Factors for Crop Insurance Uptake among Smallholder Maize Farmers: A Case Study of Njombe Region in Tanzania

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ABSTRACT

The aim of this study was to examine various factors that determine small-holder farmers' decisions towards adopting crop insurance schemes in their agricultural production activities.

The study adopted a cross-sectional survey research design using quantitative approaches to determine the factors influencing demand for crop insurance. Data was obtained through a structured questionnaire administered to 384 respondents. The collected data was analysed using STATA and MS-EXCEL software to determine descriptive statistics and validate the model used.

Based on the study's results, there was a strong correlation between independent variables such as land ownership, size, on-farm revenue, farmer organisations or groups, marital status (single) and years of experience with production risks. The decision to use crop insurance was influenced by socio-economic factors such as marital status and low levels of literacy. Crop diversification and the application of excellent agricultural methods undoubtedly had an impact on the acceptance of crop insurance, although crop insurance appeared to be more biased against women among the subscribers' group. Also, access to finance had a positive correlation with crop insurance.

Nevertheless, the overall findings indicate that a significant number of farmers do not fully comprehend the insurance concept. Furthermore, the study recommends providing targeted awareness and sensitization on the risks associated with crop farming and the tools available for hedging production risks. The provision of crop insurance should look into several factors that may affect farmers' decisions to the uptake of crop insurance, whilst the Government should encourage more formal agricultural lending by participating financial institutions.

1.0 INTRODUCTION

The agriculture sector in Tanzania is understood as a major employer of more than 65.3 percent of the population, along with its related value chains (NBS, 2021). On average, the sector contributes about 29.1 per cent of the Gross Domestic Product (The Economic Survey, 2017). The Tanzania Development Vision 2025 envisages transforming the economy from a predominantly agricultural one with low productivity, to a diversified economy with a modern rural sector and high productivity in agricultural production, which generates high incomes and ensures food security and food self-sufficiency (President's Office Planning Commission, 2009). Despite its importance, the sector is Characterised by low productivity and has continued to grow at an average growth rate of 4.3% for the 2000–2012 period (The Economic Survey, 2014). A couple of challenges face the agriculture sector, including its dependency on rainfall, making it acutely vulnerable to weather changes, effects of which have been cited as the most damaging production risk (Arce and Caballero, 2015). In addition, farmers in Tanzania experience other production risks, such as diseases and pests; market risks; enabling environment; and logistic disruptions in the supply chains, which cause huge losses and damage to the livelihoods and annual income of farmers (Arce and Caballero, 2015). (Arce and Caballero, 2015), reported that, the value of the average annual production losses in the Tanzanian agricultural sector is estimated to be approximately US$ 203 million, or 3.5 percent of agricultural GDP, as a result of unmanaged production risks. With the numerous risks involved in agriculture production, farmers have developed their own traditional ways of dealing with risks. These involve a combination of risk mitigation, risk transfer and risk coping instruments, such as crop or income diversification, use of drought resistant varieties and reduced input application (Sarris, 2002) . Recent study (e.g., Hazell & Skees, 2005; Nnadi *et al*., 2013), reveals that traditional risk minimization strategies are unfavourable and cannot adequately absorb the economic shocks that keep farmers in a poverty trap.

Crop insurance plays an important role in hedging against weather and other crop loss risks in agriculture (FAO, 2015; Abdullah *et al*., 2014; Arce, 2015; Aimin, 2010). FAO (1992), defines crop insurance as 'an instrument that provides protection against loss or damage to growing crops against specified or multiple perils, for example hail, windstorm, fire and floods.' A well-designed crop insurance can help: (1) transfer risk to a third-party, in this case an insurer, thereby eliminating fear of risk and encourage investment, and (2) spread covariate risks, for example drought and disease outbreaks across a wider geographical region by pooling risks that individual farmers nor the local risk sharing initiatives like farmer groups or cooperative are incapable (Njue *et al*., 2018).

Smallholder farmers must deal with these vulnerabilities, which often undermine their household food and income security. To transform agriculture, agriculture risk management must be addressed, as many other sectors of the economy are linked to

agriculture. Crop insurance as a formal risk management tool, is increasingly being advocated as a measure to shield farmers against production risks (Abdullah *et al*., 2014; Arce and Caballero, 2015; FAO, 2015).

For over a decade, smallholder farmers have been sensitized on the benefits of crop insurance, though uptake has remained low, at single digit percentages. In addressing the challenge for low uptake of crop insurance, this report seeks to quantify the determinants of crop insurance uptake by smallholder farmers. The argument put forward is that agriculture is highly prone to vulnerabilities, such as weather, pests, and diseases. Efforts to bundle insurance with other products have seen some positive and interesting results but have not pushed the uptake of crop insurance to double digits. This implies that there are other important factors that are driving the uptake of crop insurance. For the second question, the author aims to understand if there are any stark differences between the two groups, those that subscribe and those that do not subscribe to insurance. The aim here is to understand those differences and how they play a role in determining the factors for crop insurance uptake.

1.1 Statement of the Problem

Agriculture is known to be a high-risk sector, and while it employs majority of the population, production risks have had a significant impact on the livelihoods of value chain actors. Crop insurance as a formal risk management tool is increasingly becoming an important policy tool for sustainably transforming agriculture, by protecting farmers against vulnerabilities and enhancing household resilience against production risks. Despite this knowledge and technological advancements to reduce transaction costs, farmers' uptake of crop insurance has remained low.

Therefore, this study seeks to examine factors that determine smallholder farmers' decisions towards adopting crop insurance schemes in their agricultural production activities.

1.2 General Objective

The main objective of this study is to examine factors for uptake of crop insurance among small-holder maize farmers.

1.2.1 Specific Objectives

i. To assess socioeconomic characteristics among participants and non-participants of crop insurance.
ii. To examine factors that determine smallholder farmers' decisions to the uptake of crop insurance.

1.2.2 Research Questions

i. What are the socioeconomic differences between participants and non-participants of crop insurance?
ii. What factors determine smallholder farmers' decisions to the uptake of crop insurance?

1.2.3 Significance of the Study and Contribution to Knowledge

This study will provide important information and knowledge on how smallholder farmers make economic decisions under risk, which is vital in determining factors for the uptake of crop insurance. Additionally, problematic areas in the insurance schemes could be identified and necessary measures taken to rectify the situation. On the other hand, the study is timely and goes hand-in-hand with current Government's initiatives in creating insurance awareness and developing a national agriculture insurance scheme, which aims to promote and provide affordable crop insurance to the wider population, particularly smallholder farmers.

2.0 LITERATURE REVIEW

2.1 Crop Insurance

Generally, crop insurance was initialised in Western Europe, specifically Germany, in the 1700s, to cater against hail (Smith and Glauber, 2012). Later, the program was adopted in other European countries as well as North America in the 1800s. Currently, crop insurance is well advanced in developed countries like the United States of America (USA), Spain, Canada, Japan, Italy, and France. Globally, developed countries account for about 87 percent of crop insurance cover, while Asia and Latin America account for 3 percent and Africa 2 percent (Roberts, 2005). Crop insurance programs in developed countries are well advanced, due to government support via subsidies and research. Government and private sector support through Public Private Partnership (PPP), has also increased crop insurance coverage to fast-growing economies like Brazil, India, China, Turkey, and South Korea.

