Subsistence versus Cash Crop Weather Index Insurance. A Willingness to Pay Study for Maize and Bean Crops in Mafeteng, Maseru and Berea Districts

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The research is financed by Economic Research Consortium, through Collaborate Master of Science in Agricultural and Applied Economics Programme, P.O. Box 62882-00200, Nairobi, Kenya

Abstract

The paper analysed the potential of weather index insurance as one of the strategies for managing climate variability in Lesotho through a Double Bounded Dichotomous Choice Contingent Valuation Method with an open ended follow up question to elicit farmers’ willingness to pay. The study went further to compare willingness to pay for weather index insurance between a cash crop (Bean) and a subsistence crop (Maize). Bivariate probit model was used in the analysis. Based on data collected from 400 farmers, the results showed that majority of farmers are willing to insure their crops; maize (94.75%) and bean (92.5%) against weather perils and pay a monthly premium of M96.72 ($7.28) for maize and M101.31 ($7.63) for beans. This implies that farmers in the lowlands of Lesotho regard weather index insurance as one of the strategies for managing climate variability. The results of the t-test showed statistical significance (p<0.1) between maize and bean mean willingness to pay. Thus, policy and program intervention designed to address the climate variability problem in the study area should consider these preferences in the insurance product.

Keywords: Willingness to pay, weather index insurance, maize, beans

1. Introduction

Climate variability is a major threat to agricultural production in many developing countries including Lesotho due to its overreliance on rain fed production. Lesotho experienced severe weather conditions which affected agricultural production and suppressed growth in 2011 and 2012. The 2011/2012 heavy rainfall affected maize which is a staple food to 62% of the population. This disaster affected 514, 000 people who needed food assistance to survive (Government of the Kingdom of Lesotho [GoL], 2011). Although there was a modest recovery in the crop subsector and positive growth from animal farming, services and forestry in 2013 (GoL, 2013), the growth was short-lived. The country experienced yet another blow from dry spells in 2015 that forced government, United Nations and other humanitarian partners to invest in emergency and relief services to assist majority of the farmers who did not plant or harvest anything (United Nations [UN], 2016). Despite the climate variability challenge, agriculture is the main source of livelihoods for majority of rural families in Lesotho.

More than 80% of the population resides in rural areas and depends on subsistence farming and to a limited extent on pastoral production. However, only 9% of the total area is suitable for arable cultivation (GoL, 2014a). The major crops commonly grown are cereals and cash crops. Maize is the main cereal crop which covers 60% of agricultural land in Lesotho (GoL, 2014b). It is consumed in the households and used as an input in the industries for processing high value added products. Its straw is used as livestock feed for most animals. Dry bean is a very common cash crop because Lesotho’s topography is suitable for dry bean production. The most common dry bean types are white and sugar beans. Dry bean is a vital and high value subsistence cash crop of smallholder farmers throughout Lesotho. Beans are high in protein, and serve as a substitute for the scarce animal and fish protein (Sefume, 2010). They are also promoted by the GoL and World Food Programme (WFP) through School Feeding Programme. However, yields have been declining for major crops in Lesotho because of factors such as low rainfall during planting time, and development stage. Area planted fluctuates between 9000 to 30000 hectares annually (World Bank, 2014). This suggests that crop production damage affects the welfare of many households.

Considering the dependence of Lesotho population on agricultural production, the irreplaceable crop production loss due to weather variability makes research and development on strategies to manage climate variability risks a priority. The current climate risk management strategies employed by farmers such as intensification, diversification, savings and borrowings may relief farmers out of smaller losses. Such measures tend to fail in the event of catastrophic shocks such as drought crisis (Heltberg & Lund, 2009; Dercon, 2002).
Transferring the risks to a third party or insurance provider is one of the options to managing climate variability (Giné & Yang, 2009). Recent studies have shown that index based insurance can assist farmers to hedge against risks and also encourage farmers to venture into high value crops with high returns (Mapfumo, 2008; Bryla & Syroka, 2007). There is a large body of literature on economics of weather index based insurance (Abebe & Bogale 2014; Ramasubramanian 2014; Makaudze & Miranda, 2010). However, no study has compared farmers demand for cash and subsistence crop despite the fact that the crops play different roles on household’s welfare. This study therefore tests the hypothesis that farmers’ willingness to pay (WTP) for cash crop and subsistence crop weather index insurance is different. The study went further to establish determinants of farmers’ decision to participate in maize and bean weather index insurance.

