The conjoint analysis (CA) and choice experiment (CE) are not to be used in the current study. Several studies have assessed goods or services that are not yet in the market, respondents were asked to rate the products contingent upon market accessibility of the product (Quagrainie, 2006; Kimenju and De Groote, 2005). These kind of markets are set up by means of contingent valuation method where farmers are questioned to value the new insurance products (Lusk and Hudson, 2004). CVM has been used in the current study where respondents were asked to state how much they were able and willing to pay for the new insurance product.

Farmers in this study were presented with a hypothetical scenario and asked how much they would pay for the product. The WTP from the hypothetical market are treated as estimates of the value of the non-market product or service, contingent upon the existence of the hypothetical market. Nevertheless, Hanemann and Kanninen (1996) noted that CVM surveys give expressive results if they are correctly grounded in a purchaser maximization framework. In this framework, a bean farmer is assumed to maximize his/her utility subject to a budget constraint, and value the product with the price that gives him/her the uppermost utility. In this context, WTP is the extreme amount of money that a bean farmer is prepared to pay for the new specific flowering and pod setting insurance product (Kimenju and De Groote, 2005). The iterative bidding game was used to calculate the extreme amount of money that the bean farmers were prepared to pay.

The hypothetical scenario was presented as follows: the bean growth cycle has different growth stages namely, emergence, vegetative, flowering, pod development and maturing. Due to climate risk fluctuations, drought stress conditions affect differently these plant growth stages. In other words, the rate of grain yield decrease, due to drought conditions, depends on which plant growth stage the stress occurred. Suppose different products based on bean growth stages are presented in the insurance market and you are to buy/purchase it by cash or loan but to pay later or after harvesting, will you be willing to purchase it depending on the growth stage you think is more critical?"

3.5.3 Bidding Process

The current study used the iterative bidding game to facilitate express their extreme willingness to pay values. The bean farmers were requested whether they can pay each of the series of amount that rise or descent from a specific initial point. This iterative process in the end gave the farmer's maximum willingness to pay. The bean farmers lead through the iterative bidding game to obtain the highest amount of money they were prepared to pay for the various insurance products and the mode of payment they do prefer. The bid of 10 percent was used to calculate the highest amount of money that a bean farmer was ready to pay. If the bean farmer responds "yes" to the preliminary bid amount, there was an increment of 10 percent that was offered until the highest amount that the bean farmer was willing and ready to pay attained. If the bean farmer responds "no" to the preliminary bid, there was a decrement of 10 percent until the amount that the farmer is prepared to pay attained. This showed the maximum amount the bean farmers were ready to pay. Firstly, the bean farmers were asked whether or not they were willing and prepared to pay for the product if the answer was no, then they provide reasons why they were not prepared to pay any amount. Then the bidding amount the bean farmers were ready to pay for the various insurance products was recorded.

3.5.4 Random Coefficient

The study adopted the multivariate probit model which posits that the probability of choosing one product may affect the probability of choosing another product. Thus, the error terms for the willingness to pay for the four products are jointly distributed. Probit analysis was developed to analyze dichotomous dependent variables within the regression framework. Numerous response variables are binary by nature, requiring either 1 0r 0 (yes or no) response.

The ordinary least squares (OLS) regression has shown to be inappropriate in situations involving dependent variables that are discrete (Agresti, 2002). In such situations, probit and logit models are more appropriate and suitable. Probit and logit models have been used in previous studies to analyze willingness to pay. However, literature suggests that the estimates are usually inefficient and biased, in such case, the multivariate model is the best as it takes into account the joint nature of the decision to participate in the insurance (Benjamin *et al*., 2015). The multivariate probit model has advantage over logit models in small samples. In this study, the multivariate probit

model is preferred and used to identify the factors influencing the farmers' WTP for the index-based insurance products for bean production in Rwanda.

The multivariate probit explains the farmers' WTP premium for the specific flowering stage product and pod development product is specified as:

In current study 4 different products of insuring bean crop were provided and the farmers chose whether to insure their bean crop through one, two or multiple products, depending on their preferences, knowledge in bean production, bean type grown and many other reasons. In this case the probabilities of choosing one product is equal to another product ($\gamma_{im} = 1$) and ($\gamma_{im} = 0$).

$$\gamma_{im}^* = \beta_m' X_{im} + \epsilon_{im},\ m = 1, \ldots, M \quad (5)$$

$\gamma_{im = 1}$ if $\gamma_{im}^* > 0$ and 0 otherwise

$\epsilon_{im},\ m = 1, \ldots, M$ are error terms distributed as multivariate normal, each with a mean of zero.

Assuming that the probability that every product is a success or can be selected:

$$\Pr(y1 = 1, y2 = 1, y3 = 1, y4=1)$$
$$= \Pr(\epsilon_1 \leq \beta_1' X_1, \epsilon_2 \leq \beta_2' X_2, \epsilon_3 \leq \beta_3' X_3, \epsilon_4 \leq \beta_4' X_4)$$
$$= \Pr(\epsilon_4 \leq \beta_4' X_4 \mid \epsilon_3 < \beta_3' X_3, \epsilon_2 < \beta_2' X_2, \epsilon_1 < \beta_1' X_1) \times \Pr(\epsilon_3 < \beta_3' X_3 \mid \epsilon_2 < \beta_2' X_2, \epsilon_1 < \beta_1' X_1) \times \Pr(\epsilon_2 < \beta_2' X_2 \mid \epsilon_1 < \beta_1' X_1) \times \Pr(\epsilon_1 < \beta_1' X_1) \quad (6)$$

This expression involves the conditioning upon unobservable variables (that are correlated with each other). B_s are parameters corresponding to estimated variables' coefficients. ε_i is the error term and consists of unobservable random variables and Xs are representing the explanatory variables in the model.

Specifically, the probit regression explaining farmers' WTP for IBI in Huye district, Rwanda, is specified as follows with the explanatory variables:

$$Y_i = \beta_o + \beta_1 Age + \beta_2 hhtype + \beta_3 hheadeducation + \beta_4 hhsize + \beta_5 hheadfarmingexperience + \beta_6 farmsize + \beta_7 extension + \beta_8 groupmembership + \beta_9 creditaccess + \beta_{10} hholdincome + \varepsilon_t \quad (7)$$

Where

X_1= Age of household head (years)

X_2= Household type

X_3= Household head's education level

X_4= Household size

X_5= Farming experience of the household head

X_6= Farm size (ha)

X_7= Access to extension service

X_8= Group membership

X_9= Access to credit

X_{10}= Household income

$\beta_1,\beta_2,\ldots\beta_{10}$ are parameters corresponding to estimated variables' coefficients.

ε_i is the error term and consists of unobservable random variables.

Y_i represents the farmer's WTP for the IBI, 1 when the farmer is willing and pays and 0 otherwise.

The table 1 below here presents a description of independents variables and their theorized signs.

Table 3. 1: Elucidation of independent variables hypothesizes to influence the farmers' WTP.

Variable	Description	Measurement	Signs
Hheadage	Age	Years	+/-
Hhtype	Gender of household head	Dummy (1=Male; 0=Female)	+
Hheadeducation	Household head's education	Formal schooling i.e (0=No; 1=Primary; 2=Secondary; 3=Tertiary)	+
Hhold size	Number of people in the household	In numbers	+/-
Hhead farming experience	Years of experience in farming	Years	+
Farm size	Farm size	Acres	+
Extension service	Meeting extension agents	Number of times met with extension agents	+/-
GPmembership	Membership in farmer group/ association/ cooperative	Dummy (1= Yes, 0= otherwise)	+
CreditAccess	Access to credit	Dummy (1= Access credit; 0= Otherwise)	+
Hholdincome	Household income	Amount in Rwf	+

Source: Survey Data (2017)

3.6 Justification of Independent Variables

Age (Hheadage): Age has been measured in years for the household head. Foregoing studies informed diverse results on the relationship among age and involvement in crop insurance where the oldest farmers are probable to play a part in the insurance scheme as opposed to younger farmers because they have more resources than the young ones. However, the participation in crop insurance is expected as individuals become old. (Oyinbo *et al.*, 2013) noticed that age

undoubtedly influenced the possibility of farmers' involvement in agricultural coverage scheme in Nigeria. (Boyd *et al*., 2015) in their study conducted in China found that age of the household head increase affect negatively the WTP for the IBI where older farmers in the retirement age are less likely to purchase agricultural insurance because they are in less active age. It is was hypothesized that young farmers participate more with a decreasing trend towards their retirement age or less active age.

Household Type (Htype): this is a dummy variable. Several studies have demonstrated that farmers who are male are extra likely to take part in the insurance scheme than their female colleagues. This is because male farmers have higher responsibilities providing food to their household members. Kwadzo *et al*., (2013) found that the insurance is dominated by male farmers in the region of Kintampo North City, Ghana. According to (Boyd *et al*., 2015) in their study conducted in China found that female farmers are more likely to purchase index-based insurance than men because the women may be more risk averse than men and for the current study it is hypothesized that male household headed are more likely to insure their bean crop than their counterparts female household headed.

Years of Formal Schooling (Hheadeduc): this variable was quantified as a continous variable signifying the number of years a household head had completed in schooling. Formal schooling is expected to influence involvement in new innovations since educated farmers recognize the profits correlated with innovative interventions such as IBI and aim at having unchanging farm earnings or reimbursement whenever losses occur. In the USA farmers taking insurance were observed to be extra knowledgeable and trained, which clarified their superior responsiveness to the insurance scheme (Boyd *et al*., 2015).

Moreover, Dhanireddy and Frisvold, (2012) noticed that schooling had a positive effect on the likelihood of procuring crop coverage in the USA. High educated farmers were observed highly responsive to risk managing. Their study also discovered that farmers with more years of formal education were extra threat averse than non-educated unities and considering crop protection to be more important to them. Fallah *et al*., (2012) in their study learned that farmers with more years of formal education respond positively in participation of insurance system in Iran for the reason that they are aware and understand the premium for indemnifying their goods. In the current study,

additional years of formal schooling is predictable to certainly influence farmers' WTP for the IBI scheme in Huye district.

Family Size (Hsize): the household size is associated with willingness to pay for the insurance products. The larger the size of the family the more the dependents in the family who rely on the available income for sustainability. Kwadzo *et al*., (2013) found that the smaller household size the more they are willing to purchase crop insurance than their counterparts with larger households. For the current study it is expected that the smaller size households are more participating in the insurance scheme than the bigger size households.

Farming Experience (Hheadfarmingexperience): Experience in farming is highly associated with farmers' willingness to pay where the farmers with experience are more likely to ensure their crops than non-experienced farmers. Kwadzo *et al*. (2013) in their study conducted in Ghana found that farmers with experience were purchasing crop insurance at high rate than other farmers with less experience and for this study it is expected that the experienced bean farmers in study area are more willing to insure their bean crop than their counterparts with less experience in farming.

Farm Size (Farmsize): the farm size will be measured in acres as a continuous variable that will indicate the whole land size assigned to beans production. The farmers with larger pieces of land are more confident and invest more for the development of their land. Abdulmalik *et al*. (2013) in their studies conducted in Nigeria have resulted that the size of the farmland increase the probability of farmer involvement in crop assurance. (Nahvi *et al*., 2014) have discovered a encouraging connection between the farm size and the farmers' willingness to purchase the insurance in Iran. In Rwanda, the land is a most important restraint to crop production, it is expected that farmers with larger farm sizes are more willing to pay the IBI scheme compared to their colleagues with small farm sizes. This is for the reason that farmers with larger farm sizes are more probable to afford the insurance for their crops compared to their colleagues with small farm sizes.

Extension (Extension): The access to extension services increases the farmers' knowledge in their production process and this is assisted by the Government and the partners in development. This means a lot to the farmers having access to the extension services having high chance of being aware and adopting to technologies that would help them to increase their production. Falola *et al*., (2013) found that the farmers with access to extension services are more willing to pay for

agricultural insurance than their counterparts who do not access the service. It is hypothesized for the current study that the farmers with access to extension are more willing to insure their bean crop than their counterparts bean farmers with no access to extension.

Membership in a Cooperative (GPmembership): The cooperative membership in this study was measured as a dummy variable that takes a value of "1" if the grower is a member of a farmer cooperative and "0" if not. Cooperatives increases awareness of its members about new technologies and interventions. For example, Giné *et al*., (2008) their study showed that involvement in a farmer organization had a optimistic result on farmers' willingness to pay for the crop protection in India where farmers who belonged to groups were better notified than their colleagues who were not in any group. Farmers join cooperatives for joint action and this absolutely increases the speed of information sharing (Getachew *et al*., 2011). In this study, cooperative involvement is assumed to positively influence famers' WTP for the IBI in Huye district.