Despite crop insurance penetration in Africa, crop insurance premiums are still small, amounting to less than $5 million (Glauber, 2013). Current crop insurance coverage in Tanzania is quite dismal, at 0.02% (Munich Re Foundation, 2016). In terms of agriculture insurance coverage, Tanzania is fairing at less than 0.01%, due to poor performance of other agriculture subsectors, such as livestock, fishery, and forestry. Overall, the country's agriculture insurance coverage is quite small compared to the continent's average of 1.1% and other neighbouring countries such as Kenya (0.38%), Mozambique (0.08%) and Rwanda (1.19%) (Munich Re Foundation, 2016). Equally, crop insurance products are largely absent and underdeveloped, and farmers tend to resort to informal options or self-insurance, via accumulation and depletion of liquid assets, like food stores and livestock (Dercon, 1996, 1998; Senkondo, 2000; Sarris *et al*., 2006; Kahan, 2008; FSDT, 2012). The ongoing basic insurance premiums cover up to 21 days of germination period, at approximately $2-2.5 per 2 kg of maize seeds. This premium price can be more, depending on the length of coverage.

In Tanzania, crop insurance has been tested by numerous pilot and full projects like Tigo Insurance, AGRA, MGEN, NIC and ACRE Africa. Joab and Recha (2019), reported that since 2014 more than 12 pilots and full projects have been undertaken in more than 10 regions, involving various crop types like maize, cassava, beans, sunflower, paddy, and cotton. However, most of these projects have not been scaled up and some failed due to low uptake, attributed to high associated transaction costs, lack of understanding/awareness (perceptions and attitude on risk), low financial literacy, and low demand (TIRA, 2016; Joab and Recha, 2019).

It is also noted by Yang (2010), that crop insurance programs for developed countries cannot work the same for developing countries, largely due to the transaction costs involved, which smallholder rural farmers cannot bear. High transaction costs are a supply challenge that faces majority of crop insurance suppliers in Tanzania. Other

supply-side challenges include unavailability of historical data to adequately calibrate weather stations for weather index insurance and poor distribution channels. With these challenges, and amidst technological advancements, there's a growing interest amongst insurers to cover smallholder farmers. While it took a century for developing countries to design working crop insurance programs like named peril, multi-peril and index-based, its applicability in Tanzania requires a large pool of information in terms of specific farmers' responses to risks and their uptake of crop insurance programs. Demand and subsequent uptake cannot be elevated without expanding farmers' awareness on associated farm risks (Senkondo, 2000; Iqbal *et al*., 2016).

2.2 Information Asymmetry

The inadequacy of sufficient information in any given transactional process is known as information asymmetry. However, the resulting asymmetry in risk assessment in the insurance market presents chances for strategic activity. According to Salanié (2005), the informed party in an insurance contract preserves two crucial private details: (i) concealed information that causes adverse selection, and (ii) hidden activity that creates moral hazard. According to the concept of adverse selection, high-risk parties tend to select more coverage than low-risk parties when their risk level is kept hidden. Moral hazard, on the other hand, addresses parties' shifting behaviour, following a contract (Shettima, 2020).

Since insurance provision decisions and operational production decisions frequently coexist, it can be difficult to distinguish in agriculture between deciding to join insurance programs and changing management practices as a result of participation. As a result, it might be challenging to make an empirical distinction between moral hazard and adverse selection (Quiggin et al., 1993)

2.3 Risk management in the Agriculture Sector

Agriculture is known to be a high-risk sector. While it employs the majority of the population, production risks have had a significant impact on the livelihoods of value chain actors. Increasingly, academic scholars and practitioners have provided alternative classifications of this wide array of agricultural risks.

Risk refers to the set of unique outcomes of a given event, which can be assigned probabilities, and it exists when the decision maker is able to assign probabilities to various outcomes i.e., when a probability distribution is known to him. This can only happen when one has some historical data on the basis of which he assigns probability to other projects of the same nature. *Risk* exists if there is uncertainty about the outcome of an event or an activity. Hardarker *et al*., (2004), consider that the concept of risk analysis is the most important step in the decision-making process that can help to pursue profitable activities. *Uncertainty* refers to the outcomes of a given event, which are too unsure to be assigned probabilities. Uncertainty exists when the decision maker has no historical data from which to develop a probability distribution and must make intelligent guesses to develop a subjective probability distribution. Essentially, uncertainty is a state of doubt about the ability to predict the future outcome of

current actions. Langlois and Cosgel (1993), defined uncertainty as an unknown risk, while risk is a measurable uncertainty.

Risk theory fundamentally predicts how individuals would react in uncertain situations. Using consumer behaviour as the underlying theory of risk, consumers are certain of the outcomes from alternative decisions. However, the choices made by consumers are overwhelmingly subject to uncertainty. The risk theory is also closely associated to the utility theory since it deals with consumer behaviour. Typically, consumers are interested in minimizing costs and maximizing benefits. Given a certain world, a rational consumer aims to maximize utility, and as such will continue their willingness and ability to buy a certain good until the price and marginal utility are in equilibrium. However, under uncertainty, a farmer intuitively has to make the best decision on how best to maximize utility. The decision made will also depend on an individual's appetite for risk and the utility of other variables.

2.4 Risks and Challenges in Maize Farming:

The risks maize farmers face can be divided into two: climatic and non-climatic risks. Climatic risks are weather-related issues, while non-climatic risks are not weather related. Non-climatic risks include difficulties in market access and linkages, as well as challenges in access to credit, while climatic risks include post-harvest losses, floods, droughts and pests and diseases.

The main non-climatic risks and challenges farmers face are:

Difficulties in market access and linkages: Maize farmers have challenges getting market access for their harvest and are affected by price fluctuations, changing government policies and political upheaval. For example, the political issue between Kenya and Tanzania that prompted Kenya to ban maize imports from Tanzania, led to many farmers being unable to sell their produce, which in turn, led to income losses that season.

Challenges in access to credit: It is difficult for many farmers to access credit due to the high interest rates on loans of between 15% and 20%. This forces them to have to finance their agricultural activities directly - over 95% of smallholder farmers have to purchase inputs using their own funds[1]. Due to this, farmers are unable to purchase enough inputs for their farms as they cannot afford them.

Currently Tanzania has an agricultural financing initiative, which is aimed at increasing the farmers' access to credit. This initiative provides commercial banks with guaranteed schemes to encourage them to provide farmers with credit. But this too comes at a high cost, with about 9%-12% interest rate. As a government support to farmers, banks have slowly started reducing interested rates to below 10% and CRDB Bank has been the main champion, with 9% interest for farm loans to farmers.

[1] https://www.raflearning.org/file/1308/download?token=_yFtRUo7

The main climate risks and challenges farmers face are:

Droughts: Drought is a major risk in Tanzania. Drought occurs mostly in the Northern, Central and Lake Zone Regions. Field research showed that the regions that have been most affected by droughts over the years are Arusha, Iringa, Kilimanjaro, Manyara, Mbeya and Shinyanga - other regions have also experienced droughts, but these regions have been the most severely affected.