1.1 Study Context

Most researchers define index insurance as an insurance which compensates the insured based on the objectively observed value of an index that is correlated with the yield losses (Barnett & Mahul, 2007). The index can be in the form of rainfall data which is usually collected from local weather stations, Normalized Difference Vegetation Index (NDVI) which is collected by satellites and measures vegetation density, sea surface temperatures (SST) and cumulative temperature over a season that is strongly associated with insurable loss (Skees, 2008). The details of how the insurance works are provided by figure 1.

\[ \text{Compensation} \]

\[ \text{Weather index trigger levels} \]

Figure 2 : Weather Index based insurance compensation and index trigger levels
Adapted from Makaudze and Miranda, 2010

Figure 1 shows that when the insurance index is triggered at point “A”, the insurer will compensate the farmer “FC” which is the full payment such that the production loss is eliminated and the farmer revenue stays crop production loss free. If the index is triggered between point “A” and “B”, the farmer will get full compensation. But if the index is triggered between “B” and “C”, the farmer gets proportional compensation depending on the level of index. For instance, if the index is at “B’C”’, the compensation will be “PC”. And lastly if the index is from point “C”, the index is not triggered therefore there will be no compensation.

Thus, Index insurance is free from moral hazard (farmers cannot influence the value of the index) and adverse selection (payouts are based on generally observed variables) in that the contract is standardized and there is no need to individually design the contract or verify losses which can substantially reduce the transaction costs of monitoring and verifying the insurance contracts (Barnett & Mahul, 2007; Miranda & Vedenov, 2001; Miranda, 1991). In addition, it is cheaper to administer because it does not require on-farm inspections and field loss assessments.

2 Empirical Methodology

The study used double bounded Contingent Valuation (CV) technique to elicit WTP. With double bounded format, there are four possible outcomes “yes-yes”, “yes-no”, “no-yes” and “no-no” responses. First, the respondent \( k \) was asked if she/he would be willing to pay a certain bid \( B_k \) (starting bid) for weather index
insurance. If she/he said “yes”, she/he was offered a second, higher bid, \(B_H\) where she/he either accepted or rejected. For respondents who said “no” to the initial bid, they were offered a second, lower bid, \(B_L\) where they also had a chance to reject or accept it. Following Hanemann et al. (1991) the four discrete outcomes are;

\[
D_k = \begin{cases} 
1 & \text{if } \text{WTP} > B_H \\
2 & \text{if } B_L < \text{WTP} < B_H \\
3 & \text{if } B_L < \text{WTP} < B_S \\
4 & \text{if } \text{WTP} < B_L 
\end{cases}
\]  

(1)

The general econometric model is then specified as;

\[
WTP_{jk}^* = \mu_j + \epsilon_{kj}
\]  

(2)

where \(WTP^*\) is the unobserved WTP for \(k^{th}\) households and \(j\) is the household response to the first bid and second bid, \(\mu\) is the mean WTP of the first and second bids, and \(\epsilon\) is the error term with mean zero for the first and second bids. Treating the means as a function of individual covariates;

\[
\mu_j = \beta X_{kj} \rightarrow WTP_{kj} = \beta X_{kj} + \epsilon_{kj}
\]  

(3)

Equation (3) accommodates the \(k^{th}\) respondent to first and second responses to the CV question. To construct the likelihood function we derive the probability of observing each of the two-bid response sequence (yes-yes, yes-no, no-yes, no-no). The probabilities corresponding to the above outcomes are;

\[
\begin{align*}
\text{Pr}(D = \text{yes} - \text{yes}) & = \text{Pr}(B_S \leq \text{Max WTP}, B_H \leq \text{Max WTP}) \\
\text{Pr}(D = \text{yes} - \text{no}) & = \text{Pr}(B_S \leq \text{Max WTP} \leq B_H) \\
\text{Pr}(D = \text{no} - \text{yes}) & = \text{Pr}(B_S \geq \text{Max WTP} \geq B_L) \\
\text{Pr}(D = \text{no} - \text{no}) & = \text{Pr}(B_S > \text{Max WTP}, B_L > \text{Max WTP})
\end{align*}
\]