Access to Credit (Creditaccess): This was measured as a dummy variable that takes a value of 1 if family unit has access to loan or credit and zero if the household doesn't have access to credit. Access to credit does not only provide access capital and helps farmers to access trainings and get more information of market channels as a result of the opportunity to take part in new interventions. (Ali, 2013) in his study conducted in Pakistan found that farmers who were more willing to pay for the IBI had higher family income and had access to credit much more than the farmers who were not willing to purchase IBI. (Abdulmalik *et al*., 2013) observed that farmers with access to loan took part in crop protection system in Nigeria than those with no access. The current research, access to credit is theorized to certainly impact farmers' WTP for the IBI in the district of Huye.

Household Income (Income): This is a continuous variable and was calculated as the total income accruing to a farmer over a month. n terms of sum a farmer gained per month. Wealthy farmers have supplementary resources to finance new technologies besides participating in innovative agricultural involvements. Hiwot *et al*. (2015) found that income increases farmer's willingness to purchase farming insurance in Ethiopia; because farmers with high income have more resources to finance new interventions than their counterparts with less income. Nahvi *et al*., (2014) in their study found that growers with higher earnings were more willing to pay for farming insurance in

Iran in relation to protect their farm produces. In this study, household income is hypothesized to have a positive encouragement on farmer's willingness to pay for bean insurance in the district of Huye.

3.7 Data Analysis

The figures collected was analyzed using STATA statistical software version 14. Data cleaning was also done to remove outliers and incomplete response. Data were analyzed and measure of central tendencies and dispersion like mean, median, standard error and variance were generated.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, descriptive statistics and econometric results on the objectives of the study are presented and discussed. The descriptive results were obtained using means and proportions. The econometric results were obtained using multivariate probit analysis. The results provide insights on the factors influencing farmers' willingness to pay for various insurance products.

4.2 Socio-economic and Demographic Characteristics

Table 4.1 compares socio-economic characteristics of bean farmers willing to insure their crop and those unwilling to insure. The results show that more male-headed households (67 percent) were willing to insure their bean crop compared to 65 percent that were unwilling to insure their beans. 66 percent of the total sample were male-headed households. This is in contrary to national statistics as more female-headed households participate in agricultural activities as main occupation (NISR, 2012).

Access to credit: Households that had access to credit (34.3 percent) reported unwillingness to insure their bean crop. This is attributable to the fact that farmers use part of the credit for household consumption during crop failure, hence they see crop insurance as unnecessary. The pooled results show only 33.6 percent of the households had access to credit. Financial institutions remain out of reach for many of rural poor smallholder farmers in Rwanda due to relatively high interest rates, fixed loan repayment schedules that do not correspond to season harvesting, and collateral, which is still seen as a barrier to assessing agricultural loans poor smallholder farmers (IPAR- Rwanda, 2015).

Table 4. 1. Socio economic characteristics

Variable	Willing to insure	Not willing to insure	Pooled sample
Household type (% male- headed)	67.0	65.0	66.4
Access to credit (% yes)	33.3	34.3	33.6
Group membership (% yes)	77.2	76.2	76.9
Extension services (% yes)	47.7	41.3	45.6
Age of household head (Years)	47.5	48.3	47.8
Household size	4.55	4.47	4.53
Education level (Years)	5.2	4.7	5.04
Farming experience (Years)	19. 95	21.8	20.6
Average land size (hectares)	0.36	0.29	0.34
Household income (Rwf)	13.320	9.030	11.790

Source: Survey Data (2017)

Group membership: households participating in farmer groups or agricultural cooperatives (77.2 percent) reported willingness to insure their crops. This implies that agricultural cooperatives play a greater role in crop insurance decision among farmers. In addition, results from the pooled sample shows that 76.9 percent of the bean farmers were in farmer groups or agricultural cooperatives. Cooperatives play a big role to the members for easy access of information and also help the farmers to increase their agricultural produce compared to non-members.

Access to Extension service: Less than half of the sample size (45.6%) were had access to agricultural extension services. The extension in Rwanda is still facing the challenges like poor skills and organization of farmers, small-scale farming with less than a hectare of arable land, soil degradation, dependence of rain fed agriculture, weak coordination of agricultural actors and inadequate collaboration between farmers-researchers and extension workers but the government of Rwanda has adopted the National Agricultural Extension Strategy just to insure ideal conditions

for the dissemination and exchange of information between producers, farmer groups and other different stakeholders or partners just to modernize the agriculture (MINAGRI, 2009). About 48 percent of the households that access reported willingness to insure their bean crop.

Age of the household head and Household size: The average age of the household heads and household size was 47.8 years and 5 members for the pooled sample. Interestingly, there was no difference in average household size and age of the household head between those willing to insure and those not willing to insure. However, a study by Wairimu *et al*., (2016) in Kenya showed that the young growers were more willing to pay the insurance than the old farmers.

Education level: Most of the bean farmers in the study area attended primary level education. The results show no difference in level of education between farmers' willing to insure and those not willing to insure. In Rwanda, the urban residents receive better education than their rural counterpart, 57% of the population received primary education, 11% secondary level, 2% reached university education and about 28% receive no education but in rural areas the population with no education goes up to 30% (NISR, 2014).

Experience in farming: The pooled sample's average years of experience in farming activities was 20 years. Farmers who were willing to pay for insurance were youthful at the age of 20 years old, while the average years of experience for farmers who were not willing to pay was 22 years. This difference indicates that farmers with less experience are more likely to take up insurance products. Danso-abbeam *et al.,* (2014) demonstrated that the number of years of experience matters in crop insurance, as they discovered that farmers with more years of experience comprehend the benefits of crop insurance.

Land size: Farmers in the study area have land holding sizes of 0.34 ha. Farmers willing to insure had higher land sizes (0.36ha) than those unwilling to insure their crops (0.29ha). This is attributable to that fact that a larger area spreads the risk of crop loss and other uncertainties hence farmers insure in order to minimize or hedge against the risk that might affect a big investment on land.

Household income (Income): This is a continuous variable that was calculated based on the amount of money earned by a bean farmer per month. Farmers with higher incomes invest in new technologies such as agricultural insurance more than their lower-income counterparts (Hiwot and

Ayalneh, 2015). According to the findings of the current study, bean farmers with higher incomes were more willing to insure their bean crop than farmers with lower incomes. Farmers who were willing to insure their bean crop earned 13.320 Rwf per month, while those who were not willing to insure earned 9.030 Rwf; the overall sample earned 11.800 Rwf. Nahvi *et al.*, (2014) established that farmers with higher incomes were more willing to pay for farming insurance in Iran compared to those with lower income.

Primary occupation in the study area: Results in Table 4.2 show the occupation of farmers in the study area, results show that majority of the farmers (95 percent) were doing farming except some few among them occupied with other income generating activities (5%). The primary occupation in the study area was mainly farming. In Rwanda's labor market, 72.7 percent are in agricultural occupations and 27.3 percent are in non-agricultural occupations, as the country's vision is to create more jobs in non-agricultural occupations while decreasing the number of people employed in the agricultural sector (NISR, 2012).

Table 4. 2. Primary occupation of the households in the study area

Activity	Willing to insure (N=285)	Not willing to insure (N=143)	Pooled sample
Farmer	95.09	94.4	94.86
Salary worker	1.05	0.7	0.93
Self-employed (business)	2.11	2.8	2.34
Casual labor	0.7	2.1	1.17
Students	1.05	0	0.7

Source: Current study Author's computation created on survey data (2017)

4.3 Bean Production Summary Statistics

4.3.1 Bean Type and Sources of seeds

Bush beans are the most popular bean type in the study area. Bush beans are grown by the majority of farmers (64.3%) in the study area (Figure 4.1). This due to its lower complexity compared to climbing beans, which require staking materials and are not always affordable. The findings

revealed that approximately 51% of the bean farmers in the study area use home saved or recycle seeds, 31% use seeds purchased from the local market (Figure 4.2). The results corroborate with the findings of a study conducted in western Kenya which showed that 60% of bean farmers use the local bean types and 40% grow improved types; 75% of the farmers keep seeds for periods which they considered more economical and more readily available (Opole *et al*., 2005).

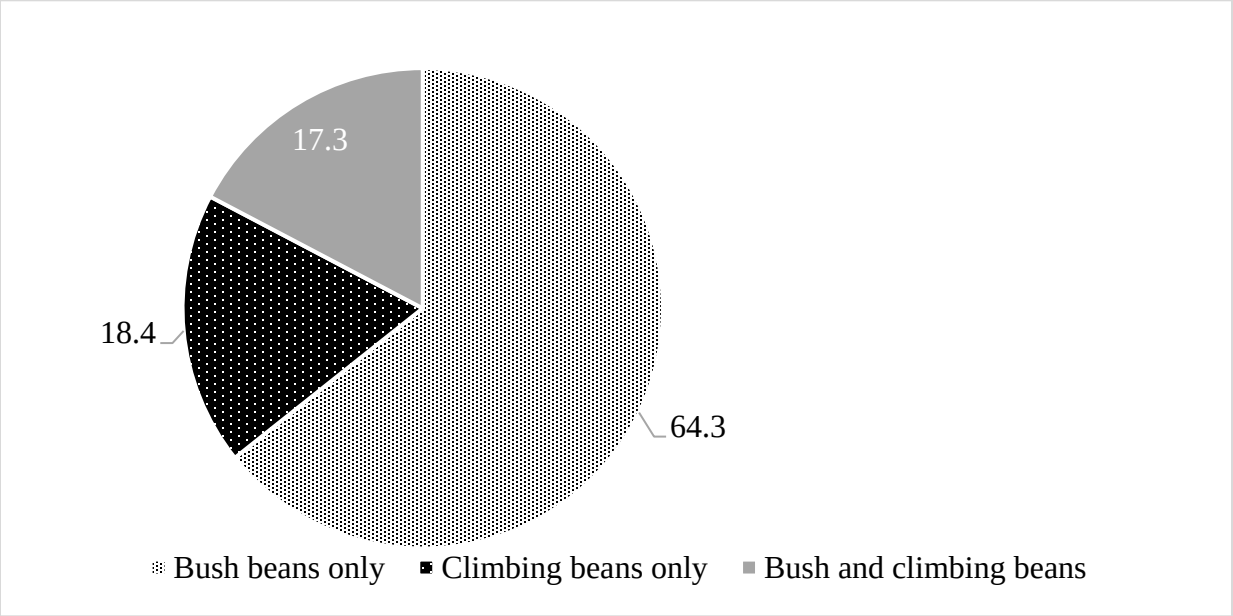

Figure 4. 1: Bean type grown by the farmers in the study area

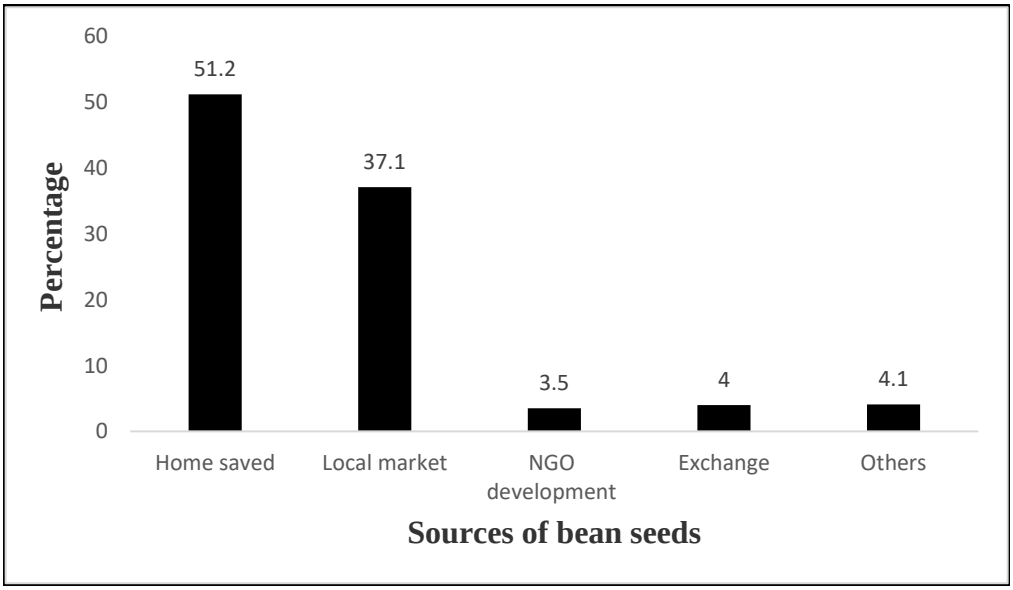

Figure 4. 2: Sources of bean seeds

4.3.2. Critical Growth Stages

Figure 4.3 shows the critical stages of bean production. Drought causes the flowers to dry and fall off, reducing the number of pods per plant and small grains in the pods for those that survive. According to farmers, the pod formation stage is the most vulnerable to excess rain because when there is excess rain, the pods become full of water instead of grains, reducing the number and quality of grains per pod and thus the yield. A study conducted by Ntukamazina et al. (2017) on the effect of excessive and minimal moisture stress on agronomic performance on bush and climbing bean genotypes discovered that for both bean genotypes, the pod development stage was the most sensitive to drought stress.