Floods: Field research showed that the country faces flood issues roughly every two years. This is a huge challenge, especially in low-rain regions, such as Mtwara, Singida, and Dodoma. Njombe and Iringa, despite having good climatic conditions for farm produce, remain highly vulnerable to floods and heavy rains.

Pests and diseases: Pests and diseases are a major risk for farming activities. With pests such as fall armyworm (FAW) and locusts being the biggest challenges and causing farmer yield losses. For example, regions bordering Kenya experienced locust issues and faced huge yield losses.

Post-harvest losses: Weevils attacking stored maize produce has been a major issue for farmers. This pest has led to farmers' post-harvest losses.

2.5 Determinants of Crop Insurance Uptake

Factors that determine the uptake of crop insurance amongst smallholder farmers have been studied and documented through literature. Factors behind the uptake of crop insurance have evolved over the years, depending on the product developed to attract farmers to purchase/subscribe to insurance. Particularly for smallholder farmers with low levels of income, a careful attention to product development, accessible distribution channels, combined with a keen understanding of their vulnerabilities have helped inform the kind of insurance that will cater for their needs. Given their income levels, smallholder farmers' coping mechanisms to vulnerabilities are largely shaped by their socioeconomic characteristics.

Saqib *et al.*, (2016), studied the impacts of socio-economic factors on the adoption of agricultural credit as risk management strategy by farmers in Pakistan in a post-disaster situation, by incorporating an explanatory research design to investigate the causal relationship between the dependent (binary) and independent variables. The study employed a probit regression model to explore the relationships. Findings revealed that several factors influence farmers' adoption of credit, including age, farming experience, education, income, and access to formal and informal credit. Arun *et al.*, (2012), showed a strong positive relationship between past shocks and a rising probability of using micro insurance; however, Cole *et al.*, (2013), find no such evidence.

Other studies, Oyinbo *et al.*, (2013), looked at the determinants of agricultural insurance participation in the Federal Capital Territory, Abuja, Nigeria. They examined the effects of age, educational attainment, farm size, accessibility to credit, household size, membership of associations and contact with extension agents to the decision of

farmers to uptake insurance. The authors employed descriptive statistics and logistic regression analysis to assess the influence of the abovementioned factors to the uptake of crop insurance. Their study revealed that age, educational level, farm size and accessibility to credit, significantly affect the farmers' choice to purchase agricultural insurance. Among socioeconomic factors, education was highly significant, as educated farmers were reported to have better knowledge on sources of risk, and the possible strategies they can adopt at the farm level to secure themselves from such risks (Iqbal, 2016; Saqib *et al.,* 2016).

However, Dadzie and Acquah (2015), reported an inverse relationship with education, citing that as farmers' education increased, they became less risk averse in nature. Numerous research findings have supported the idea that there exists a relationship between the level of wealth and purchase of micro insurance (Ndurukia *et al*., 2017). Giné *et al*., (2008), found that uptake of rainfall insurance in India is high among wealthier households. Similarly, in another research in India, Cole *et al*., (2013), establish that more families that are affluent have a higher chance of buying rainfall insurance. Gulseven (2014), used the logistic regression model to estimate demand factors and willingness to pay for agricultural insurance in Turkey. According to the author, farmers are buying insurance primarily because it is attached to credit and that education and farming income increase the chances to buy agricultural insurance among rural households. In light of the reviewed literature, there's currently little assessment done to understand factors affecting demand for crop insurance in the maize sub-sector in Tanzania. This study will fill the existing knowledge gap in Tanzania and may help to spearhead efforts for affordable and farmer-friendly insurance products.

2.6 Conceptual Framework

Based on the background information, the problem statement, and the objectives, this chapter explains the conceptual framework influencing farmers' demand for crop insurance. This study used a modified conceptual framework by Tsikirayi et al. (2013), who studied the uptake of agricultural insurance services in Zimbabwe. The ultimate uptake of crop insurance begins with assessment of farmers' awareness and behaviour towards farm risk. Due to uncertainty in yield and price, risk is always a factor in all farm management decisions. The decision to demand for crop insurance is explained by either demand factors, like the effects of tastes and preference, income, premium price, complementary goods, farmers' expectations about future prices or incomes and availability of substitutes.

For the purpose of the study, farm and farmer socioeconomic attributes, such as education, age, income (farmer and off-farm), farming experience, family size, landholding size, type of land ownership, farm labour proportion, size of premiums, distance from natural water source, such as river or stream, will be used to measure the factors of tastes and preferences influencing farmers' decisions to avail crop

insurance. In line with risk theory, it is expected that farmers with higher levels of education are likely to access crop insurance because of the assumption that they have a higher level of awareness and understanding about risk management instruments. Landowners are more likely to access insurance as they have more stable income than tenants or sharecroppers (Balcita, 2015). Income factor includes both on-farm and off-farm income. It is expected that farmers with expected high on-farm income, will have a higher demand for crop insurance to protect against income loss. Where off-farm income exists, this is often used as a form of diversification, thus maybe a factor in reducing the demand for crop insurance. In making production decisions, farmers are most often confronted with costs and prices (Senkondo, 2000), thus own price factor is measured using the premiums farmers must pay to access crop insurance. Consequently, the higher the premiums, the less likely a farmer is to access crop insurance and conversely, lower premiums see a higher demand in crop insurance.
Availability of substitutes refer to the availability and accessibility of other risk management practices, such as crop diversification, small ruminants and poultry farming as well as membership in cooperatives. The study presumes that there will be a negative relationship on demand for crop insurance with farmers who have access to risk management alternatives, as they are considered a substitute for insurance. The study also recognizes the positive relationship between crop insurance and farm credit. Accordingly, famers who have accessed crop insurance are also more likely to access formal credit as it's an insurance against payment defaults.

Finally, the study considers farmers' expectations of future prices and income, by addressing yield forecast. Farmers with high yield forecasts expect higher levels of on-farm income, so naturally they are more inclined to access crop insurance.

3.0 METHODOLOGY

3.1 Study Area

The selection of the study area was based on three main criteria, which are maize production, presence of crop insurance by smallholder farmers and presence of natural disaster risk. The study will sample smallholder farmers from Njombe. Njombe has favourable geographic and climatic conditions for a range of food and cash crops, including maize grain, beans, and potatoes (food and cash crops), tobacco, tea, pyrethrum, and coffee (cash crop), vegetables and sunflowers (cash crops), and lumber (cash crop). Njombe is one of the most grain producing regions of Tanzania, named "the big five" (FSDT, 2017). Approximately 69% of its population engaged in crop production only (Annual Agricultural Sample Survey, 2014/15). The region is considered one of the more progressive regions in agriculture production, both during the short and long rainy seasons.