(4)

The log-likelihood function then becomes;

\[
\log L = \sum_{i=1}^{N}[\text{Pr}(B_S \leq \text{Max WTP}, B_H \leq \text{Max WTP}) + \text{Pr}(B_S \leq \text{Max WTP} \leq B_H) + \text{Pr}(B_S \geq \text{Max WTP} \geq B_L) + \text{Pr}(B_S > \text{Max WTP}, B_L > \text{Max WTP})]
\]

The WTP for each individual has a bivariate normal distribution with mean zero and constant variance. Thus, the bivariate probit model was estimated to determine the mean WTP. Following Greene (2002), the bivariate probit model is specified as;

\[
\begin{align*}
WTP_1^* & = \alpha + \beta X + \varepsilon_1 \\
WTP_2^* & = \theta + \varphi X + \varepsilon_2
\end{align*}
\]  

(5)

(6)

where \(WTP_1^*\) and \(WTP_2^*\) are household willingness to pay for the first bid and second bid, respectively. \(\beta\) and \(\varphi\) are parameters to be estimated for each model and \(\varepsilon_1\) and \(\varepsilon_2\) are model disturbance terms. The error terms are independent of each other and normally distributed with mean zero and constant variance. The Xs are explanatory variables.

Equations (5) and (6) were estimated through bivariate probit using maximum likelihood method. From the bivariate probit model, the mean willingness to pay which is the demand for weather index insurance was then estimated as;

\[
MWTP_1 = -\frac{\alpha}{\beta} \quad \text{and} \quad MWTP_2 = -\frac{\theta}{\varphi}
\]  

(7)

where \(\alpha, \beta, \theta\) and \(\varphi\) are parameter estimates for the constants and \(\beta\) and \(\varphi\) are parameter estimates explanatory variables (Haab & McConnell, 2002).

2.1 Study variables and their measurement

Based on the reviewed literature, socio-economic and geographical variables used in the empirical models are summarized in a table below;
Table 2.1: Variables description, units of measurement and hypothesised sign

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code</th>
<th>Measurement</th>
<th>Postulated sign</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-economic characteristics of the farmer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household monthly income</td>
<td>Income</td>
<td>Continuous</td>
<td>+/-</td>
<td>Ghazanfar et al. 2015; Ali, 2013</td>
</tr>
<tr>
<td>Previous exposure to risk</td>
<td>Lossexper</td>
<td>1= Yes if the farmer has been exposed to weather risk before, 0= No</td>
<td>+/-</td>
<td>Ghazanfar et al. 2015; McIntosh et al. 2013; Liu et al. 2015</td>
</tr>
<tr>
<td>Number of years of farming</td>
<td>Yearsoffarm</td>
<td>Continuous variable indicating number of years the farmer has been practicing farming</td>
<td>+/-</td>
<td>Zhang and Fan, 2016</td>
</tr>
<tr>
<td>Education type</td>
<td>Eductype</td>
<td>1= Formal, 0= Informal</td>
<td>-</td>
<td>Gebre, 2014</td>
</tr>
<tr>
<td>Access to climate variability information</td>
<td>Climateinfor</td>
<td>1= Yes, if the farmer owns a radio, and 0= No</td>
<td>+</td>
<td>Abebe and Bogale, 2014</td>
</tr>
<tr>
<td>Current risk management strategies</td>
<td>Strategyadeq</td>
<td>1= Adequate, 0= Inadequate</td>
<td>-</td>
<td>McIntosh et al. 2013</td>
</tr>
<tr>
<td>Age of the farmer</td>
<td>Age</td>
<td>Continuous variable showing number of years of the farmer</td>
<td>+/-</td>
<td>Abebe and Bogale, 2014; Zhang and Fan, 2016; Abdullah et al. 2014</td>
</tr>
<tr>
<td>Gender of the farmer</td>
<td>Gender</td>
<td>1= male, 0= female</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Institutional factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Size</td>
<td>Landsize</td>
<td>Number of acres planted by the farmer, Continuous</td>
<td>+</td>
<td>Ghazanfar et al. 2015; McIntosh et al. 2013; Akter et al. 2009</td>
</tr>
<tr>
<td>Geographical factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mafeteng</td>
<td>Mafeteng</td>
<td>This is a dummy variable that indicates whether a farmer stays in Mafeteng District or not; 1= Yes, 0= No</td>
<td>+/-</td>
<td>Bendig et al. 2009</td>
</tr>
<tr>
<td>Maseru</td>
<td>Maseru</td>
<td>This is a dummy variable that indicates whether a farmer stays in Maseru District or not; 1= Yes, 0= No</td>
<td>+/-</td>
<td></td>
</tr>
<tr>
<td>Berea</td>
<td>Berea</td>
<td>This is a dummy variable that indicates whether a farmer stays in Berea District or not; 1= Yes, 0= No</td>
<td>+/-</td>
<td>Barry et al. 2004; Cole et al. 2009</td>
</tr>
</tbody>
</table>