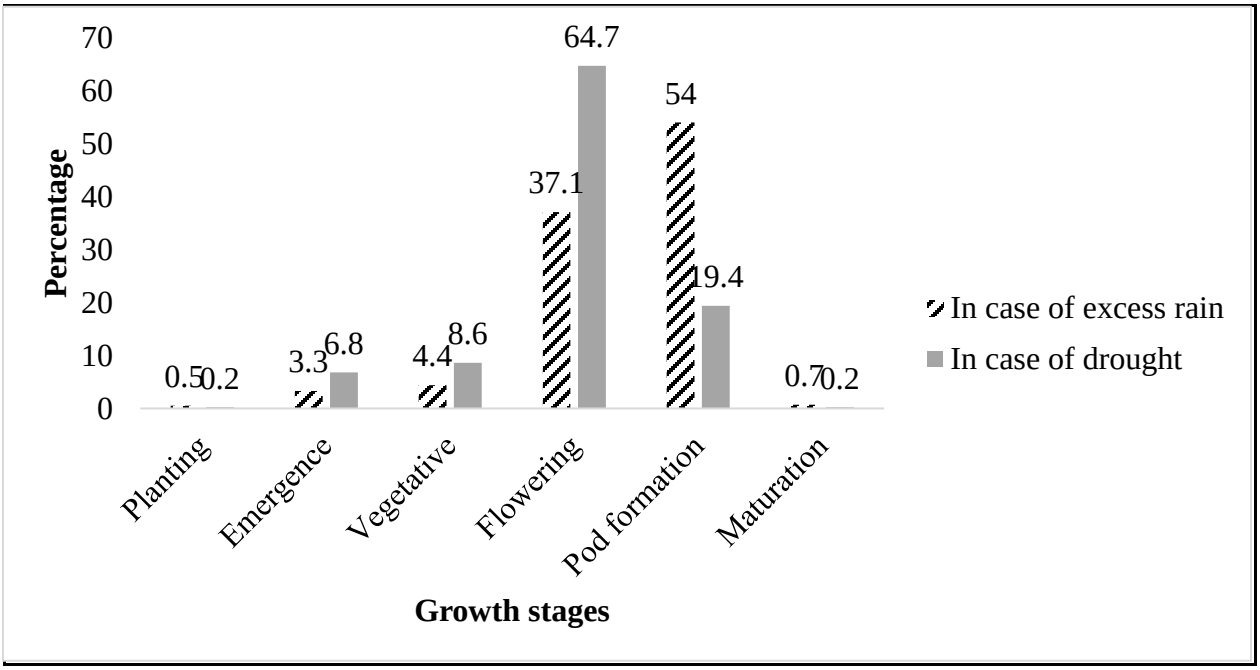

Figure 4. 3: The critical growth stage in case of excess rain and drought

Drought conditions affect approximately 60% of common beans grown under rain-fed conditions, reducing grain yield by up to 80% in some areas (see Figure 4.3). Drought stress can occur at any stage of bean crop development, but the flowering and pod development stages are the most vulnerable. Drought stress in these stages is classified as terminal drought, as it restricts water availability during the reproductive stages until physiological maturity with no additional water supplied (Dipp et al., 2017).

Farmers were also asked to mention the critical stages that requires to be insured. 62.6% of the farmers felt that the flowering stage is the most vulnerable that require to be covered, and 22.2% recommended that the pod development stage be covered by insurance (Figure 4.4). Just as farmers in Karnataka, India, receive very little rainfall, prompting them to consider adverse weather conditions prevalent during the flowering and pod formation stages as the most vulnerable (Goudappa et al., 2012).

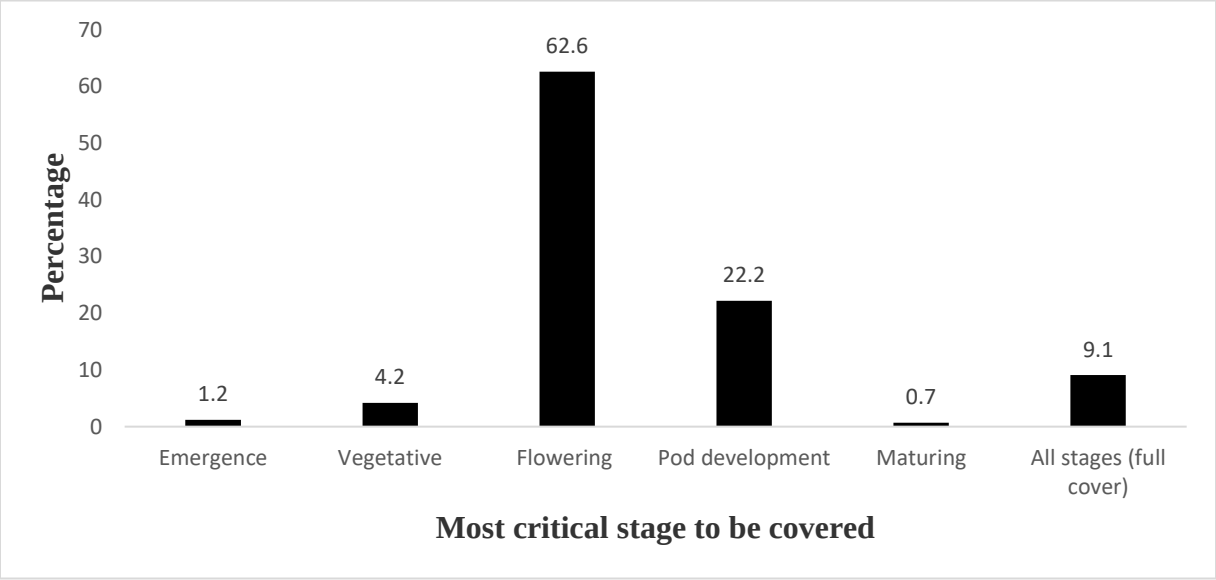

Figure 4. 4: Most critical growth stage suggested to be covered

4.4. Crop Insurance and Insurance Products

4.4.1. Mode of Delivery of Insurance Products

One Acre Fund sells insurance products through the sale of input credits, and the cost that farmers pay includes both the cost of the inputs and the cost of the insurance. Farmers are given credits for seeds and fertilizer, which they must pay for later in the season. Furthermore, One Acre Fund, in collaboration with the government, assists farmers by bringing agricultural extension training to every village in Rwanda and bringing inputs to a large network close to farmers (One Acre Fund, 2017). Figure 4.5 depicts the majority of bean farmers who work with the insurance company. 53% are interested in insuring their beans by purchasing fertilizer with insurance, 43% purchase seeds and fertilizer, 2.8% purchase seeds only with insurance, and 1% are interested in other products provided by the insurance company such as solar lights, cook stoves, and others. As

shown in Figure 4.5, many farmers were interested in purchasing fertilizer and using their own saved seeds.

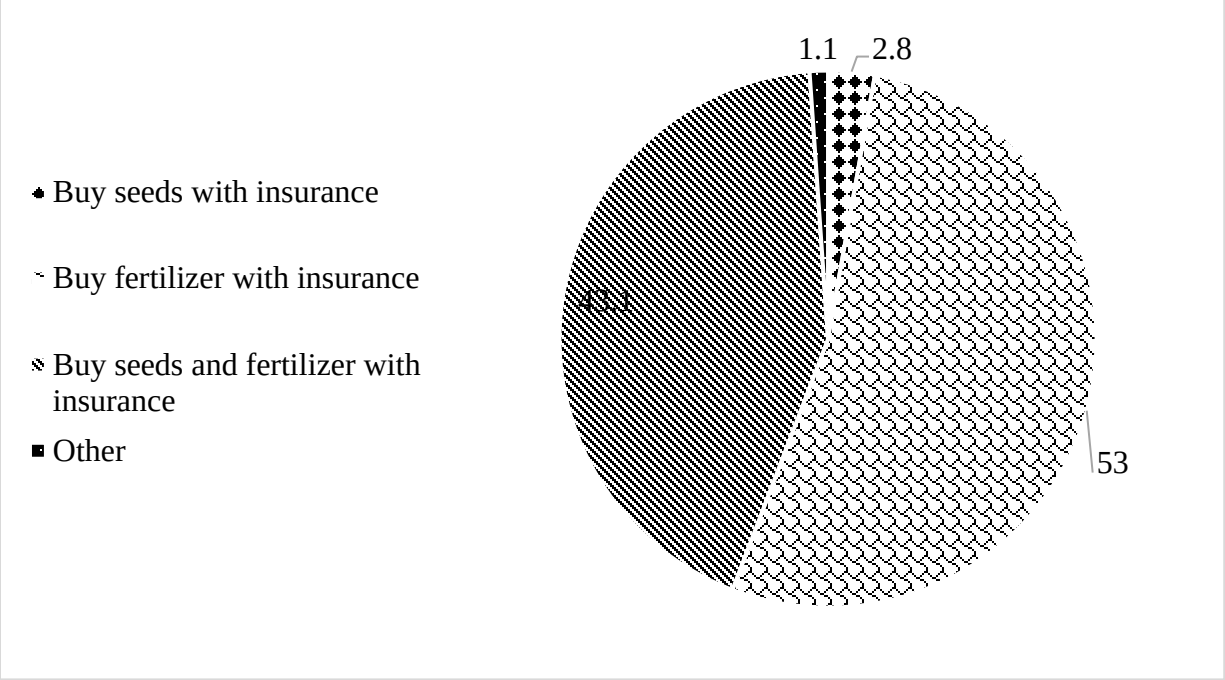

Figure 4. 5: Mode of Delivery of Insurance Products

4.4.2. Farmers' Awareness and Perceptions on Current Insurance Products

Farmers reported to be were aware of the insurance company, how it operates, and the types of insurance offered to farmers. Approximately 95% of the bean farmers interviewed were aware of the bean insurance offered (Table 4.3). According to Chikaire et al. (2016), a study conducted in Nigeria on farmers' perceptions of agricultural insurance discovered that most farmers were unaware of the agricultural insurance product. According to a study conducted by Goudappa et al., (2012) on farmers' perceptions and awareness of crop insurance in Karnataka, India, most farmers were aware of the agricultural insurance. However, majority (80%) were unaware of the implementing agency.

Farmers' satisfaction about the mode of delivery of the current insurance products was measured using Likert scale ranging from 1 to 5 (very satisfied, somehow satisfied, neutral, somehow not satisfied and not satisfied at all). Table 4.3 shows that about 87% of the bean farmers were satisfied with the mode of delivery of insurance products.

Table 4. 3: Farmers' perceptions on current insurance products

	Very satisfied	Somehow satisfied	Neutral	Somehow not satisfied	Not satisfied at all
Satisfaction on mode of delivery	158	15	5	3	1
Credibility of the provider	153	20	6	1	1
Information flow	141	35	4	1	1
Adequate compensation	51	18	40	72	1
Speed timeliness	124	41	10	6	1
Appreciation of Tubura services	158	17	4	2	1
Crop insurance is an important risk management tool	145	23	10	1	2
Crop insurance provide good assurance against crop failure	99	61	16	4	1
Crop insurance is not relevant due to low yield	21	14	37	101	8
Crop insurance is not relevant due to unpredictable weather conditions	15	17	36	94	19

Source: Current study Author's computation based on study data (2017)

Majority of the bean farmers (78%) reported that they got information on time just before the cropping season through the private extension service personnel. Farmers were asked if the compensation provided by the insurance company was adequate. The results shows that about 40% disagreed on the statement, 22% were neutral and 28% strongly agreed. When asked on the importance of farming activities, 10% agreed to that farming activities were important. Farmers

also reported that they were not happy with the compensation they get when they face a risk because of the modality used to assess the risk level. Farmers were not aware about how the loss is determined when a risk occur and how the compensations are calculated by the insurance company.

4.4.3. Product significance in demand to farmers

The four products that farmers purchased with insurance were the two bean types which are climbing type (MAC44) and a bush type (RWR2245) and two fertilizer types used during planting (DAP) and another during top dressing (UREA).