In Njombe, Wanging'ombe District was specifically sampled. Wanging'ombe is one of the six districts of Njombe Region, with a population of 203,425 (Annual Agricultural Sample Survey, 2014/15). Its geographical coordinates are 08° 51' South, 034° 38' East, and it shares borders with Iringa Region to the North; Morogoro Region to the East; Mbeya Region to the West; Ruvuma Region to the South and the Republic of Malawi via Lake Nyasa, to the Northwest. The selection of the study area was based on three main criteria, which are maize production, presence of crop insurance by smallholder farmers and presence of natural disaster risk. The study sampled smallholder farmers from Wanging'ombe, Njombe Region. Wanging'ombe district is highly favourable for agricultural production, with majority of their population dependent on agriculture (Annual Agricultural Sample Survey, 2014/15). On the second criteria, the study area is also selected due to its vulnerability to flash floods and heavy rains, which create a suitable study area for risk-related studies. On the third criteria, the area is selected due to the presence of crop insurance.

3.2 Research Design and Sampling Procedure

The study adopted a cross-sectional survey research design, using quantitative approaches to determine the factors influencing demand for crop insurance. Qualitative data was collected from key informants to give a well-rounded picture of how crop insurance works in the selected area. A structured questionnaire was used to capture quantitative data, while interview guides were employed to collect qualitative data, to allow a free flow of information. The questionnaire was chosen due to its ability to collect concise data on crop insurance.

A multi-stage sampling technique was employed to select insurance and non-insurance policy holders. In the first stage, purposive selection of the district where there's a presence of micro insurance policy holders will be selected. The second stage involved a purposive selection of 6 wards. The third stage involved a random sampling

procedure, whereby a total of 32 villages was sampled. The fourth stage involved random sampling of farmers within the 32 villages, with a criterion that farmers cultivate between 1 – 3 ha of maize (NPS, 2017). A total of 384 respondents were interviewed, whereby crop insurance beneficiaries were 56.25% and non-beneficiaries 43.75%, 52.3% of the respondents were male and 47.7% were female.

Sample size determined by using the *Cochrach* formula: $\frac{n = z^2 p(1-p)}{e^2}$

Where n = sample size; Z = Z statistic at 1.96 for a level of confidence of 95%, which is conventional and used by most statistical studies. P = expected proportion or standard deviation. Expected proportion (P) is the proportion that was used by the investigator to estimate the total number of all smallholder farmers in the study area. That is a safe estimate of 0.5; e = precision of error. The value of e was, e = 0.05 (5%) since it gives the confidence interval of 95% which is acceptable in social science research (Naing *et al*., 2006). Therefore, p = 0.5%; z = 1.96; e = 0.05;

$$n = \frac{3.84 \times 0.5(1 - 0.5).}{(0.05)^2} \quad \text{So, } n = 384$$

Therefore, sample size used was approximated to be 384 respondents that was selected among 6 wards.
Then, sample size was required from each ward;

$$n.v \approx \frac{Nv}{Nt} * 384$$

where; n.v = Sample size required, *Nv* = Population in a ward, *Nt* = Total population

Sample size from Igwachanya Ward- 777 farmers: $\frac{777}{3198} * 384 = 93$

Sample size from Itulahumba Ward - 441 farmers: $\frac{441}{3198} * 384 = 53$

Sample size from Mdandu Ward – 133 farmers: $\frac{133}{3198} * 384 = 16$

Sample size from Udonja Ward – 544 farmers: $\frac{544}{3198} * 384 = 65$

Sample size from Uhenga Ward – 187 farmers: $\frac{187}{3198} * 384 = 22$

Sample size from Wanging'ombe – 1116 farmers: $\frac{1116}{3198} * 384 = 135$

3.3 Data

Data used in the study consisted of primary data collection from smallholder farmers through structured questionnaires. The study was compelled to use primary data due

to its nouveau nature in Tanzania, hence the absence of secondary data. The study adopted a cross-sectional survey research design, using quantitative approaches to determine the factors influencing demand for crop insurance. Qualitative data was collected from key informants to give a well-rounded picture of how crop insurance works in the selected area. Pre-tested questionnaires with open and close-ended questions were used for the interview. An online data collection tool, Kobotoolbox was used for data collection.

3.4 Empirical Model Specification

For the econometric model, a logit mode is used to determine the demand for crop insurance from smallholder farmers. For the benefit of the study, a smallholder farmer is one who cultivates between 1 – 3 ha of maize to fit in the smallholder qualification criteria (NPS, 2017).

The study used STATA software to estimate a logistic regression model in order to determine factors determining farmers' decisions to purchase or not to purchase crop insurance (Enjolras *et al.*, 2012; Saqib *et al.*, 2016; Akhtar *et al.*, 2018). The model takes the form below:

$$Ip = f(X_1, X_2, \dots, X_n) \quad \text{..... (2)}$$

Where Ip represent insurance purchase by farmers. It carries the value of 1 if the farmer purchased insurance and 0 if a farmer did not purchase insurance.

$X_1, X_2, \dots, X_n$ represents factors influencing insurance purchase.

The relation in equation (2) is estimated econometrically in the model specified in equation (3) below

$$p_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots . \beta_n X_{ni} \quad \text{.....(3)}$$

Where p_i represents the probability of whether a farmer subscribes to crop insurance or not. β_o is the intercept, $\beta_1, \beta_{2,\dots,} \beta_{n,}$ represent the estimated coefficients and $X_{1i}, X_{2i}, \dots, X_{ni}$ represent the explanatory variables.

Whereby determinant factors for explanatory variables are:

X_1 = level of education, X_2 = Age, X_3= Farming experience, X_4 = Size of land, X_5 = Land ownership, X_6 = Distance from water source, X_7 = availability of other risk management alternatives, X_8 = membership in organisation/group, X_9 = crop diversification, X_{10} = access to credit, X_{11} = availability of off-farm income X_{12} = availability of on-farm income, X_{13} = yield forecast, X_{14} = perceived yield risk, X_{15} = self-experience on production risks (poor harvest)

Therefore,

The empirical model used to estimate the Logistic Regression model is given below.

$$\boldsymbol{Z_i^*} = \boldsymbol{\beta_0}\mathrm{SEX} + \boldsymbol{\beta_1}\mathrm{AGE} + \boldsymbol{\beta_2}\mathrm{MRT} + \boldsymbol{\beta_3}\mathrm{EDUC} + \boldsymbol{\beta_4}\mathrm{EXP} + \boldsymbol{\beta_5}\mathrm{ORG} + \boldsymbol{\beta_6}\mathrm{HHSIZE} + \boldsymbol{\beta_7}\mathrm{OWNERS_L} + \boldsymbol{\beta_8}\mathrm{SIZE_L} + \boldsymbol{\beta_9}\mathrm{ONF_{In}} + \boldsymbol{\beta_{10}}\mathrm{OFF_{In}} + \boldsymbol{\beta_{11}}\mathrm{FERTIL} + \boldsymbol{\beta_{12}}\mathrm{DIVERS\_C} +$$

$\boldsymbol{\beta_{13}}\text{ROTAT\_C} + \boldsymbol{\beta_{14}}\text{IRRIG} + \boldsymbol{\beta_{15}}\text{PROD\_RISK} + \boldsymbol{\beta_{16}}\text{WTP\_Acr} + \boldsymbol{\beta_{17}}\text{Prim\_Occ} + \varepsilon_i$
..... (4)

Whereas;

AGE = Age of the respondent, SEX = Sex of the respondent

EDUC = Education level of the respondent, EXP = Experience on farming activity

MRT = Marital status, ORG = Member of Organisation

HHSIZE = Household size, OWNERS_L = Land ownership

SIZE_L = Land size, ONF_{In} = On farm Income

OFF_{In} = Off farm income, FERTIL = Use of fertilizer

DIVERS = Diversification of crop, ROTAT_C = Rotation of crop

IRRIG = Irrigation, PROD_RISK = Experience production risk

WTP_Acr = Willing to Pay Per acre, Prim_Occ = Primary occupation.