3 Data and Sampling

400 farmers were face to face interviewed using structured questionnaires in the three districts of Lesotho: Mafeteng, Maseru and Berea in 2016. The questionnaire was structured using National Oceanic and Atmospheric Administration (NOAA) guidelines for conducting CV surveys. The first part of the questionnaire consisted of farmers’ perception on climate variability and its effects on their farms. The second part looked at the current strategies and their weaknesses in managing ex-ante climate variability risks. The third part described the CV scenario and lastly the final part looked at the socio-economic characteristics of the farmers. Before the implementation of the study, a pilot study was conducted to establish starting bids and also to pre-test the questionnaire for modifications.

4 Results and Discussion

4.1 Descriptive statistics

The study results as summarised in table 4.1 show that out of 400 smallholder farmers interviewed, 95% were willing to participate in the weather index insurance for Maize and 93% were willing to pay for weather index insurance for beans. This implies that most farmers are willing to insure their crops based on weather derivatives. The average household monthly income for each household is M1293.88. The primary source of income was stated by most farmers as farming (48.60%), self-employed (25.19%), employed (21.12%) and lastly pension was stated by 5.09% of the farmers as their primary source of income. On average each household had access to 5.51 acres of agricultural land. Most of the land was owned by the farmers, few stated that they rented and share cropped. The results of the survey further showed that farmers have been practising farming for a long time. Further 75.43% of the farmers stated that they had suffered production loss due to climate variability in the previous years. Climate variability information help farmers to prepare against weather hazards before they occur and 97.24% of the smallholder farmers indicated that they have access to climate variability information in the country through radio, television set, newspapers and cell phones. Majority of the farmers (75.9%) stated

that they perceive more extreme weather conditions to prevail in the country in the next 10 years. This suggests that farmers are aware of the climate variability situation and the fact that it is not over yet. Farmers have their own indigenous climate variability risk management strategies, however few of the farmers 42.61% stated that their risk management strategies are adequate. This implies that more farmers 57.39% feel that their current coping mechanisms are lacking. Out of the sampled respondents, 58.39% were men while 41.61% were women. This is not surprising since after retrenchment from the South African mines, most men had to venture into farming so as to make living while majority of the women worked at the factories. In line with the national statistics, majority of the sampled farmers have attended formal schooling. Thus they have basic reading, writing and calculation skills. They can therefore weigh options which is important when making decision whether to take part in agricultural insurance or not.