Table 4. 4: Product significance in demand to farmers

Equation	Obs	"R-sq"	chi2	P
Max amount MAC44	285	0.0465	13.89	0.1782
Max amount RWR2245	285	0.0550	16.58	0.0841
Max amount DAP	285	0.1324	43.5	0.0000
Max amount UREA	285	0.1386	45.84	0.0000

Source: Current study Author's computation based on study data (2017)

Farmers do not prefer to grow climbing beans because there aren't any staking materials nearby, so the climbing bean type (MAC44) was not significant at any significance level (see Table 4.4). The percentage of farmers who bought seeds with insurance from the company was low because most of them used home-saved seeds and other farmers bought them from the market, making the bush bean type significant at 10% level. Both types of fertilizers were significant at 99% confidence level. This implies that farmers in the study area were more interested in buying fertilizers with insurance.

4.4.4. Premiums that bean farmers were prepared to pay for the various insurance products

The premiums that bean farmers were willing to pay for the various products to cover the most crucial growth stages of bean production—flowering and pod development—are shown in Table 4.5.

Table 4. 5: The premiums that bean farmers were WTP for the various insurance products to insure the most critical growth stages

	Flowering stage					Pod development stage				
Product	**Initial bid**	**Mean**	**St. dev.**	**Min.**	**Max.**	**Initial bid**	**Mean**	**St. dev.**	**Min.**	**Max.**
MAC44	3914	3720	486.96	2300	5000	4123	3551	674.53	2000	4275
RWR2245	3374	3247	385.2	1750	3975	3554	3144	534.37	2000	3725
DAP	2214	2208	181.31	1500	3450	2331	2202	233.98	1500	2760
UREA	1755	1760	124.27	1350	2650	1848	1825	172.94	1500	2650

Source: Current study Author's computation based on study data (2017)

Results showed that farmers are willing to pay 3720 Rwf to insure their bean crop through the purchase of climbing bean type MAC44 seeds with insurance for flowering stage and for pod development stage they were willing to pay 3551 Rwf. The average price farmers were willing to pay for the bush bean variety RWR2245 to guarantee flowering stage was 3247 Rwf, and the average price they were willing to pay to guarantee pod development stage was 3144 Rwf.

Farmers reported their willingness to pay upto 2208 Rwf for the DAP fertilizer that is used during planting to insure flowering stage and 2202 Rwf for pod development. Farmers were prepared to pay 1760 Rwf, which was more than their initial bid, for UREA fertilizer, which is used during top dressing and is needed to ensure flowering growth stage and pod development. Farmers were also willing to pay 1825 Rwf for this product.

4.5. Factors influencing farmers' willingness to pay

Table 4.6 shows the factors influencing bean farmers willingness to pay for various insurance product.

Table 4. 6: Factors influencing farmers' WTP for various insurance products

	Factors influencing farmers' willingness to pay for various bean insurance products.								Factors influencing farmers' maximum amount to pay for various bean insurance products.							
	MAC 44		RWR 2245		DAP		UREA		MAC 44		RWR 2245		DAP		UREA	
Variable	**Coef.**	**Z-value**	**Coef.**	**Z-value**	**Coef.**	**Z-value**	**Coef.**	**Z-value**	**Coef.**	**Z-value**	**Coef.**	**Z-value**	**Coef.**	**Z-value**	**Coef.**	**Z-value**
Household type	0.3 (0.2)	1.6	-0.08 (0.2)	-0.4	0.38 (0.2)	1.8*	0.63 (0.2)	3.3***	459.8 (260.6)	1.76*	-7.7 (218.8)	-0.04	239.5 (124)	1.9*	341.7 (117)	2.9***
Household size	0.05 (0.05)	1.03	0.03 (0.05)	0.58	-0.07 (0.05)	-1.3	-0.11 (0.05)	-2.4**	37.2 (66.6)	0.6	16.3 (56.1)	0.29	-48.1 (31.8)	-1.51	-56.6 (30)	-1.9*
Age of household head	-0.004 (0.01)	-0.5	0.02 (0.01)	2.3**	-0.01 (0.01)	-1.4	-0.005 (0.01)	-0.5	-5.8 (12.7)	-0.45	25.4 (10.7)	2.4**	-6.6 (6.1)	-1.1	-5.8 (5.7)	-1.01
Education level	-0.005 (0.03)	-0.2	0.05 (0.03)	1.7*	0.04 (0.03)	1.2	0.05 (0.03)	1.7*	1.9 (41.3)	0.05	62.7 (34.6)	1.8*	19.7 (19.6)	1	26.7 (18.5)	1.44
Land Size	-7.05 (0.00)	-0.33	-5.14 (0.00)	-0.23	0.00 (0.00)	1.6	0.00 (0.00)	1.8*	0.01 (0.03)	0.34	0.01 (0.02)	0.3	0.03 (0.01)	2.2**	0.02 (0.01)	1.78*
Farming experience	0.002 (0.01)	0.25	-0.02 (0.01)	-2.2**	0.02 (0.01)	1.4	0.01 (0.01)	0.74	3.5 (14)	0.25	-26.2 (11.8)	-2.2**	5.8 (6.7)	0.9	5.7 (6.31)	0.91

Access to credit	0.1 (0.2)	0.6	0.02 (0.2)	0.14	0.1 (0.2)	0.3	0.03 (0.2)	0.2	126.1 (247.2)	0.51	-0.6 (207.6)	-0.00	68.2 (117.7)	0.6	48.1 (111)	0.43
Group membership	0.2 (0.2)	0.8	-0.1 (0.2)	-0.6	0.8 (0.2)	3.6***	0.9 (0.2)	4.4***	448.9 (279.6)	1.6	-52.7 (234.7)	-0.22	574.9 (133.1)	4.3**	555.3 (125.6)	4.4***
Extension services	0.2 (0.2)	1.4	0.4 (0.2)	2.3**	0.26 (0.2)	1.4	-0.44 (0.2)	-2.6***	219.7 (224.8)	0.98	348 (188.7)	1.84*	90.7 (107)	0.85	-275 (100.9)	-2.7***
Household income	8.2 (7)	0.12	1.35 (7.2)	0.2	-5.6 (8.8)	-0.64	-5.96 (7.14)	-0.83	-0.003 (0.01)	-0.33	0.001 (0.01)	0.15	-0.003 (0.005)	-0.77	-0.004 (0.004)	-0.93

Source: Current study Author's computation based on study data (2017)

***, ** and * signify 1%, 5% and 10% significance levels in that order, Standard errors are in Parentheses

4.4 Bean Seeds (MAC 44 Climbing Bean and RWR2245 Bush Bean)

Table 4.6 shows that climbing beans are grown by a small number of farmers and no variable is affecting farmers' willingness to pay for MAC44 (no variable is significant to this product); however, household type (male headed) affects the amount farmers are willing to pay for MAC44 at 10% level of significance. This implies that male head households are willing to pay 459.8 Rwf more than their female counterparts. Male headed households are more willing to cultivate and insure their bean crop through climbing bean seeds purchase than the female headed households. Delavallade *et al*., (2015) in West Africa found that male household heads tend to put more efforts on the risks to their farm activities while women household heads are concerned with the shocks affecting health and school of the household members.

Age of the household head, farming experience, and extension service are all significant at the 5% level, while education is significant at the 10% level. Younger farmers were more willing to insure their bean crop than their elderly counterparts. A study led by Abdullah et al. (2014) on Malaysian farmers' willingness to pay for crop insurance discovered that age was a significant factor influencing farmers' willingness to pay for insurance. The findings also revealed that an increase in education level increases the likelihood of taking bush bean type insurance, and access to extension services influences farmers' willingness to pay because awareness and knowledge contribute to farmers' decision to insure their bean crop. Educated farmers are more likely than uneducated farmers to purchase an insurance (Hill et al., 2013). Farmers' willingness to pay increases when they have access to extension services (Wairimu et al., 2016). Farming experience had a negative impact on farmers' willingness to pay and decision on the maximum amount to pay for the product, with high experienced farmers less likely to insure their bush bean type, implying that the increase in years of experience in farming activities reduces the probability of insuring the bean crop through bush bean type. In their study on the factors influencing weather index-based crop insurance conducted in Kenya, Wairimu et al. (2016) discovered that experience in farming activities has a negative impact on the adoption of weather index-based crop insurance. However, the coefficients show that only the farmers with high incomes are interested in securing their bean crop through the purchase of bean seeds, whereas the farmers with low incomes have the choice of using home-saved seeds or purchasing them on the local market at a low price but of poor quality. The variable household income is not significant to all products at all significance levels.

Farmers with higher incomes are more likely than their less wealthy counterparts to insure their crops (Nahvi et al., 2014).

4.5 Fertilizers (DAPP and UREA)

Results have shown that majority of the farmers in the study area were more interested in purchasing fertilizers with insurance than seeds or both. Group membership and household type are two socioeconomic factors that have an impact on farmers' willingness to pay for DAP, while household type, land size, and group membership have impact on the maximum amount that farmers are willing to pay. Being a member of a farmers' group or cooperative has a positive effect on bean farmers' willingness to pay and the maximum amount to pay for the DAP fertilizers, which is significant at 1% confidence interval. Being a member of a group influences farmers' willingness to purchase crop insurance in a favorable and significant way (Wairimu et al, 2016; Ali, 2013).

Household type (male headed) positively influenced farmers' willingness to pay and decision on the maximum amount to pay for the DAP fertilizer in bean production insurance (significant at 10 percent level). The male headed households are more likely to insure bean crop through DAP fertilizer input than female headed households. Female household heads have less access to inputs, education and associated agricultural extension services showing the lack of access to information that negatively affect them to be less likely willing to insure their crops against weather-related production shocks (Akter *et al*., 2016).

Land size was significant at 5% confidence interval. The results showed that farmers with larger land sizes were more likely to insure their bean crop through buying DAP fertilizer than their counterparts with smaller land sizes. Several studies have shown that land size has a positive significant influence on farmers to participate in crop insurance scheme (Nahvi *et al*., 2014 ; Danso-abbeam *et al*., 2014).

Household type, household size, education level, land size, group membership, and extension services all have an impact on how much farmers are willing to pay for UREA fertilizer. On the other hand, how much farmers decide to pay for this input depends on household type, household size, land size, group membership, and extension services. Household type significantly affected willingness to pay and decision on maximum amount to pay for the input, at 1 percent confidence interval; male headed households were more likely to insure their bean crop through UREA

fertilizer. Being a male bean farmer increased a chance of purchasing UREA fertilizer in bean insurance scheme than being a female bean farmer. Female household heads involved in agricultural activities are vulnerable to weather related shocks and have low adaptive ability than the male household heads (Akter *et al.*, 2016).

Household size affected willingness to pay and maximum amount to pay for the UREA fertilizer negatively and it was significant at 5 percent confidence interval. Households with less number of family members were less willing to pay while their counterparts with a higher household sizes were the more willing to pay for the UREA fertilizer in bean insurance. The literature suggests that families with small household size or less number of family members are more likely to insure their crop against crop failure than the families with more family members (Danso-abbeam *et al*., 2014). This is attributable to the fact that larger families are likely to have income constraints hence unable to cover additional cost of insurance.

Education level of the household head was significant at 10 percent level. Farmers with higher education level were expected to purchase bean insurance through UREA fertilizer input more than their counterpart with no or less education level. Several studies have shown that education is an important determinant of farmers' willingness to pay for crop insurance *(*Yakubu *et al*, 2016 ; Falola *et al*., 2013 ; Abdinasir, 2005).This is explained by the fact that more educated individuals are enlightened and likely to take up new technologies faster than their uneducated counterparts.

Land size positively and significantly influenced farmers' willingness to pay and maximum amount to pay for UREA product at 10 percent level of significance. Farmers with more acreage were more likely willing to insure their bean crop through purchasing UREA fertilizer input than the farmers with small land or small acreage (Nahvi *et al*., 2014). Farmers with larger land sizes experience higher losses in case of risks, as such they would most likely insure their crop to cover for the potential losses.

Group membership positively and significantly affected farmers' WTP and maximum amount of money to pay for UREA fertilizer input at 1 percent level of significance. Bean farmers in groups or cooperatives were more likely to insure their bean crop through purchasing of UREA fertilizer input than farmers that do not belong to any farmer group or cooperative. Lietrature suggests that farmers in groups or cooperatives are more likely to insure their crops than the farmers who are not the members of any development group. A study by Ali (2013) corroborates this finding

indicating that farmers who belong are likely to access information faster hence ease of taking up insurance.