3.5. Data Analysis

The analysis involved the establishment of data categories and application of those categories to raw data through coding, tabulation and drawing of inferences (Kothari, 2004).

For the first objective of this study (characteristics that distinguish subscribers and non-subscribers of crop insurance), cross-sectional data was collected. Data gathered in this objective was analysed using STATA and EXCEL software to determine a relationship, percentages, and frequencies of the variables.

The aim of the second objective was to quantify the determinants of crop insurance uptake by smallholder farmers, in analysing this objective to determine factors for crop insurance between subscribers and non-subscribers of crop insurance, the researcher employed logistic regression, and econometric test was used to validate the model used.

4.0 RESULTS AND DISCUSSION

4.1 Characteristics of Farmers Who Subscribed to Crop Insurance and Those Who Did Not Subscribe to Crop Insurance.

This section analysed the socioeconomic and demographic characteristics between the two groups of farmers - those who participated in crop insurance and those who did not participate, to establish if there were any stark differences in terms of their characteristics, that may explain their vulnerabilities and decisions to uptake crop insurance. Table 4.1 indicate characteristics of the farmers.

4.2 Socioeconomic Characteristics

Table-4.1. Percentage Difference in Characteristics for the Two Groups

Variable		Participated (%)	Not Participated (%)
Social Economic Characteristics			
Gender	Male	52.29	47.71
	Female	61.45	38.55
Education level	No schooling	57.14	42.86
	Primary	57.68	42.32
	Secondary	45.45	54.55
	Vocational	28.57	71.43
Marital status	Married	55.37	44.63
	Single	42.86	57.14
	Widowed	60.38	39.62
	Divorced/separated	57.89	42.11
	Single parent	71.43	28.57
Occupation	Farmer	57.26	42.74
	Entrepreneur	45.45	54.55
	Formal employment	33.33	66.67

A total of 384 respondents were interviewed for the study, out of which 216 (56.25%) participated in a crop insurance scheme, while 168 (43.75%) did not participate in crop insurance. Women are considered the most gender type group engaged in farming activities in developing countries. In most African traditions, agricultural activities are considered to be for women, while men specialize in other economic activities like animal grazing, lumbering and construction (Alesina et al, 2013). Although due to increased modernization and population, the number of men engaged in agriculture has been increasing over time (FAO, 2013). Literature shows that men use more advanced technology in farming as compared to women. Women's farming activities are small-scale and rely on local farming tools (Taibat et al., 2014). The study captured gender as one of the social characteristics that could influence participation in the crop

insurance scheme in Njombe Region, and the results are portrayed in table 4.1, which shows that more women (61.45%) subscribed to crop insurance compared to their male counterparts (52.29%). These results signify that uptake of crop insurance could be gender biased. Results may also be linked to the household decision-making process, particularly in matters of ensuring food security in the household.

From the same table, marital status shows that farmers who participated in crop insurance were as follows: 55.37% of the respondents were married, 42.86% were single, 57.89% were divorced or separated and 60.38% were widowed. In comparison, more single respondents did not subscribe to crop insurance at 57%, compared to about 44.6% who were married and 39.6% who were widowed and did not subscribe to crop insurance. This implies that most of the respondents who participated in crop insurance were either widows, divorced or married, which could explain the fact that given the high levels of risk involved in farming, they tend to be more responsible and will tend to worry about food security more compared to those who are single. Also, it is also in line with Tiraee (2002), who confirmed that marital status does have an influence in the uptake of agriculture insurance.

Table 4.1 further shows that about 57.14% of farmers who insured their crops had no schooling and 57.68% reached primary education level. Farmers who reached secondary education level and above were less than 75%, combined. The study further revealed that smallholder farmers who did not participate in crop insurance were 42.32%, 42.32%, 54.55% had no schooling, primary level, and secondary level, respectively. The results generally indicate that the decision to purchase crop insurance leans towards farmers with low levels of education. This could not be truer as those with vocational education are 2.4 times less likely to purchase crop insurance. This is contrary to the other literature, since the study showed that most of the respondents that participate in crop insurance had low levels of education. According to Torkamani (2002) and Oyinbo, et.al (2013), the level of education significantly affects the decision to purchase crop insurance. However, Dadzie and Acquah (2015) and Fonta, et.al (2018), indicated an inverse relationship between high levels of education and crop insurance, citing that better educated farmers are well informed of the risk management options, and likely to have better access to formal credit facilities and to irrigate their lands, hence less need for crop insurance.

Table 4.1 reveals that respondents whose main occupation was farming, had a higher rate of participating in crop insurance at 57.26%, compared to those engaged in formal employment, where only 33.33% participated.

4.3 Household Characteristics

Table 4.2: Household Characteristics

Variable	Participated	Not Participated

Age of respondent (mean)	49	44
Household size (mean)	5	5
On-farm income (mean)	871,300	677,800
Off-farm income (mean)	311,856	271,500

Table 4.2 shows the household characteristics of farmers who participated and those who did not participate in crop insurance. The mean age of both farmer groups indicates that they are in their productive age, with subscribers at approximately 49 years of age and non-subscribers at 44 years of age. According to Torkamin (2002), age has an influence in adoption of agriculture insurance, where an individual tends to be more risk averse the older, they get.

The mean household size of subscribers and non-subscribers for crop insurance is approximately five members, which implies that according to the study, household size has nothing to do with either subscription or non-subscription of crop insurance. Results from the study reveal a clear difference in the mean on-farm income between farmers who subscribed to crop insurance at TZS 871,300, compared to those who did not subscribe (TZS 677,800). These results are not surprising, since farmers covered by crop insurance, enjoyed added products and services such as farm inputs on credit and training on GAP practices, that were bundled with the insurance, and they also received regular advisory services from private extension workers. Bundling of crop insurance with other equally important services like credit and better farm inputs, is fast emerging as a possible solution to help agriculture insurance to achieve better social outcomes, make insurance more tangible and enable schemes to scale faster (Mukherjee, et.al 2017).

