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Willingness to Pay For Climate Change Adaptation Strategies among Small-scale Crop Livestock Farmers in Limpopo Province, South Africa

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ABSTRACT This study analysed factors affecting small-scale farmers' willingness to pay for climate change adaptation strategies in the Limpopo province, South Africa. It employed a Binary Logistic Regression Model, which fitted to data from a cross-sectional survey of 456 small-scale farmers based on the probability proportional to sample size. About seventy-four percent sampled small-scale farmers were willing to pay for climate change adaptation strategies. The empirical results revealed that age, gender, marital status, farming experience, total household income, household size, number of sources of income, access to credit, livestock value, land size owned, experience of crop failure and livestock loss, access to climate change information and total household expenditure have a significant effect on small-scale farmers' willingness to pay for climate change adaptation strategies. These results have policy implications for government and stakeholders to improve the welfare of small-scale farmers by enhancing their sustainable agricultural development.

INTRODUCTION

Agriculture remains to be a significant sector of the South Africa's economy despite its dropping portion in the national income and Gross Domestic Product (GDP) (Gbetibouo 2009). The current decline in agricultural production in South Africa would be addressed through effective climate change adaptation and mitigation strategies. Therefore, climate change adaptive strategies in agricultural production are essential for socio-economic development and maintaining sustainable livelihoods of small-scale farmers in rural communities of South Africa. Adaptation is generally acknowledged as an imperative constituent of any policy's response to climate change impacts and variability. Studies from developing countries, particularly, South Africa have shown that without adaptation, climate change is generally detrimental to the agricultural sector; but with adaptation, vulnerability can be fundamentally abridged (Alam et al. 2011; Bhusal 2009). Additionally, the adaptation strategies that the farmers adopt also vary by location, resources, socio-economic and institutional factors. Adaptation approaches are strategies that permit the community to handle with or adjust to the impacts of the climate in the local areas (Amusa et al. 2015; Deressa et al. 2011). According to Deressa et al. (2011), adaptation to climate change is the alteration in natural or human systems in response or expected climatic stimuli or their effect, which moderates harm or exploits beneficial opportunities. Adaptations necessitate the participation of various stakeholders, including policymakers, extension agents, Non-government Organisations, researchers, communities, and farmers (Bryan et al. 2013). Adaptation at the community level refers to the capability to sustain and preferably expand the current living standards in the face of expected changes in climate trends, that may affect people's livelihoods (Alam et al. 2011; Deressa et al. 2009).

An excessive number of researches have been conducted on farm-level adaptation to climate change across dissimilar disciplines in several countries including South Africa, which discovered farmers' adaptive performance and their determinants (Erasmus et al. 2000; Gbetibouo 2009; Apata 2009). These climate change adaptation strategies are widely documented in various sources and ways such as books, journal

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articles, reports, etc. However, when it comes to proving or analysing whether these strategies will be adopted at the farm-level, limited studies have been established, particularly, in the Limpopo province. Various studies have shown that diverse socio-economic and institutional factors are important determinants of small-scale farmers' willingness to pay for conservational and natural resource-based (Akhter 2013; Anemut 2006; Aydogdu and Bilgic 2016; Ayedun et al. 2017; Birara and Beneberu 2019; Ghazanfar et al. 2015; Kong et al. 2014; Masud et al. 2015; Tadesse and Bishu 2018; Zhu et al. 2016). Akhter (2013) showed a study on factors affecting farmers' willingness to pay for the index based crop insurance in Pakistan. The empirical results of the above-mentioned study indicated that farmers' economic status, household assets and membership of community organisation are the important factors of their willingness to pay a higher insurance premium. Moreover, Ghazanfar et al. (2015) employed the Contingent Valuation Method (CVM) and Heckman selection models to analyse factors influencing farmers' willingness to participate and pay for crop insurance in Pakistan. Findings revealed that farmers were interested in paying a minimum amount of premium. Landholdings and farm income were found to be significant factors that influence farmers' willingness to pay for crop insurance. Moreover, landholding, farm income, credit, loss experience, land tenure and expected yield were found to be significant influencing factors towards willingness to participate in crop insurance. In addition, Mustafa and Abdulbaki (2016) conducted a study on an evaluation of factors influencing farmers' willingness to pay for efficient irrigation for sustainable usage of resources in Turkey.

Based on the authors' knowledge, no studies have been conducted delineating whether Limpopo province small-scale farmers are willing to pay for these relative adaptation strategies. Willingness to pay is the amount of money that a respective small-scale crop and a livestock farmer is willing to pay for a certain existence climate change adaptive strategy. The extents to which the farmer would look forward to pay for climate change adaptive strategy depends on the type of the adaptive strategy ascribed to its relative benefits or outcomes. The decision of whether or not to use and pay for some adaptation choice might fall under the general framework of random utility and profit maximisation. Additionally, willingness of these types of farmers to accept or adopt a particular strategy does not completely mean willingness to pay for that strategy, and this could be for a number of reasons. Therefore, this study was undertaken to bridge this particular above-mentioned research information gap.