Extension service is negatively affecting farmers' WTP and the maximum amount to pay for UREA fertilizer input in bean insurance. The variable was significant at 1 percent level where the farmers not accessing the extension services were willing to purchase the product than the farmers accessing the extension service. In contrast, literature suggests that the farmers accessing extension services are more likely to insure their crop than the farmers not accessing extension services as it has been shown by Falola *et al*., (2013) that farmers accessing extension services were more likely willing to pay for agricultural insurance than those who did not access it. Despite household income being insignificant to willingness to pay, farmers with less income are more willing to insure their bean crop through fertilizers purchase than purchasing bean seeds. The increase in income leads to the willingness of insuring bean crop through the purchase of bean improved seeds while farmers with less income insure their bean crop through purchase of fertilizers and use the home saved seeds. The income increases the farmer's willingness to pay agricultural insurance (Hiwot and Ayalneh, 2015).

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study's first objective was to assess farmers' perceptions of the current bean insurance program. This goal was achieved if farmers received adequate information from the insurance company's extension agents, and if the bean farmers had a favorable opinion of the business, received training from the business on agricultural practices, and received inputs on schedule. Farmers were not pleased with the compensation they received when a risk occurred because the risk had to be verified at the district level, which was difficult because it required the cooperation of numerous institutions. To gauge farmers' opinions of the current bean insurance program, a likert scale was used.

The study's second objective was to determine what factors affected the farmers' willingness to pay for IBI products used in the production of beans. For the bush bean variety (RWR2245), farmers' willingness to pay and premium for the product was influenced by the household head's age, educational attainment, farming experience, and access to extension services. Household type and group membership affected farmers' willingness to pay for the DAP fertilizer used during planting, while household type, land size, and group membership affected farmers' maximum amount to pay for the product. Last but not least, household type, household size, education level, land size, group membership, and extension service were all factors that affected farmers' willingness to pay for UREA fertilizer, while household type, household size, group membership, and extension service were all factors that determined the maximum amount to pay for the product.

The third objective was to determine the WTP for various IBI products by small-holder bean farmers. The study tested to understand farmers willingness to insure their bean crop in terms of bush bean type (RWR2245) and fertilizers (DAP and UREA) to ensure flowering growth stage as the most critical growth stage in drought conditions, followed by pod development growth stage. The average amount that farmers were willing to pay for the various insurance products against the most critical bean growth stages (flowering and pod development) was calculated. It was established to be less than the initial amount for all bean insurance products. Farmers were willing

to pay the most for MAC44, which was RWF 3914, and the least for RWR2245, which was RWF 3374. Farmers were willing to pay the least for UREA fertilizer, which was RWF1755.

According to the study's findings, the majority of farmers were aware of bean insurance and had heard about it from insurance company agents in their community. Farmers had positive perception about the company providing the service, however, they were dissatisfied with the compensation given when risk occurs because it needed to be approved by the local administration at the district level.

Flowering stage was reported as the most critical growth stage in bean production during drought conditions and should be covered by insurance, followed by the pod development stage. Farmers acknowledged the value of the inputs in bean insurance and were willing to spend money to insure their bean crop on the specific sensitive growth stages. There is therefore need for the insurance product developers and entrepreneurs to consider flowering stage and pod development specific products. This will enhance adoption of insurance products in the bean sector.

5.2 Recommendations

Farmers expressed negative perception on the long process of requiring the risk assessment approved by local administration. As such, local administration at the district level should strengthen collaboration with the insurance company and the Ministry of Agriculture. This will encourage more farmers to join the bean insurance scheme, as well as increase farmers' willingness to pay for bean insurance. Specifically, the collaboration should ensure seamless approval process to ensure risk compensation is offered in time.

Most farmers in the study area were illiterate and hence had a negative perception on the insurance products. Government agencies should collaborate with other stakeholders to sensitize and create awareness among farmers on the benefits of the insurance scheme. Farmers’ knowledge and awareness of the product is essential to build positive perception and eventually adoption of the technology.

Farmers' willingness to pay for bean insurance products is influenced significantly by group membership. The government together with other stakeholders should promote farmer participation in groups and cooperatives, this will enhance awareness and adoption of insurance products.

Female-headed households are less common among bean farming households; however, these households should be targeted for insurance information dissemination to increase adoption. Female-headed households were more likely to be members of a group that was more likely to adopt new technology. Government agencies and insurance companies should target female-headed households to increase their awareness of insurance products and, as a result, their willingness to pay.

Insurance companies should incorporate the flowering stage and pod development into their insurance policies. In drought-prone areas, the flowering stage is critical for insurance, whereas pod development is critical in areas prone to heavy rains. As a result, insurance providers should think about including these critical stages in the development of insurance products.

Given the low rate of adoption of bean insurance, draught management methods such as provision of irrigation equipment and training farmers on how to irrigate their bean crop will help to reduce bean crop yield losses caused by draught.

5.3 Recommendation for Further Research

The study focused on general factors influencing farmers' willingness to pay for index based bean insurance. It was noted that gender significantly influences willingness to pay for bean insurance. Further research should consider a gendered disaggregated approach to establish factors influencing willingness to pay for index based bean insurance among different gender groups. This will be useful in targeting different farmer types.

REFERENCES

Abdinasir, A. (2005). Willingness to pay for improved rural domestic water services: A contingent valuation study of sericho division, isiolo district. *Department of Agricultural Economics, University of Nairobi*, (September).

Abdullah, A. M., Auwal, A. G., Darham, S. and Radam, A. (2014). Farmers willingness to pay for crop insurance in North West Selangor integrated agricultural development area (Iada), Malaysia. *Journal of the International Society for Southeast Asian Agricultural Sciences*, *20*(2), 19–30.

Abdulmalik, R. O., Oyinbo, O. and Sami, R. A. (2013). Determinants of Crop Farmers Participation in Agricultural Insurance in the Field Capital Territory, Abuja, Nigeria. *Greener Journal of Agricultural Sciences*, *3*, 21–26.

Adamowicz, W., Boxall, P., Williams, M. and Louviere, J. (1998). Stated preference approaches for measuring passive use values : Choice experiments and contingent valuation. *American Journal of Agricultural Economics*, *80*(1), 64–75.

Adamowicz, W., Louviere, J. and Williams, M. (1994). Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. *Journal of Environmental Economics and Management*, 271–292.

Agresti, A. (2002). *Categorical Data Analysis*. *Wiley series in probability and statistics* (Vol. 45). https://doi.org/10.1198/tech.2003.s28

Akter, S., Krupnik, T. J., Rossi, F. and Khanam, F. (2016). Gender gap in agricultural insurance demand, (3), 1–5.

Alhassan, M., Loomis, J., Frasier, M., Davies, S. and Andales, A. (2013). Estimating Farmers' Willingness to Pay for Improved Irrigation: An Economic Study of the Bontanga Irrigation Scheme in Northern Ghana. *Journal of Agricultural Science*, *5*(4), 31–43. https://doi.org/10.5539/jas.v5n4p31

Ali, A. (2013). Farmers ' Willingness to Pay for Index Based Crop Insurance in Pakistan : A Case Study on Food and Cash Crops of Rain-fed Areas. *Agricultural Economics Research Review*, *26*(2), 241–248.

Antón, J., Cattaneo, A., Kimura, S. and Lankoski, J. (2013). Agricultural risk management policies under climate uncertainty. *Global Environmental Change*, *23*(6), 1726–1736. https://doi.org/10.1016/j.gloenvcha.2013.08.007

Arrow, K., Solow, R., Portney, P. R., Leamer, E. E., Radner, R. and Schuman, H. (1993). *Report of the NOAA Panel on Contingent Valuation*.

Ashimwe, O. (2016). *An Economic Analysis of Impact of Weather Index-based Crop Insurance on Household Income in Huye District of Rwanda*. University of Nairobi.

Bardsley, P., Abey, A., and Davenport, S. (1984). The economics of insuring crops against drought. *The Australian Journal of Agricultural Economics*, *28*.

Batz, F. J., Janssen, W. and Peters, K. J. (2003). Predicting technology adoption to improve research priority - Setting. *Agricultural Economics*, *28*(2), 151–164.

Benjamin, T. A., Timo, S., Stefan, B. and Jukka, K. (2015). Factors influencing smallholder farmers access to agricultural microcredit in Northern Ghana. *African Journal of Agricultural Research*, *10*(24), 2460–2469. https://doi.org/10.5897/AJAR2015.9536

Bennett, J. and Birol, E. (2010). Introduction : the roles and significance of choice experiments in developing country contexts, 1–14.

Bennett, J. and Blamey, R. (2001). The choice modelling approach to environmental valuation. *Edward Elgar Pub. Ltd . UK*, 1–69.

Birol, A. O. E., Katsvairo, A. M. L., Diressie, M. T. and Butare, J. d'Amour N. L. (2015). *Consumer Acceptance of Biofortified Iron Beans in Rural Rwanda: Experimental Evidence*. *HarverstPlus Working Paper*.

Birol, E., Karousakis, K. and Koundouri, P. (2006). Using a choice experiment to account for preference heterogeneity in wetland attributes : The case of Cheimaditida wetland in Greece, *0*, 145–156.

Blackden, M., Munganyinka, T., Mirembe, J. and Mugabe, A. S. (2011). *USAID Rwanda Gender Assessment*.

Bliem, M. and Getzner, M. (2008). *Valuation of ecological restoration benefits in the Danube River basin using stated preference methods – Report on the Austrian case study results*.

Borch, K. (1986). *Economics of insurance*. (C. J. BLISS and M.D.INTRILIGATOR, Eds.). Bergen, Norway: Norwegian School of Economics and Business Administration.

Boyd, J. L. and M., Porth, J. P. and L., and Wang, Q. Z. and K. (2015). Factors affecting farmers' willingness to purchase weather index insurance in the Hainan Province of China. https://doi.org/http://dx.doi.org/10.1108/MRR-09-2015-0216

Braden, J. B. and Kolstad, C. D. (1991). Measuring the Demand for Environmenal Quality.

Amsterdam: North-Holland.

Budak, D. B., Budak, F. and Kaçira, O.¨Ö. (2010). Livestock producers' needs and willingness to pay for extension services in adana province of Turkey. *African Journal of Agricultural Research*, *5*(June), 1187–1190. https://doi.org/10.5897/AJAR09.567

Calia, P. and Strazzera, E. (2000). Bias and efficiency of single versus double bound models for contingent valuation studies: a Monte Carlo analysis. *Applied Economics*, *32*(10), 1329–1336. https://doi.org/10.1080/000368400404489

Castellani, D., Tamire, B. and Viganò, L. (2013). The willingness-to-pay for insurance: evidence from southern Ethiopia. *Journal of Universities and International Development Cooperation*, (September), 19–21.

Castellani, D. and Vigano, L. (2015). An analysis of the demand of weather index-based insurance with flexible attributes in a risk management framework. *European Scientific Journal*, *11*(16), 1–22.

Chikaire, J. U., Tijjani, A. R. and Abdullahi, K. A. (2016). The perception of rural farmers of agricultural insurance as a way of mitigation against climate change variability in Imo State, Nigeria. *International Journal of Agricultural Policy and Research*, *4*(2), 17–21.

Ciriacy-wantrup. (1947). Capital returns from soil-conservation practices. *Journal of Farm Economics*, *29*(4).

Competition, and Commission. (2010). *Review of stated preference and willingness to pay methods*.

Cranfield, J. A. L. and Magnusson, E. (2003). Canadian Consumer ' s Willingness-To-Pay For Pesticide Free Food Products : An Ordered Probit Analysist 1. *International Food and Agribusiness Management Review*, *6*(4).

Cummings, R., Schulze, W., Gerking, S. and Brookshire, D. (1986). Measuring the elasticity of substitution of wages for municipal infrastructure: A comparison of the survey and wage hedonic approaches. *Journal of Environmental Economics and Management*, *13*(3), 269–276. https://doi.org/10.1016/0095-0696(86)90027-6

Danso-abbeam, G., Addai, K. N. and Ehiakpor, D. (2014). Willingness to Pay for Farm Insurance by Smallholder Cocoa Farmers in Ghana. *American Research Institute for Policy Development*, *2*(1), 163–183.

Delavallade, C., Dizon, F., Hill, R. V. and Petraud, J. P. (2015). Managing Risk with Insurance

and Savings: Experimental Evidence for Male and Female Farm Managers in the West Africa. *Policy Research Working Paper*, (March), 1–44. Retrieved from http://ideas.repec.org/p/wbk/wbrwps/7176.html

DeLay, N. D., Brewer, B., Featherstone, A., & Boussios, D. (2023). The impact of crop insurance on farm financial outcomes. Applied Economic Perspectives and Policy, 45(1), 579-601.

Dhanireddy, P. K. R. and Frisvold, G. (2012). Disaster Assistance and Crop Insurance Participation in US. *Selected Paper Prepared for Presentation at the Agricultural and Applied Economics Association's Annual Meeting, Seattle, Washington, August 12-14, 2012*.