Table 4.1: Summary statistics of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTPMAIZE (yes = 1)</td>
<td>0.947468</td>
</tr>
<tr>
<td>WTPBEANS (yes = 1)</td>
<td>0.924812</td>
</tr>
<tr>
<td>Household monthly income</td>
<td>1293.885</td>
</tr>
<tr>
<td>Land size in acres</td>
<td>5.514286</td>
</tr>
<tr>
<td>Age of the farmer</td>
<td>44.88722</td>
</tr>
<tr>
<td>Number of years of farming</td>
<td>19.96684</td>
</tr>
<tr>
<td>Number of years of schooling</td>
<td>8.876574</td>
</tr>
<tr>
<td>Previous exposure to risk (yes= 1)</td>
<td>0.754386</td>
</tr>
<tr>
<td>Access to climate variability information (yes= 1)</td>
<td>0.9724311</td>
</tr>
<tr>
<td>Forecast severe weather conditions in the future (yes= 1)</td>
<td>0.7593985</td>
</tr>
<tr>
<td>Current risk management strategy adequate (yes= 1)</td>
<td>0.4260652</td>
</tr>
<tr>
<td>Gender of the farmer (Male=1)</td>
<td>0.5839599</td>
</tr>
<tr>
<td>Education type (Formal= 1)</td>
<td>0.9348371</td>
</tr>
</tbody>
</table>

Source: Survey, 2016

4.2 Farmers WTP distribution by crop type, location and Reasons for not willing to pay

Majority of farmers (94.75%) are willing to pay for maize weather index insurance (see Figure 4.1). Likewise, majority of farmers (92.5%) are willing to pay for bean weather index insurance (see Figure 4.2). The results are consistent with Abebe and Bogale (2014). Abebe and Bogale (2014) found that majority of farmers were willing to pay for rainfall insurance in central Rift valley, Ethiopia. Similarly, Gebre (2014) and Ramesubramanian (2014) found that many farmers were willing to pay for insurance. This implies that farmers regard weather index insurance as one of the strategies that can be adopted on their farms for managing climate variability risks.

Figure 4.1: WTP distribution for maize weather index insurance
Source: WTP Survey, 2016
Figure 4.2: WTP distribution for bean weather index insurance

Source: WTP Survey, 2016

Few farmers are not willing to pay for maize and bean weather index insurance. The reasons are provided in Table 4.2

Table 4.2. Reasons for not willing to pay for insurance

<table>
<thead>
<tr>
<th>Reason for not WTP</th>
<th>Maize model</th>
<th>Bean Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mafeteng (N=8)</td>
<td>Maseru (N=6)</td>
</tr>
<tr>
<td>Cannot afford insurance</td>
<td>59%</td>
<td>21%</td>
</tr>
<tr>
<td>Current risk management strategies are enough</td>
<td>0%</td>
<td>45%</td>
</tr>
<tr>
<td>Lack of information about insurance</td>
<td>41%</td>
<td>34%</td>
</tr>
</tbody>
</table>

Source: WTP Survey, 2016

Table 4.2 shows that the major reason for not willing to pay for both maize and bean weather index insurance is lack of information about the insurance. This is consistent with Sadit et al. (2010) who indicated that farmers' knowledge of advantages and disadvantages of rainfall insurance have positive impact on their propensity to accept insurance.

4.3 Farmers’ WTP Responses Distribution by Geographical District and Crop Type

In double bounded method, initial bids were randomly distributed to respondents. The initial bids were obtained from the pilot study of 10 randomly chosen respondents in the areas not targeted for the study. Each initial bid was doubled when the respondent answered yes to the initial bid and halved if the respondent answered no to it. The initial bid is represented by Bid1 and the follow up bid by Bid2 (Table 4.3). The double bounded CV yields four outcomes (No-No, No-Yes, Yes-No and Yes-Yes) (Haab & McConnell, 2002:118).

Table 4.3. Summary of discrete responses to maize double bounded questions

<table>
<thead>
<tr>
<th>Bid 1</th>
<th>Bid2</th>
<th>No-No</th>
<th>No-Yes</th>
<th>Yes-No</th>
<th>Yes-Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>40</td>
<td>20</td>
<td>6</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>40</td>
<td>80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>60</td>
<td>30</td>
<td>9</td>
<td>18</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>60</td>
<td>120</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>80</td>
<td>40</td>
<td>7</td>
<td>21</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>80</td>
<td>160</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>100</td>
<td>50</td>
<td>13</td>
<td>22</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>37</td>
<td>66</td>
<td>140</td>
<td>157</td>
</tr>
</tbody>
</table>