4.4 Farming Characteristics

Table 4.3: Farming Characteristics

Variable		**Participated**	**Not Participated**
Farming Characteristics			
Farming experience (year) mean		29	23
Farm size (acre) mean		2.4	2.2
Access to credit (%)	Access	57.67	42.33
	No access	54.44	45.56
Farmers association (%)	Yes	79.17	20.83
	No	5.83	94.17
Crop rotation (%)	Yes	53.33	46.67
	No	58.26	41.74
Practice irrigation (%)	Yes	59.73	40.27
	No	54.51	45.49

Use of fertilizer/farm manure (%)	Yes	56.76	43.24
	No	33.33	66.67
Crop diversification (%)	Yes	58.02	41.98
	No	47.46	52.54

Table 4.3 shows the farming characteristics of the two groups of farmers where the mean years of farming for farmers who engaged in crop insurance were 29 years for crop insurance subscribers and 23 years for non-subscribers. This implies that farmers who are interested in purchasing crop insurance had higher farming experience, which also implies that they have more experience with production risks and can make meaningful farm decisions. Agricultural experience leads farmers to understand risk sources; their incidence and severity, and consequently enhance their capabilities to manage farm risk more efficiently (Shoaib Akhtar, et al., 2017). Likewise, results indicate farmers with slightly larger farms (2.4 acre) were more interested in purchasing crop insurance than those with lower acreage (2.2 acre) that did not subscribe to crop insurance. This could be that those with more farmlands prefer purchasing crop insurance to protect their agricultural businesses and minimize risks in order to ensure the livelihoods of their families.

Approximately 79% of respondents who were involved in farmers' groups had subscribed to crop insurance, leaving 20.83% who had not insured through the crop insurance and only 5.8% of respondents who are not in farming associations were participants in crop insurance (table 4.3). This implies that farming associations/groups have a big influence in the decision to uptake crop insurance in the study area. Farmer associations/groups are an easy avenue for knowledge transfer, peer to peer learning about agricultural insurance, but also a good approach to minimize associated risks of not paying premiums. These results concur with various studies (Suresh et al., 2011, E. Njue, 2018, Hellin, et al., 2007), that reveal participation in farmers' organisations has the capacity to encourage intensive purchase of crop insurance premiums and access to credit in rural households.

Access to credit indicates a positive correlation with subscription of crop insurance, with about 57.67% of respondents with access to credit subscribing to crop insurance, compared to 42% with crop insurance but without access to credit. Credit suppliers such as banks and microfinance institutions (MFIs) prefer giving credit to farmers with crop insurance to minimize the risk of losing crops or non-payment of premiums. According to a study done by ILO, access to agriculture insurance makes access to credit easier, at times at softer rates than when the farmer is uninsured (Mukherjee, et al., 2017).

Good agricultural practices are considered a form of risk management practice, as they reduce the likelihood of production risks. Tsikirayi et al. (2012), regarded crop

diversification, livestock and poultry farming and union membership as among risk management options that reduce the potential uptake of crop insurance. According to the study, farmers who engage in good agricultural practices (GAP), such as the use of fertilizer and irrigation, have a higher rate of participation in crop insurance at 56.7% and 59.7%, respectively, compared to those who did not use GAP. Comparison between the two groups also indicates that insured farmers practice more crop diversification (58.02%) and crop rotation (53%), compared to non-insurers. While the results are contrary to Tsikirayi et al. (2012), they are in line with other studies, such as Masoumi & Tirkolaei (2013), who indicated that these risk management practices have a positive effect on the decision of farmers to access crop insurance. Results from the study indicate that farmers who have been availed with crop insurance are required to follow GAP to ensure high yield and high farm income for repayments of crop insurance premiums.

4.5 Awareness of Crop Insurance

Respondents were asked to indicate whether they had heard of insurance or not. These were presented in the table below.

Table 4.4 Have you ever heard of any crop insurance programme in Wanging'ombe?

Response	Frequency	Percent	Cumulative Percent
Yes	164	43	43
No	220	57	100.0
Total	384	100.0	

Table 4.4 shows that only 43% of the respondents interviewed had heard of agriculture insurance, while 57% had never heard of it. The findings are somewhat contrary to expectation, given that about 56% of farmers have accessed crop insurance in their input bundles. Field results found that even though farmers were insured, their understanding and awareness of crop insurance was quite minimal, and some had no schooling at all, hence could not read. But as the farmers revealed their contractual terms, it was clear that farmers under the crop insurance program were covered by insurance. These results are somewhat in line with findings of other studies conducted in Tanzania, citing that more targeted awareness and sensitization are needed to educate farmers on crop insurance. According to Baker (2000), farmers' awareness on the importance of insurance and its influences on their income, supports the uptake of agriculture insurance.

4.6 To Examine Factors that Determine Farmers' Decisions to Access Crop Insurance

This section presents results on factors that determine farmers' uptake of crop insurance in Tanzania. Data was analysed using STATA software version 16 and based on objective number two of the study. The findings are presented herein below in the form of descriptive statistics and logistic regression.

Table 4.6 Descriptive Statistics of Variables Used in Econometrics

Variable	Observations	Mean	Std. Dev.
Participation Crop Insurance (1=yes, 0=no)	384	0.563	0.497
Age respondent (years)	384	47	13.633
Years farming (years)	384	26	14.141
Sex (1=male, 0=female)	384	0.568	0.496
Marital status			
Married (1=yes, 0=no)	384	0.776	0.417
Single (1=yes, 0=no)	384	0.018	0.134
Widowed (1=yes, 0=no)	384	0.138	0.345
Divorced/separated (1=yes, 0=no)	384	0.049	0.217
Education level			
No schooling (1=yes, 0=no)	384	0.091	0.288
Primary (1=yes, 0=no)	384	0.831	0.375
Secondary (1=yes, 0=no)	384	0.057	0.233
Graduate (1=yes, 0=no)	384	0.003	0.051
Members of Organisation (1=yes, 0=no)	384	0.688	0.464
HH_Size (number of members)	384	4.846	1.93
Land_Ownership			
Ownership_Bought (1=yes, 0=no)	384	0.44	0.497
Ownership_Rented (1=yes, 0=no)	384	0.154	0.361
Ownership_Inherited (1=yes, 0=no)	384	0.648	0.478
Ownership_Borrowed (1=yes, 0=no)	384	0.063	0.242
Land Size (acre)	384	2.341	1.59
Onfarm Income (TZS)	384	876343.75	1260013.3
Offfarm Income (TZS)	384	294200.52	701164.22
Use of fertilizer (1=yes, 0=no)	383	0.984	0.124
Crop Diversification (1=yes, 0=no)	384	0.844	0.364
Crop rotation 1=yes, 0=no)	383	0.431	0.496
Crop Irrigation (1=yes, 0=no)	382	0.39	0.488
Experience production risk/Coping strategy (1=yes, 0=no)	384	0.607	0.489

Variable	Observations	Mean	Std. Dev.
WTP_acre (TZS)	274	6686.131	7854.214

4.6.1 Multicollinearity Test Results

This is an econometric problem which occurs when two or more independent variables in a regression model have a perfect or exact linear relationship, such that the independent variables fail to have an effect on the dependent variables. Thus, in estimating parameters, it is always advised to have less correlation between the explanatory variables. Presuming that if a perfect multicollinearity exists, the regression coefficients of the explanatory variables will be indeterminate and have standard errors that are infinite. However, if multicollinearity is less perfect then the regression coefficients will be determinate with large standard errors, which implies that coefficients cannot be estimated with great accuracy (Gujarati, 2004).