Dipp, C. C., Marchese, J. A., Woyann, L. G., Bosse, M. A., Roman, M. H., Gobatto, D. R. and Finatto, T. (2017). Drought stress tolerance in common bean : what about highly cultivated Brazilian genotypes ? *Euphytica*, *213*(5), 1–16. https://doi.org/10.1007/s10681-017-1893-5

Dong, H., Kouyate, B., Cairns, J. and Sauerborn, R. (2003). A comparison of the reliability of the take-it-or-leave-it and the bidding game approaches to estimating willingness-to-pay in a rural population in West Africa. *Social Science and Medicine*, *56*(10), 2181–2189. https://doi.org/10.1016/S0277-9536(02)00234-4

Dror, D. M., Radermacher, R. and Koren, R. (2007). Willingness to pay for health insurance among rural and poor persons : Field evidence from seven micro health insurance units in India, *82*, 12–27. https://doi.org/10.1016/j.healthpol.2006.07.011

Fallah, R., Armin, M. and Tajabadi, M. (2012). A Study of Attitudes and Determinant Factors in Insurance Development for Strategic Agricultural Products. *Technical Journal of Engineering and Applied Sciences*, *2*(2), 44–50.

Falola, A., Ayinde, O. E. and Agboola, B. O. (2013). Willingness to take agricultural insurance by cocoa farmers in Nigeria. *International Journal of Food and Agricultural Economics*, *1*(1), 97–107.

Feder, G., Just, R. and Silberman, D. (1981). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change*.

Garming, H. and Waibel, H. (2007). Pesticides and Farmer Health n Nicaragua- A Willingness to Pay Approach.

Getachew, Y., Jaleta, M., and G/medihin, B. (2011). Impact of Input and Output Market Development Interventions on Input Use and Net Income of Households in Ethiopia. *Journal of Economics and Sustainable Development*, *2*(9).

Giné, X., Townsend, R. and Vickery, J. (2008). Patterns of rainfall insurance participation in rural India. *World Bank Economic Review*, *22*(3), 539–566.

Goodwin, B. K. and Smith, V. H. (2003). An Ex Post Evaluation of the Conservation Reserve, Federal Crop Insurance, and Other Government Programs: Program Participation and Soil Erosion. *Journal of Agricultural and Resource Economics*, *28*(2), 201–216.

Goudappa, S. B., Reddy, B. S. and Chandrashekhar, S. M. (2012). Farmers Perception and Awareness about Crop Insurance in Karnataka, *II*(Volume II), 218–222.

Habimana J. (2023). Small holder farmers capacitated to cope with the impacts of climate change through agroforestry action research project. blogspot. Available at: https://www.iucn.org/blog/202302/small-holder-farmers-capacitated-cope-impacts-climate-change-through-agroforestry

Hanemann, M., and Kanninen, B. (1996). THE STATISTICAL ANALYSIS OF DISCRETE-RESPONSE CV DATA. *Department of Agricultural and Resource Economics. University of California, USA.*, *798*.

Hanemann, M., Loomis, J., and Kanninen, B. (1991). Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation. *American Journal of Agricultural Economics*, *73*(4), 1255–1263. https://doi.org/10.2307/1242453

Hanley, N., Mourato, S. and Wright, R. E. (2001). Choice Modelling Approaches : a Superior Alternative for Environmental Valuation. *Journal of Economic Surveys*, *15*(3), 435–462. https://doi.org/10.1111/1467-6419.00145

Hat, J. L. and Prueger, J. H. (2015). Temperature extremes : Effect on plant growth and development, *10*, 4–10. https://doi.org/10.1016/j.wace.2015.08.001

Hazell, P. B. R. (1992). The appropriate role of agricultural insurance in developing countries. *Journal of International Development*, *4*(6), 567–581.

Hazell, P., Pomareda, C., Valdes, A. and Hazell, J. S. (1986). *Crop Insurance for Agricultural Development : Issues and Experience*.

Hill, R. V., Hoddinott, J. and Kumar, N. (2013). Adoption of weather-index insurance: Learning from willingness to pay among a panel of households in rural Ethiopia. *Agricultural Economics (United Kingdom)*, *44*(4–5), 385–398.

Hiwot, T., and Ayalneh, B. (2015). Willingness to pay for rainfall risk insurance by smallholder farmers in Central Rift Valley of Ethiopia: The case of Dugda and Mieso Districts. *African*

Journal of Agricultural Research, *10*(28), 2738–2747.

Iturrioz, R. (2009). Agricultural Insurance, 35. Retrieved from www.worldbank.org/nbfi

J.Hubbell, B., C.Marra, M., and Carlson, G. A. (2000). Estimating the demand for a new technology: Bt Cotton and Insecticide Policies. *American Agricultural Economics Association*, 118–132.

Just, R. E., Calvin, L. and Quiggin, J. (1999). Adverse Selection in Crop Insurance : Actuarial and Asymmetric Information Incentives. *American Journal of Agricultural Economics*, *81*(4), 834–849.

Kimenju, S. C. and De Groote, H. (2005). Consumers' willingness to pay for genetically modified foods in Kenya. *Agricultural Economics*, *38*(1), 35–46. https://doi.org/10.1111/j.1574-0862.2007.00279.x

Kimenju, S. C. and Groote, H. De. (2008). Consumer willingness to pay for genetically modified food in Kenya. *Agricultural Economics*, *38*, 35–46.

Kwadzo, G. T., Kuwornu, J. K. M. and Amadu, I. S. B. (2013). Food Crop Farmers ' Willingness to Participate in Market-Based Crop Insurance Scheme : Evidence from Ghana. *Research in Applied Economics*, *5*(1), 1–21.

Larochelle, C. and Alwang, J. (2015). Impacts of improved bean varieties on food security in Rwanda. *Crop Improvement, Adoption, and Impact of Improved Varieties in Food Crops in Sub-Saharan Africa*, 314–337.

Larochelle, C., Asare-Marafo, D., Birol, E. and Alwang, J. (2016). *Assessing the Adoption of Improved Bean Varieties in Rwanda and the Role of Varietal Attributes in Adoption Decisions*.

Liesivaara, P. and Myyra, S. (2014). Willingness to pay for agricultural crop insurance in the northern EU. *Agricultural Finance Review*, *74*(4), 539–554. https://doi.org/10.1108/AFR-06-2014-0018

Lusk, J. L. and Hudson, D. (2004). Willingness-to-pay estimates and their relevance to agribusiness decision making. *Review of Agricultural Economics*, *26*(2), 152–169. https://doi.org/10.1111/j.1467-9353.2004.00168.x

Mahul, O., and Stutley, C. (2010). *Government Support to agricultural insurance: Challenges and Options for Developing Countries*. Washington, D.C.: The World Bank. https://doi.org/10.1596/978-0-8213-8217-2

Manski, C. F. (1977). The structure of random utility models introduction. *D. Reidel Publishing Company, Dordrecht-Holland*, *8*, 229–254.

Martinsson, P., Alpizar, F., and Carlsson, F. (2001). Using Choice Experiments for Non-Market Valuation. *Göteborg University*, 1–37.

McCarthy, N. (2003). Demand for Rainfall-Index Based Insurance : a Case Study From Morocco. *International Food Policy Research Institute*.

MINAGRI. (2009). *National Agricultural Extension Strategy*.

MINAGRI. (2012). *Farm Land Use Consolidation in Rwanda*.

MINECOFIN. (2000). *Republic of Rwanda, Ministry of Finance and Economic Planning*.

Mojarradi, G. R., Zamani, G. H., and Zarafshani, K. (2008). Analysis of Factors Influencing Farmers' Attitude Toward Private Crop Insurer Using Path Analysis, 247–252.

Mukarugwiza, E. (2010). *The hope for rural transformation: A rejuvenating cooperative movement in Rwanda*. *International Organization*. Retrieved from http://www.ilo.org/public/english/employment/ent/coop/africa/info/publ.htm

Nahvi, A., Kohansal, M. R., Ghorbani, M., and Shahnoushi, N. (2014). Factors affecting rice farmers to participate in agricultural insurance. *Journal of Applied Science and Agriculture*, *9*(4), 1525–1529.

National Institute of Statistics of Rwanda (NISR). (2012). *Access to Finance*.

National Institute of Statistics of Rwanda (NISR). (2014). *Fourth Population and Housing Census, Rwanda, 2012*. https://doi.org/10.1017/CBO9781107415324.004

Ngabitsinze, J. C., Mukashema, A., Ikirezi, M. and Niyitanga, F. (2011). *Planning and costing adaptation of perennial crop systems to climate change : Coffee and banana in Rwanda Case study report*. *Report-NUR*.

Ngango, J., Nkurunziza, F., & Ndagijimana, J. (2022). Assessing rural farmers' willingness to pay for crop insurance scheme: Evidence from Rwanda. Cogent Economics & Finance, 10(1), 2104780.

NISR. (2010). *National Agricultural Survey 2008*. *World* (Vol. 2008).

Niyuhire, M., Pypers, P., Vanlauwe, B., and Nziguheba, G. (2017). Profitability of diammonium phosphate use in bush and climbing bean- maize rotations in smallholder farms of Central Burundi. *Field Crops Research*, *212*(June), 52–60. https://doi.org/10.1016/j.fcr.2017.06.024

Nnadi, F. N., Chikaire, J., Echetama, J. A., Ihenacho, R. A. and Umunnakwe, P. C. (2013).

Agricultural insurance : A strategic tool for climate change adaptation in the agricultural sector. *Net Journal of Agricultural Science*, *1*(March), 1–9.

Ntukamazina, N., Onwonga, R. N., Sommer, R., Claude, J., Mukankusi, C. M., Mburu, J. and Kariuki, R. (2017). Index-based agricultural insurance products : challenges , opportunities and prospects for uptake in sub-Sahara Africa. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, *118*(2), 171–185.

Ntukamazina, N., Onwonga, R. N., Sommer, R., Mukankusi, C. M., Mburu, J., Rubyogo, J. C. and Phaseolus, L. (2017). Effect of excessive and minimal soil moisture stress on agronomic performance of bush and climbing bean (Phaseolus vulgaris L .). *Cogent Food and Agriculture*, *35*(1). https://doi.org/10.1080/23311932.2017.1373414

Ogunniyi, L. T., Sanusi, W. A. and Ezekiel, A. A. (2011). Determinants of rural household willingness to pay for safe water in Kwara State , Nigeria. *International Journal of the Bioflux Society*, *4*(5), 660–669.

Ohnson, T. H. G. J. (2000). *The rural economy*. *Review Literature And Arts Of The Americas* (Vol. 24).

One Acre Fund. (2017). *2016 Annual Impact : Country Report*.

Oparinde, A., Murekzi, A., Birol, E. and Katsvairo, L. (2017). *Demand-Pull Creation, Public Officer's Endorsement, and Consumer Willingness- to-Pay for Nutritious Iron Beans in Rural and Urban Rwanda*.

Opole, R., Mathenge, P., Auma, E. O. and Wambugu, P. (2005). On-farm seed storage of common bean in Western Kenya, *7*(December), 1175–1178.

Owusu, V., Abdulai, A., & Ali, W. (2022). Preferences for crop insurance attributes among cocoa farmers in Ghana. Journal of Agribusiness in Developing and Emerging Economies, 12(5), 849-867.

Patrick, G. F. (1988). Mallee wheat farmers' demand for crop and rainfall insurance. *Australian Journal of Agricultural Economics*, *32*(1), 37–49.

Pinsonneault, A. and Kraemer, K. L. (1993). Survey research methodology in management information systems: An assessment. *Center for Research on Information Technology and Organizations UC Irvine*.

Qaim, M. and Janvry, A. De. (2003). Genetically modified crops , corporate pricing strategies , and farmers ' adoption : the case of bt cotton in a rgentina. *American Journal of Agricultural*

Economics, *85*(November), 814–828.

Quagrainie, K. (2006). IQF catfish retail pack: A study of consumers' willingness to pay. *International Food and Agribusiness Management Review*, *9*(2), 75–87.

Rivera, W. M. and Zijp, W. (2002). Contracting for Agricultural Extension: Interna- tional Case Studies and Emerging Practices. https://doi.org/10.1016/S0169-5150(03)00023-9

Rob Fraser. (1992). AN ANALYSIS OF WILLINGNESS-TO-PAY FOR CROP INSURANCE. *Australian Journal of Agricultural Economics*, *36*(1), 83–95.

Ruto, E. and Garrod, G. (2009). Investigating farmers â€™ preferences for the design of agri-environment schemes : a choice experiment approach. *Journal of Environmental Planning and Management*, *52*(5), 631–647.