Percentage (n = 400) | 9.25 | 16.5 | 35 | 39.25

Source: WTP Survey, 2016
Determinants of farmers’ decision to participate in maize and bean weather index insurance were estimated using the probit model. The probit model estimates do not have economic meaning and therefore average partial effects which showed changes in the probability of a farmer participating in maize and bean weather index insurance were computed. The results are presented in Table 4.6.
positive and significant effect on farmers’ decision to insure both maize and bean crops. Abebe and Bogale (2010) also observed that if a farmer spends more years in farming, they are more likely to pay for insurance. This implies that farmers who have experienced crop production loss due to weather variability are more likely to insure their maize and bean crops than those who have not because they have knowledge of effects of weather changes in maize and bean production. Similar results were reported by Ghazanfar et al. (2015). McIntosh et al. (2013) however, found that previous exposure to loss adversely affects willingness to pay for crop insurance while Liu et al. (2015) found no significant difference between farmers who had previously experienced floods on their farms and those who did not in China.

Agricultural practices are more likely to be followed by farmers with adequate strategies (McIntosh et al., 2013). Barry et al. (2015) found no significant difference between farmers with limited resilience to climate variability effects and those who have not because they have knowledge of effects of weather changes in maize and bean production. Similar results were reported by Ghazanfar et al. (2015). McIntosh et al. (2013) however, found that previous exposure to loss adversely affects willingness to pay for crop insurance while Liu et al. (2015) found no significant difference between farmers who had previously experienced floods on their farms and those who did not in China.

Farmers’ decision to insure their bean crop is positively and significantly affected by the type of education attended by farmers implying that farmers with formal education on agricultural practices are more likely to insure their bean crop than farmers with informal education. Similarly, Paulos (2002) found that education type positively influenced farmers’ demand for crop insurance.

The number of years a farmer has been practicing farming has a positive and significant effect on maximum amount to pay for maize weather index insurance only. This is because farmers have experience of the farming business and risks and opportunities associated with. Thus, farmers with more years of farming will be willing to pay for maize index insurance. Sadit et al. (2010), also observed that if a farmer spends more years in farming, then there is a high likelihood of him/her paying for index insurance since he/she tends to understand the farming problems and opportunities better.

The average partial effect results show that farmers’ decision to insure their maize crop is negatively and significantly influenced by adequacy of current weather variability risk management strategies. This means that farmers with limited resilience to climate variability effects are more likely to insure their maize crop than those with adequate strategies (McIntosh et al. 2013). This is expected because low resilient farmers see insurance as their next best option for protecting their crop production from fluctuating.

Access to climate variability early warning information assists farmers to prepare in advance for any changes that may happen in their production. The results show that access to this kind of information has a positive and significant effect on farmers’ decision to insure both maize and bean crops. Abebe and Bogale (2014) reported that farmers with access to weather variability early warning information resources such as radio are more likely to insure their crop than their counterparts.

Age of the farmer positively and significantly affects farmer decision to pay for Maize weather index insurance. However, age-squared variable shows a negative relationship between age and willingness to pay. Thus, farmers have an increasing WTP up to a specific age, before the WTP for insurance decreases due to higher incentives to protect their families from certain hazards the age of the farmer follows a u-shape (Bendig and Arun, 2011).

The coefficient for land size is positive and significant for both maize and bean crops weather index insurance models. This implies that farmers with more land are more likely to take maize and bean insurance. This is expected because farmers with more land lose more in terms of inputs used in planting their fields or opportunity cost of not planting in case planting is skipped due to weather changes (Ghazanfar et al. 2015; Akter et al. 2009; McIntosh et al. 2013). Barry et al. (2004) also found that farmers with larger land size have greater managing capacity and utilize economies of scale, therefore they will be willing to pay for insurance.