Table 4.6.1: Mean VIF

Variable	VIF	SQRT VIF	Tolerance	R squared
Participated	2.58	1.61	0.3880	0.6120
Age	8.84	2.97	0.1131	0.8869
Years_Farming	9.06	3.01	0.1104	0.8896
Sex	1.36	1.17	0.7341	0.2659
Marital_Status	1.39	1.18	0.7180	0.2820
Level_Education	1.37	1.17	0.7295	0.2705
Member_Organisation	2.47	1.57	0.4049	0.5951
HH_Size	1.38	1.18	0.7238	0.2762
Land_Ownership	1.82	1.35	0.5493	0.4507
Land_Size	1.83	1.35	0.5477	0.4523
On-farm_Income	1.82	1.35	0.5486	0.4514
Off-farm_Income	1.23	1.11	0.8138	0.1862
Use_Fertilizer	1.07	1.03	0.9381	0.0619
Diversific_Crop	1.08	1.04	0.9261	0.0739
Rotation_Crop	1.14	1.07	0.8793	0.1207
Irrigation_Crop	1.19	1.09	0.8372	0.1628
Exp Production Risk	1.12	1.06	0.8928	0.1072
WTP_Acre	1.29	1.13	0.7765	0.2235
Primary_Occup	1.12	1.06	0.8929	0.1071
Mean VIF	**2.17**			

In our model, findings from the multicollinearity test show that there is no multicollinearity problem in our study, since findings obtained show that mean VIF is 2.17, which is less than the usual threshold of 10. Age and years of experience seem to suffer from multicollinearity, but there VIF is tolerable not above 10. Therefore, there

could only be a multicollinearity problem when the Variance Inflation Factor (VIF) statistic is greater than 10. This indicates that the explanatory variables can be used to model our equations.

4.6.2 Results of the Shapiro-Wilk Test

The Shapiro-Wilk test is a statistical test used to check if a continuous variable follows normal distribution. The null hypothesis (H_0) states that the variable is normally distributed, and the alternative hypothesis (H_1) states that the variable is NOT normally distributed. Determining the distribution of the variables was important for choosing an appropriate statistical method. So, a Shapiro-Wilk test was performed and showed that the distributions were significantly non-normal for the variables (Table 4.6). Hence the variables followed a normal distribution.

Table 4.6.2: Shapiro-Wilk (W) Test for Normal Data Distribution

Variable	N	W	V	z	Prob>z
Age of respondent	384	0.988	3.252	2.801	0.003
Years of farming	384	0.977	5.98	4.247	0.000
HH Size	384	0.978	5.803	4.176	0.000
Land Size	384	0.834	44.118	8.994	0.000
On farm Income	384	0.566	115.179	11.273	0.000
Off farm income	384	0.648	93.525	10.778	0.000
WTP acre	274	0.836	32.302	8.122	0.000

N = Number of respondents; **W**=Wilk test; V= Variances; z = the ratio of the coefficient to the standard error of the respective predictor.

4.6.3 Link Test for Model Specification

This test is specifically done to examine whether the model is correctly specified or not. There are two types of variables generated from the computation of this test; _hat and _hat sq. The model is said to be specified accurately if _hat is statistically significant (Wooldridge, 2010). Consider the **Table 4.6.3** below.

Table 4.6.3: Link Test Results

Participant	Coef.	Std.Err.	Z	P>z	[95%Conf Interval]	
_hat	1.002	0.128	7.820	0.000	0.751	1.253
_hatsq	-0.004	0.047	-0.090	0.926	-0.096	0.087
_cons	0.013	0.272	0.050	0.961	-0.519	0.546

From the results above in **Table 4.6.3**, it depicts that _hat is statistically significant at 1 percent level of significance with a p-value less than 0.00. However, _hat sq is found not to be significant at 5 percent level of significance since p-value is greater than 0.05

and z- value is less than 1.96. Therefore, if these conditions are met it may be concluded that the model is correctly specified.

Table 4.6.4: Logistic Model for Participation of Crop Insurance, Goodness-of-Fit Test

Number of observations	273
Number of groups	10
Hosmer-Lemeshow chi2(8)	2.35
Prob > chi2	0.9683

The Hosmer–Lemeshow test is a statistical test for goodness-of-fit for logistic regression models. The null hypothesis (H_0) states that the mode is fit, and the alternative hypothesis (H_1) states that mode is NOT fit. Therefore, from the table above (Table 4.6.42), the prob of Chi2 is >0.05 we fail to reject the null hypothesis. Hence the insignificancy of prob of Chi2 suggest that the model is fit.

Table 4.7: Logistic regression

Participation in Crop Insurance	Odds ratio	St. Err.	t-value	p-value	Sig
Age	0.99	0.041	-0.25	0.806	
Years_farming	1.089	0.046	2	0.046	**
Sex (Dummy)	1.636	0.871	0.92	0.355	
Marital status(dummy)					
Single	39.223	57.618	2.5	0.012	**
Widowed	0.208	0.157	-2.08	0.037	**
Divorced/Separated	1.987	2.925	0.47	0.641	
Single parent	0.649	0.944	-0.3	0.766	
Education level (dummy)					
Primary	1.092	0.927	0.1	0.917	
Secondary	0.268	0.366	-0.96	0.335	
Vocational	0.449	0.799	-0.45	0.653	
Member_Organ	585.836	502.732	7.43	0	***
HH_Size	0.795	0.119	-1.54	0.124	
Land_Ownership					
Ownership_Bought	0.287	0.175	-2.05	0.041	**
Ownership_Rented	0.701	0.444	-0.56	0.575	
Ownership_Inherited	0.438	0.277	-1.31	0.191	
Ownership_Borrowed	1.36	1.652	0.25	0.8	
Land_SIZE	1.851	0.425	2.68	0.007	***
On-farm_Income	1	0	-2.65	0.008	***
Off-farm_income	1	0	1.12	0.263	
Use_fertilizer (dummy)	7.544	9.371	1.63	0.104	
Diversific_farm (dummy)	1.842	1.112	1.01	0.312	
Rotation_farm (dummy)	0.587	0.291	-1.08	0.282	
Irrigation_farm (dummy)	1.593	0.793	0.94	0.35	
Experience in Risk/Coping Strategy	2.594	1.238	2	0.046	**
WTP_acre	1	0	-1.13	0.26	
Primary_Occup	0.73	0.372	-0.62	0.537	
Credit (dummy)	0.737	0.178	-1.26	0.206	
Constant	0.001	0.002	-2.99	0.003	***
Mean dependent var		0.612			
Pseudo r-squared		0.6014			
Chi-square		217.708			
Akaike crit. (AIC)		201.005			