Sadati, S. A., Ghobadi, F. R., Sadati, S. A., Mohamadi, Y., Sharifi, O., and Asakereh, A. (2010). Survey of effective factors on adoption of crop insurance among farmers: A case study of Behbahan County. *African Journal of Agricultural Research*, *5*(16), 2237–2242. abstract/B1BCE4B39597

Sarris, A., Karfakis, P. and Christiaenseren, L. (2006). Producer demand and welfare benefits of rainfall insurance in Tanzania, (18).

Sathya, T. and Sekar, C. (2012). Mangrove Eco-system And their Multifunctionalities: An Analysis of the Provision of Economic and Environmental livelihoods to the Fishermen Communities in the South-East Coast of India.

Sibiko, K. W. (2016). *Economics of Weather Index-Based Insurance : Analysis of Smallholder Farmers ' Preferences and the Impact of Insurance on Productivity in Kenya*.

Smith, V. H. and Baquet, A. E. (1996). The Demand for Multiple Peril Crop Insurance : Evidence from Montana. *American Journal of Agricultural Economics*, *78*(February), 189–201.

Smith, V. H. and Glauber, J. W. (2012). Agricultural insurance in developed countries: Where have we been and where are we going? *Applied Economic Perspectives and Policy*, *34*(3), 363–390. https://doi.org/10.1093/aepp/pps029

Smith, V. H. and Goodwin, B. K. (1996). Crop Insurance , Moral Hazard , and Agricultural Chemical Use. *American Journal of Agricultural Economics*, *78*(May), 428–438.

The Institute of Policy Analysis and Research (IPAR- Rwanda). (2015). *Annual A nalysis of Rwanda ' s Agriculture Budget Expenditure 2015-2016*.

Train, K. (2002). Discrete Choice Methods with Simulation.

Trang, N. M. (2013). *Willingness to Pay for Area Yield Index Insurance of Rice Farmers in the Mekong Delta , Vietnam*.

Venkatachalam, L. (2004). The contingent valuation method: A review. *Environmental Impact Assessment Review*, *24*(1), 89–124. https://doi.org/10.1016/S0195-9255(03)00138-0

Verhofstadt, E. and Maertens, M. (2015). Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda. *Applied Economic Perspectives and Policy*, *37*(1), 86–106. https://doi.org/10.1093/aepp/ppu021

Wairimu, E., Obare, G. and Odendo, M. (2016). Factors affecting weather index-based crop insurance in Laikipia County , Kenya. *Journal of Agricultural Extension and Rural Development*, *8*(7), 111–121.

Wattage, P. (2001). A targeted literature review - contingent valuation method. *Centre for the Economics and Management of Aquatic Resources (CEMARE), Department of Economics, University of Portsmouth*, (August).

Willis, K. G. (2002). Iterative Bid Design in Contingent Valuation and the Estimation of the Revenue Maximising Price for a Cultural Good. *Journal of Cultural Economics*, *26*(4), 307–324.

World Bank. (2008). *Agriculture Development*. *Agriculture* (Vol. 54). https://doi.org/10.1596/978-0-8213-7233-3

World Bank. (2011). Weather index insurance for agriculture: guidance for development practitioners. *Agriculture and Rural Development Discussion Paper*, (50), 116.

Yakubu, B., Buadu, L. W., Joy, B. and Richard, Y. N. (2016). Willingness to participate in the market for crop drought index insurance among farmers in Ghana. *African Journal of Agricultural Research*, *11*(14), 1257–1265. https://doi.org/10.5897/AJAR2015.10326

FARMERS' WILLINGNESS TO PAY FOR BEANS INDEX-BASED INSURANCE PRODUCTS IN HUYE DISTRICT, RWANDA

Questionnaire (01-06-2017)

WILLINGNESS OF FARMERS TO PAY FOR INDEX-BASED INSURANCE PRODUCTS FOR BEANS IN HUYE DISTRICT, RWANDA

==========SURVEY QUESTIONNAIRE==========

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A: GENERAL INFORMATION

0. Identification of respondent

	Date of interview: /___/___/ 2017
Name of Respondent: _	Questionnaire ID: /_ _ _ _ _/
Individual number: /_ _ _ _ _/	Enumerator: _ _ _ _ _ _ _ _ _ _ _ _
Country : _ _ _ _ _ _ _ _ _ _ Province: _ _ _ _ _ _ _District: _ _ _ _ _ _ _ _	
Sector : _ _ _ _ _ _ _ _ _ _ Cell: _ _ _ _ _ __ _ _ _ Village:_ _ _ _ _ _ _ _ _	
Gender: /___/ (1. Male, 2. Female)	
Type of household /___/ (1. Male headed household; 2. Female headed household;	
Are you a household head? /___/ (1. Yes, 2. No)	

I. Household characteristics

1. Please provide the number of your household members /___/ and their details as indicated bellow

Members of the household	Age / Year of birth	Gender 1.Male 2.Female	Relationship with household head (codes below)	The highest level of education attended (in years)	Primary occupation (codes below)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
Codes for relationship with house hold head: 1. Head; 2. Spouse; 3. Son; 4. Daughter; 5. Stepchild; 6. Brother; 7. Sister; 8. Nephew/niece; 9. Son/daughter-in-law; 10. Grandchild; 12. Worker, 13. Parent, 14. Father/mother-in-law					
Codes for primary occupation: 1. Farmer; 2. Salary worker; 3. Self-employer (business), 4. Casual labour, 5. Student, 6. None, 7.Other, specify …….					

2. How big/large is your arable land (in m^2)?					/___/
	1st	2nd	3rd		

3. What is the estimated area devoted to bean production for the last three bean growing season (in m^2)?	/__ _/	/__ _/	/___/		
4. What is your experience in farming activities (in years)					/___/
5. What is your primary enterprise in regard to bean production? [codes below]					/___/
1. Grain production 2. Seeds production 3. Grain and seeds production 4. Others, specify _ _ _ _ _ _ _ _ _ _					
6. Have you ever applied for a loan over the last 12 months? (1.[Yes], 2.[No]					/___/
If yes, do you usually receive it in cash or in kind? 1. [cash] 2. [Kind] 3. [other, specify]					/___/
7. What did you use that money for? Three main reasons [codes below]				1. /___/ 2. /___/ 3./___/	
1.[buying food] 2.[buying agricultural inputs] 3.[buying assets] 4.[school fees] 5.[medical] 6.[other, specify]					
8. Are you a member of any development group like farmers cooperatives? (1=Yes; 2=No)					/___/
9. If yes, which one? [codes below]					/___/
1.[farmers cooperative] 2.[credit and saving cooperative] 3.[cooperative union] 4.[other, specify_ _ _ _ _ _ _ _]					
10. Have you ever met an agricultural extension agent? 1.[yes] 2.[no]					/___/
11. If yes, how many times in a year?					/___/
12. Where do you usually get agricultural information?					/___/
1.[radio] 2.[tv] 3.[internet] 4.[newspaper] 5.[mobile phone] 6.[extension service] 7.[farmer groups] 8.[other, specify, _ _ _ _ _ _ _ _ _ _]					
13. Is the information relevant to you and helped you to improve in your farming activities? 1.[yes] 2.[no]					/___/

14. What are the three main crops grown on your farm?			
Crops	Area	Unit area (m2)	Main use (codes below)
Crop 1.			/___/

Crop 2.			/___/
Crop 3.			/___/
1: Home consumption , 2: Supply grains at market, 3: Both food and market, 4: Selling bean seed			

15. What are the main constraints do you face in crop production (for the three main crops indicated above) and how do you address them		
Crops	Constraints	How addressed
Crop 1.		
Crop 2.		
Crop 3.		

16. Is the following your main sources of the household income? (1: Yes, 2: No)			
Crop sales (specify)_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	/___/	Remittances	/___/
Small business	/___/	Pension	/___/
Artisan	/___/	Wages	/___/
Sale of livestock and livestock products	/___/	Salary from employment	/___/
Casual labour	/___/	Others, specify…….	/___/

II. Common bean production

17. Which bean type (bush, climbing) is commonly grown in the area?	/___/
1. Bush bean only 2. Climbing bean only 3. Both bush and climbing beans	
18. Which one (bean type) do you grow often? (codes below)	/___/
1. Bush bean only 2. Climbing bean only 3. Both bush and climbing beans	

19. Why do you prefer to grow climbing/bush bean?		/___/
1. Seeds available 2. High yields 3. Ideal to weather conditions 4. Well marketable 5. Easy to grow, 6. Lack of staking materials, 7. Insufficient arable land		
20. Why don't you grow climbing/bush beans? (choose the most important reason)	Climbing	/___/
	Bush	/___/
1. Seeds not available 2. Low yielding 3. Inappropriate to the area 4. Unfavorable weather conditions 5. Vulnerable to pests and diseases 6. Lack of staking materials, 7. Insufficient arable land		

21. What is your main reason of growing bush/climbing beans? (choose the most important reason)	Climbing		/___/
	Bush		/___/
1. Food for family 2. Grain market supply 3. Seed supply 4. Others (specify)_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _			
22. What are the three main sources of bean seeds used for planting (start with the most important)?	1st	2nd	3rd
	/___/	/___/	/___/
1. Home saved, own stock 2. Local market 3. Neighbor agro-dealer 4. Gift 5. Exchange 6. Seed company 7. Seed aid 8. Extension/Research 9. Tubura, 10. NGO/Development 11. Others (specify)_ _ _ _ _ _ _ _			

23. What are the three main bean varieties and consistently grown on your farm (provide reasons)?	
Climbing/ Bush bean variety	*Reason of growing the variety*
Variety 1. _ _ _ _ _ _ _ _ _ _ _ _	1. _

Variety 2. _ _ _ _ _ _ _ _ _ _ _ _	2. _
Variety 3. _ _ _ _ _ _ _ _ _ _ _ _	3. _

24. Which cropping system do you use most to grow climbing/bush beans?		
1. Monoculture 2. Monoculture with agronomic practices 3. Intercropping/Mixed system 4. Intercropping with agronomic practices 5. Hedge 6. Crop rotation 7. Others (specify)_ _ _ _ _ _ _ _ _ _ _ _		
25. In case of intercropping with which crops do you intercrop beans? 1)_ _2) _3) _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _		
26. In case of rotation, which bean based rotation system do you use on your farm? _		
27. Which/what is the main preference season for growing climbing/bush beans in this locality?		
1.Season A (sept-Jan) 2.Season B (feb-may) 3.Season C (jun-aug)		

28. In case of excess rains, which plant growth stage is the most critical for crop failure? (choose one stage) /___/					
1. Planting	2.Emergence	3.Vegetative	4.Flowering	5.Pod formation	6.Maturation
29. In case of drought, which plant growth stage is the most critical for crop failure? (choose one stage) /___/					
1.Planting	2.Emergence	3.Vegetative	4.Flowering	4.Pod formation	5.Maturation

30. Do you use fertilizers on your bean production plots?	1. Yes ☐	2. No ☐
31. If YES, what types of fertilizers do you use for bean production, when are they applied during normal season?		

Names of fertilizers	Time of input application (days after sawing) [Codes below] 1. Planting 2. Top dressing/before flowering
Fertilizer 1.	/___/
Fertilizer 2.	/___/
Fertilizer 3.	/___/
Fertilizer 4.	/___/

32. Do you use chemicals (pesticides) on your bean production plots?	1. Yes ☐	2. No ☐

33. If YES, what types of pesticides do you use for bean production, when are they applied during normal season?

Names of pesticides	Time of input application (days after sawing)
Pesticide 1.	
Pesticide 2.	
Pesticide 3.	
Pesticide 4.	