The results further indicate that farmers in Maseru District are more likely to participate in maize insurance markets than farmers in Mafeteng. This is shown by the positive and significant effect of Maseru District dummy variable on WTP decision for maize weather index insurance. This result might be due to the differences in the

### Table 4.6. Determinants of farmer’s decision to pay for maize and bean weather index insurance

<table>
<thead>
<tr>
<th>Variable</th>
<th>APE after probit Maize weather index insurance</th>
<th>APE after probit bean weather index insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>APE</td>
<td>Std. Err.</td>
</tr>
<tr>
<td>Losssexper</td>
<td>0.0480</td>
<td>0.0218</td>
</tr>
<tr>
<td>Eductype</td>
<td>0.0515</td>
<td>0.0351</td>
</tr>
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Key: *, **, *** represent significance level at 10%, 5% and 1%. APE is the average partial effect after probit.
average household incomes of farmers between the districts. The descriptive statistics have shown that farmers in Mafeteng have higher average monthly income than farmers in Maseru. Therefore, higher income functions as an endogenous risk management capability of the farmer to buy grain in case their crop fails (McIntosh et al. 2013). Furthermore, Mafeteng is a high risk area as it has very low rainfall. Bendig et al. (2009) indicated that households which assume that they are more vulnerable to risk opt not to use any financial services at all and are especially unlikely to use insurance on top of other services. This explains the low WTP for farmers in Mafeteng District.

5. Conclusion and Recommendations

The purpose of this study was to determine the mean WTP for maize and bean weather index insurance and to test the hypothesis that the mean WTP for maize and bean weather index insurance is different in Mafeteng, Maseru and Berea Districts. The mean WTP was estimated for the full model and at district levels. The study has shown that majority of farmers are willing to pay for bean and maize weather index insurance estimated at 94.75% for maize and 92.5% for bean. The district with the highest percentage of farmers willing to pay for both maize and bean weather index insurance is Maseru. The mean WTP for maize weather index insurance is M103.12 in Maseru, as opposed to M101.46 in Berea and M77.74 in Mafeteng Districts. For bean weather index insurance, mean willingness to pay in Maseru is M110.56 as opposed to M99.38 in Berea and M92.11 in Mafeteng District. The results have shown that the monthly mean WTP for maize weather index insurance is M96.72 and M101.31 for beans. Thus, farmers are willing to pay a higher amount for bean than maize weather insurance.

This study rejects the hypothesis that mean WTP for maize and bean crop insurance in the lowlands of Lesotho is the same. The study therefore concludes that the mean WTP differs by crop type and geographical location (district). Further the study concludes that there are some factors that have significant effect on farmer’s decision to join MWI such as loss experienced, adequacy of applied current risk management strategies access to climate variability information, age of the farmer, land size, and being located in Maseru district. The study further concluded that loss experienced, education type, access to climate variability information, and land size positively influenced farmers’ decision to participate in BWI whilst adequacy of current risk management strategies have a negative effect.

The study recommends that since farmers are willing to pay for maize and bean weather index insurance, there is a need for policy makers and stakeholders to establish maize and bean weather index insurance program in Lesotho. However, the policy and program intervention should consider differentiating the insurance product by crop type and location and also consider the following:

- Access to climate variability information significantly influenced farmers’ decision to participate in weather index insurance and majority of the farmers had access to this information. Therefore, continued provision of climate variability early warning information is likely to increase the demand for weather index insurance for both crops. Thus, broadcasting of this information is advocated.

- Lack of knowledge of weather index insurance is identified as the main reason for not willing to join insurance. Extension services through awareness programs on the long term impacts of the existing informal risk coping strategies and how these measures may fail in certain circumstances is recommended to help households re-think their risk coping portfolio. Enlightening households on how formal insurance works and how they can cater to catastrophic shocks by pooling risks across larger geographies may encourage them to invest in market-based formal risk management techniques such as weather index insurance to deal with shocks in the long run.

- The study focused only on the demand side of weather index insurance, therefore further study is recommended on the supply side of weather index insurance to determine if the amount farmers are willing to pay is an actuarially fair insurance premium.

References
Bryla E & Syroka J, (2007). Developing Index-Based Insurance for Agriculture in Developing Countries. United nations Department of Economic and Social Affairs Division for Sustainable Development Policy Integration and Analysis Branch Innovation Brief, New York, NY.