Results in Table 4.7 above are from the logit model analysis used to estimate factors that determine farmers' uptake of maize crop insurance in Tanzania. The two categories were specified as follows: Not participated (non-subscribers); Participated (Subscribers) that formed the dependent variable as 0, 1 respectively. Out of the 19 explanatory variables specified in the model, 7 significantly contributed to smallholder farmers' decisions to access crop insurance (either to subscribe for crop insurance or not). The model reveals that the log-likelihood ratio of 217.7 is highly significant ($p \leq 0.000$). The explanatory power of the model is good and that variability of the dependent variable or the decision to uptake crop insurance or not is associated with the specified independent variables.

i) **Farming experience** as the continuous variable from table 4.7 depicts that; one year increase in farming will influence an 8.9 percent increase in the probability of participation in a crop insurance scheme, keeping other factors constant. This is true since experienced farmers are more likely to understand the risks involved in farming and are willing to uptake crop insurance to protect their farms. This is because experience in farming enhances human capital so that information accumulated through years of farming experience is channelled into decision-making about farming. It is expected that experienced farmers will have more knowledge about the benefits of insurance and therefore be more likely to decide to access crop insurance. The result agrees with Abdullah et al. (Abdullah et al, 2015), in a study involving paddy farmers that farming experience has influence in up-taking crop insurance.

ii) **Marital status** as an independent variable is categorical (discrete change), as it takes dummy variable from 0 to 1 therefore, its influence on the decision to uptake crop insurance is as follows; Marital status (1 = single, 0 if otherwise such that married, divorced or widowed) as a dummy variable was found to be significant at the 5% significance level, meaning that under ceteris paribas being single as farmers, influences the probability of the decision to uptake crop insurance by 22.3 percent, compared to other marital statuses (married or divorced). This is conformed to the a-priori expectation and is also consistent with other studies (Danso-Abbeamet al., 2014). Farmers who are single were also observed to be able to participate in crop insurance schemes, which could be due to the fact that with limited responsibility of catering for other individuals, these farmers are more likely to set aside money to purchase insurance. This was consistent with the findings of Munkaila (2015), among cereal farmers in Ghana.

Contrary to marital status (1=widowed, 0 if otherwise such that married, divorced, or widowed) as a dummy variable, which was found to be significant at the 5% significance level, which has negative influence on crop insurance, since a farmer who is divorced or widowed is less likely to be interested in insurance than a farmer who is single. Typically, most widowed household heads in Tanzania are females. In majority

of the rural communities, once the husband dies, the wife is less likely to inherit land and is left to support the family. Without a non-farming income flow, widows may be less interested in adopting crop insurance, given the cost. From the table above, being widowed as farmers reduces the possibility of participating in crop insurance by 20.8 percent. Also, it agrees with Tiraee (2002), who confirmed that marital status does have an influence in the uptake of agriculture insurance.

iii) **Membership in farmers' groups/organisations** was found to be highly significant at the 1% significance level and positively affected farmers' decisions to uptake crop insurance. Being in a farmers' organisation and cooperatives/associations, influences the probability of farmers to uptake crop insurance by 83 percent (585.836 odds ratio). Membership in these groups provides farmers with important information concerning modern technologies and risk management strategies, and thereby influences their purchasing decision positively. According to prior expectation, the more farmers had access to these associations, the higher the probability of engaging in crop insurance. These results are also in line with insurance supply practices, as they prefer smallholder farmers to be part of famer groups as a risk management solution that will ensure repayment of premiums. Therefore, farmer groups are considered to be less risky compared to individual farmers, particularly when their income levels are low. These results are consistent with many others, including Ellis, 2016.

iv) **Land ownership** that was specifically bought by respondents was found to be significant at 5% level, indicating that landowners are more likely to uptake crop insurance because of greater access to land and more stable income than their counterparts. Land ownership signifies wealth and investment in most rural families, where a farmer usually has an intention to buy a particular piece of land for a purpose.

v) **Land size** as an independent variable is the continuous variable and was captured in acres. The higher the holding size, the higher the probability of taking insurance cover, as indicated by the positive and significant coefficient for the land variable at 1% level. This implies that a one acre increase in farming leads to an increase in the probability of participating in crop insurance by 85 percent (1.851 odds ratio). With the increase in holding size, the level of marketable securities also increases and makes greater the chance that farmers will go for formal credit sources, with which the insurance product is bundled. As land size increases, so does the risk of losing crops and farm income. Hence, securing it with crop insurance will protect the farmer from future losses.

vi) **On-farm income** as a continuous variable was found to be highly significant at almost 1%, but with a negative coefficient, implying that as on-farm income

increases, farmers become more relaxed with their risk choices and options and are less risk averse. Increase in on-farm income is an indication of increase in wealth by most farming households which may imply that in case of disasters, farmers have various ways of managing income loss, while having enough left to cushion other household expenditures.

vii) **Experience with production risks** as a dummy variable coded (1=Yes, 0 = No) and was significant at 5% level. When faced with risks, farmers use different coping strategies, such as selling of assets and agricultural products, and borrowing from relatives or neighbours to help cushion them during disasters. This variable had a significant and positive relationship with the decision to uptake crop insurance. From the results, farmers who had experienced production risks before and were compelled to sell off their assets and agricultural products, were more determined to insure their crops so as not to lose more assets. There is consistency between these results and other findings by Ramasubramanian (2012) and Kumar, (2011).

5. CONCLUSION

The study was conducted in Wanging'ombe District in Njombe Region, using cross-sectional data with the objective of assessing factors for crop insurance uptake and assessing whether there was any significant difference between subscribers of insurance and non-subscribers. The study findings indicated that there was a significant relationship between the following independent variables: marital status-single, years of farming, farmer organisations/groups, land ownership, land size, on-farm income, and experience with production risks. Of the variables, all had a positive relationship except for land ownership. Socio-economic characteristics such as marital status and low literacy levels had an influence on the decision to access crop insurance. Crop insurance appeared to be more gender biased on the subscribers' group, while crop diversification and use of good agricultural practices certainly influenced the uptake of crop insurance. Crop insurance also had a positive relationship with access to credit.

Overall findings indicate that a substantial number of farmers do not fully understand the insurance concept. Awareness of the instrument is low, and it implies that there should be greater efforts to increase awareness on crop insurance, to promote the uptake of crop insurance. A common challenge from key informant interviews established that trust has remained a constraint for crop insurance uptake, as most of those who did not access crop insurance, did not trust the project that provided crop insurance.

6. RECOMMENDATIONS

- Based on the above results, it is recommended that the Government's efforts to develop an agriculture insurance scheme should start with providing targeted awareness and sensitization on the risks associated to crop farming and the tools available for hedging production risks.
- Provision of crop insurance should look into several factors that may affect farmers' decisions to uptake crop insurance. These factors range from socio-economic, farm characteristics and other exogenous factors. It was evident that the sampled project performed well due to bundling of crop insurance with other farm inputs. Most farmers are poor, so bundling crop insurance with inputs such as fertilizer and agro-chemicals is more attractive to farmers and will increase crop insurance uptake.
- Access to credit for farmers remains an untapped input by agri-lending institutions. If credit is bundled well with insurance, it will not only guarantee premium payments in case of crop loss but will also increase financial access to most smallholder farmers, resulting in more inclusivity and better economic outcomes. Government should encourage more formal agricultural lending by participating financial institutions.

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