34. How do farmers in this locality (including you) normally access to fertilizers? /___/

1. Do not buy inputs at all, 2. Own finances, 3. Money lenders, 4. Inputs loans 5. Others (specify)_ _ _ _ _

35. How do farmers in this locality (including yourself) normally access to pesticides? /___/

1. Do not buy inputs at all, 2. Own finances, 3. Money lenders, 4. Inputs loans 5. Others (specify)_ _ _ _ _

36. For the last three cropping seasons estimate the grain yields of climbing/bush beans

	Year 2016		Year 2017
	2016A	2016B	2017A
Size of land			

Unit (m^2)			
Quantity produced			
Unit			

37. What is the main reason of this (ascendant/descendant) bean production trend? (codes below)	/__ _/
1. Soil fertility, 2. Pest and diseases, 3. Agronomic practices, 4. Weather stresses 5. Others (specify)_ _	

III. Knowledge on weather related risks

38. Do farmers in this locality (including yourself) face any risks in bean production?	1.Yes☐	2.No☐	
39. If the answer is YES, what are the three most important risks for bean production in the area (please list in order of importance)?	1st risk	2nd risk	3rd risk
	/___/	/___/	/___/
1. Pests and diseases, 2. Weather stresses, 3. Access to inputs, 4. Improved seeds, 5. Poor agronomic practices, 6. Others (specify)_ _ _ _ _ _ _ _ _ _ _ _			
40. What is the specific weather risk that bean production is facing? (Please list in order of importance)?	1st risk	2nd risk	3rd risk
	/___/	/___/	/___/
1. Deficit rains, 2. Drought, 3. Excess rains, 4. Floods, 5. Others (specify)_ _ _ _ _ _ _ _ _ _ _			

41. How do farmers (including yourself) handle these weather challenges in regard to bean production
1. _
2. _
3. _

B: EXISTING KNOWLEDGE ON BEAN INSURANCE PRODUCT

IV. Use of index-based insurance products on common bean

42. Have you ever heard **about agricultural** (crop or livestock) insurance?	1. Yes ☐	2. No ☐
If the answer is NO, go to the section V 43. If the answer is YES, how did you get information on the **agricultural insurance (codes)**?		/___/ /___/ /___/
1) Radio and television, 2) Relatives and friends and neighbor farmers, 3) Government extension agents, 4) insurance company's promotion, 5) out to work , 5) education, 6) others, specify - - - - - - - - - - -		
44. After hearing about **agricultural insurance**; did you buy/adopt an insurance contract?	1. Yes ☐	2. No ☐
If the answer is NO, go to the question 74, section V If the answer is YES, go to the next question		

45. Did you use/adopt after hearing about agricultural insurance for **bean crop**?	1. Yes ☐	2. No ☐
If the answer is NO, go to the question 74, section V 46. If the answer is YES, who sold the insurance product to you (codes below)? /___/ and when (year)? _ _ _ _ _ _		
1. Kirimo Salama, 2. TUBURA/ACRE, 3. UAP insurance company, 4. Farmers' organizations, 5. Insurance microfinance/Bank, 6. Others (specify)_ _ _ _ _ _ _ _ _ _ _ _ _ _		

47. Why did you buy the insurance contract from that organization?(select the most important reason)
1. Premium affordable, 2. Easy access to their products, 3. No other insurer in the area for beans, 4. Easy mode of premium payment, 5. Others (specify)_ _ _ _ _ _ _ _ _ _ _ _ _ _

48.		
49.		
50.		

51. Which bean type (climbing or bush) have you purchased an insurance contract for?	/___/
1. Bush bean only 2. Climbing bean only 3. Both bush and climbing beans	
52. Why did you consider insuring your bean crop? (start with the most important reasons)	
1_ 2_ 3_ _	
53. What is the mode of delivery of insurance contract?	/___/
1. [Buy seeds with insurance], 2. [Buy fertilizer with insurance], 3. [Buy both (seed & fertilizer) with insurance], 4. [Other, specify] ………………………………..	
54. What is the mode of payment of the insurance contract?	/___/
1. [Direct purchase of the contract] 2.[loan of the contract] 3.[other, specify]	
55. Are you satisfied with the mode of delivery of the insurance service?	/___/
1.[very satisfied] 2.[somehow satisfied] 3.[neutral] 4.[somehow not satisfied] 5.[not satisfied at all]	

56. How important are the following to you in the current insurance program? (1: Very important; 2. Somehow important, 3. Neutral, 3. Somehow not important, 4. Not important at all)	
Credibility (faithfulness) of providers	/___/
Information flow	/___/
Adequate compensation by providers	/___/
Speed timeliness	/___/
Other (specify)	/___/

57. What are the most important climate related risks covered by the bean insurance contract you purchased? (start with the most important)	/___/ /___/ /___/
1. Deficit rains, 2. Drought, 3. Excess rains, 4. Floods, 5. Diseases, 6. Temperature, 7. Others (specify)_ _ _ _ _ _ _ _ _ _ _ _ _	

58. What are other climatic related risks that you could suggest to be included in the bean insurance contract (start with the most important)?	1st /___/	2nd /___/	3rd /___/
1.[Deficit rains] 2.[Drought] 3.[Excess rains] 4.[Floods] 5.[Diseases] 6.[Temperature] 7.[other, specify]			

59. Do you know other crop insurance companies that are active in your neighborhood?	1.Yes ☐	2.No ☐
If yes provide names of the companies		
1.		
2.		
3.		

60. How do you appreciate the service provided by TUBURA while delivering the bean insurance [codes below]	/___/

(1 = very important, 2= somehow important, 3= neutral, 4= somehow not important, 5= not important at all)	

61. Have you ever been compensated for bean production losses due to weather related risks? If Yes, provide details on the following

Season	Insurance name	Insured peril	Area planted by beans (m2)	Total premium paid (Rwf)	Amount lost (kg)	Payout received (Rwf)

62. Did you receive the payout on time without delay?	63. 1.Yes ☐	2.No ☐
64. What can the insurance company (ACRE) do to improve the bean insurance product?	Leave this column empty for survey data cleaning	
1._____ _____ 2._____ _____ 3. _____ _____	_____ __ _____ __ _____ __	

65. Will you continue to insure your bean crop and sensitize others to do so?	1.Yes ☐	2.No ☐

66. If YES, what are the three most things do you appreciate from the insurance products you have?	Leave this column empty for survey data cleaning
1. _	_ _ _ _ _ _ _ _ _ _ _ _ _ _
2. _	_ _ _ _ _ _ _ _ _ _ _ _ _ _
3. _	_ _ _ _ _ _ _ _ _ _ _ _ _ _

Please provide your opinions on the following:	
67. Bean crop insurance is an important risk management tool in crop production	/___/
68. Bean crop insurance provides good assurance against crop failures	/___/
69. Bean crop insurance is not relevant due to low yield	/___/
70. Bean crop insurance is not relevant due to unpredictable weather conditions	/___/
1. Strongly agree; 2. Somehow agree; 3. Neutral; 4. Somehow disagree; 5. Not disagree at all.	

71. Did the insurance contract you bought motivate you to increase bean production?	1.Yes☐	2.No☐
72. If YES, have you increased your bean supply?	1.Yes☐	2.No☐
73. And how [codes below]?		/___/
1. Selling at local market, 2. Selling at district market, 3. Selling at national market, 4. Exportation, 5. Other, specify_ _ _ _ _		

V. Views and perspective of uninsured bean farmers on bean insurance

	1st	2nd	3rd

74. Why are you not yet purchasing bean insurance contract? (Please select and list in order of importance)?	/___/	/___/	/___/
1. Not afford the premium, 2. Low compensation, 3. Complex claim settlement procedures, 4. Disbelieve insurance companies, 5. Insurance is unlucky, 6. People around do not buy, 7. Do not know where to buy, 8. Others (specify) …….. …….. …….. …….. …….. …….. …….. ……..……..……..…			

75. Do you know other farmer who has insured bean in your neighborhood?	1.Yes☐	2.No☐
If the answer is YES, continue to the following questions		

76. Do they tell you about the advantages of insuring bean crop?	1.Ye☐	2.No ☐
77. If yes, how has that information helped you?	Leave this column empty for survey data cleaning	
Help 1. _	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	
Help 2. _	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	
Help 3. _	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	

C. ITERATIVE BIDDING GAME FOR ELICITING WILLINGNESS TO PAY FOR BEAN GROWTH STAGES INSURANCE PRODUCTS

VI. Willingness of farmers to pay for specific bean growth stages insurance products (hypothetical scenarios)

78. What type of common bean (Bush or climbing) would you like to insure? /___/	
1. Bush, 2.Climbing	
79. Suppose an insurance company is selling an insurance product aiming at covering drought conditions that may happen at a **selected plant growth stage**; what is the **most** critical plant growth stage would you like to be covered by the contract ? /___/	
1. Emergence, 2.Vegetative, 3. Flowering, 4. Pod development, 5. Maturing, 6. All stages (full cover)	
What is the problem with this stage?	Leave this column for survey data cleaning
1…… ……	…… ……..
2…… ……	…… ……...

80. If an insurance company has an insurance product for that particular stage and it has been assessed you can pay the insurance through inputs (MAC44, RWR2245, DAP, Urea) charged a particular premium, will you be willing to be contracted?	1.Yes☐	2.No☐
If the answer is NO go to the last question		
If the answer is YES, use the iterative bidding game to estimate the maximum amount that a farmer can pay to cover the selected plant growth stage.		

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Inputs (5kg packet)	Unit cost with no insurance	Initial bids for specific growth stages insurance products (Rwf)

		Emergence	Vegetative	Flowering	Pod devpnt	Maturing
MAC44 (climbing)	3,625	120	110	290	500	110
RWR2245 (bush)	3,125	100	95	250	430	95
DAP (fertilizer)	2,050	65	60	165	280	60
Urea (fertilizer)	1,625	55	50	130	225	50

IB+10%IB

	Emergence	Vegetative	Flowering	Pod devpnt	Maturing
3625	130	120	320	550	120
3125	110	105	275	475	105
2050	70	65	180	310	65
1625	60	55	145	250	55

IB+20%IB

	Emergence	Vegetative	Flowering	Pod devpnt	Maturing
3625	145	130	350	600	130
3125	120	115	300	515	115
2050	80	70	1200	335	70
1625	65	60	155	270	60

IB+30%IB

	Emergence	Vegetative	Flowering	Pod devpnt	Maturing
3625	150	145	375	650	145
3125	130	125	325	560	125
2050	85	78	215	365	80

1625	70	65	170	295	65

IB-10%IB

	Emergence	Vegetative	Flowering	Pod devpnt	Maturing
3625	110	100	260	450	100
3125	90	85	225	385	85
2050	60	55	150	250	55
1625	50	45	115	205	45

IB-20%IB

	Emergence	Vegetative	Flowering	Pod devpnt	Maturing
3625	95	90	230	400	90
3125	80	75	200	345	75
2050	50	50	130	225	50
1625	45	40	105	180	40

IB-30%IB

	Emergence	Vegetative	Flowering	Pod devpnt	Maturing
3625	85	75	205	350	75
3125	70	65	175	300	65
2050	45	40	115	195	40
1625	40	35	90	160	35

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WTP for insured 5 kg of MAC 44		
81. An insurance company is proposing an insurance contract covering drought conditions at …….. stage, will you be willing to buy the insurance contract at ……Rwf?	1.Yes☐	2.No☐

If the answer is yes, increase the insurance cost by 10%, 20%, 30%, etc… until the respondent reaches the highest amount he/she is willing to pay for that insurance product. Record this amount.	...……Rwf
If the answer is no, decrease the insurance cost by 10%, 20%, 30% etc… until the respondent reaches the lowest amount he/she is willing to pay for that insurance product. Record this amount.	...…… Rwf

WTP for insured 5 kg of RWR2245		
82. An insurance company is proposing an insurance contract covering drought conditions at ……. stage, will you be willing to buy the insurance contract at ……Rwf?	1.Yes☐	2.No☐
If the answer is yes, increase the insurance cost by 10%, 20%, 30%, etc… until the respondent reaches the highest amount he/she is willing to pay for that insurance product. Record this amount.		...……Rwf
If the answer is no, decrease the insurance cost by 10%, 20%, 30% etc… until the respondent reaches the lowest amount he/she is willing to pay for that insurance product. Record this amount.		...……Rwf

WTP for insured 5 kg of DAP		
83. An insurance company is proposing an insurance contract covering drought conditions at …….. stage, will you be willing to buy the insurance contract at ……Rwf?	1.Yes☐	2.No☐
If the answer is yes, increase the insurance cost by 10%, 20%, 30%, etc… until the respondent reaches the highest amount he/she is willing to pay for that insurance product. Record this amount.		...…… Rwf
If the answer is no, decrease the insurance cost by 10%, 20%, 30% etc… until the respondent reaches the lowest amount he/she is willing to pay for that insurance product. Record this amount.		...…… Rwf

WTP for insured 5 kg of Urea

An insurance company is proposing an insurance contract covering drought conditions at …….. stage, will you be willing to buy the insurance contract at ……Rwf?	1.Yes☐	2.No☐
If the answer is yes, increase the insurance cost by 10%, 20%, 30%, etc… until the respondent reaches the highest amount he/she is willing to pay for that insurance product. Record this amount.	...…… Rwf	
If the answer is no, decrease the insurance cost by 10%, 20%, 30% etc… until the respondent reaches the lowest amount he/she is willing to pay for that insurance product. Record this amount.	...…… Rwf	

84. If you are not willing to pay any amount what are the reasons? (Please select and list in order of importance)?	1st /___/	2nd /___/	3rd /___/
1. Not afford the premium, 2. Not interested to this product, 3.Low compensation, 4. Complex claim settlement procedures, 5. No trust to insurance companies, 6. Insurance is unlucky, 7. People around do not buy, 8. Do not know where to buy, 9. Others (specify) …….. …….. …….. …….. …….. …….. …….. ……..……..……..…			

Thank you so much for your time