Scope of the Study

The aim of the study was to profile socio-economic characteristics of small-scale farmers by analysing factors affecting their willingness to pay for climate change adaptation strategies in the districts of Limpopo province, South Africa. Furthermore, the study explored small-scale farmers' perceptions towards their actual climate change adaptive measures using the Likert-scale analysis.

Specific Objectives of the Study are to:

i. Profile small-scale farmers' socio-economic characteristics and their perceptions towards climate change in the study area.

ii. Analyse the socio-economic factors influencing the decision of small-scale farmers' willingness to pay for climate change adaptation strategies.

Research Hypothesis

Socio-economic factors do not influence the decision of small-scale farmers' willingness to pay for climate change adaptation strategies.

METHODOLOGY

Study Area

This research was conducted in the Limpopo province, which is situated in the northern part of the Republic of South Africa and shares borders with Botswana, Zimbabwe and Mozambique. The province is divided into high (Vhembe and Mopani) and low (Capricorn, Waterberg and Sekhukhune) veld districts wherein, each district consists of a number of small-scale crop

and livestock farmers at different municipalities. The Limpopo province has rainfall of over 700mm per annum, which makes it suitable for agricultural production (M'Marete 2003). Figure 1 shows the location of the districts in the province depicted by the shaded part in the map.

Sampling and Data Collection

A multi-stage sampling procedure was used to select small-scale farmers in municipalities from each district. A simple random sampling procedure based on probability proportional to sample size was considered and is shown in Table 1. In addition, primary data source was used for this study. Quantitative cross-sectional data was collected through face-to-face interviews using structured questionnaires from mid-March to mid-June 2018. The list of small-scale farmers was obtained from the district offices of the Limpopo Department of Agriculture. A total of 456 small-scale farmers in five districts of Limpopo province were surveyed using a structured questionnaire from a sample frame of 2,619. Both IBM SPSS version 25.0 and STATA version 12.0 computer programs were utilised to process the data. Two types of analysis, namely, descriptive and econometric were used for analysing the collected data.

Table 1: A simple random sampling procedure based on probability proportional to sample size was considered

Districts	*Total number small-scale farmers*	*Percentage*	*Total small-scale farmers interviewed*
Capricorn	422	16	**73**
Mopani	622	24	**107**
Sekhukhune	724	28	**126**
Vhembe	607	23	**108**
Waterberg	245	9	**42**
Total number of sampled small-scale farmers	2619	100	456

Source: Author's own calculations

Empirical Data Analysis

The study employed Binary Logistic Regression Model (BLRM) to analyse factors affecting small-scale farmers' willingness to pay for climate change adaptation strategies. According to Gujarati and Porter (2009), the BLRM model is a statistical modelling technique that is widely used whereby the probability of an outcome has a positive relationship with the series of explanatory variables. Green (2003) explains that the BLRM is used when the dependent variable is dichotomous, and moreover this model's analy-

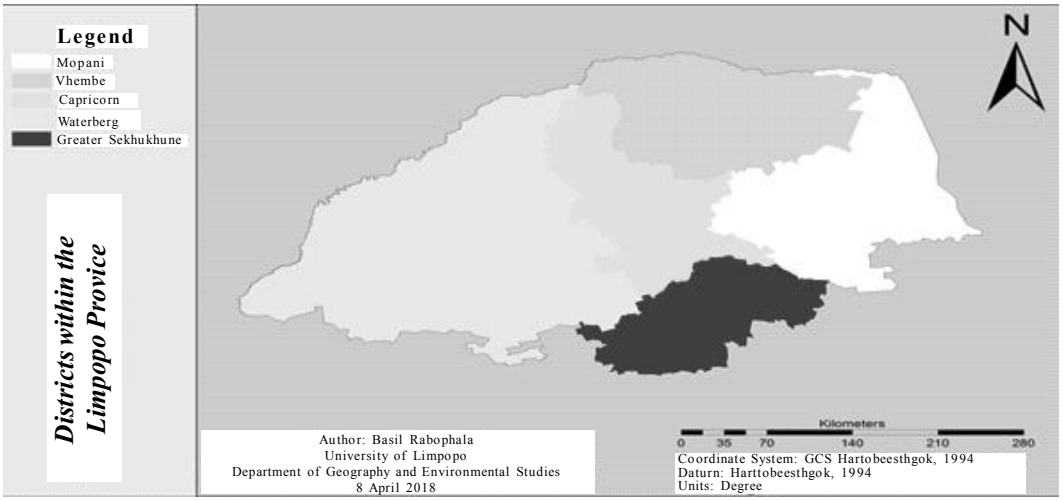

Fig. 1. Location of five districts of Limpopo Province, South Africa
Source: Department of Geography and Environmental Studies

sis spreads the techniques of multiple regression analysis to research situations in which the outcome variable is categorical. This BLRM is suitable for the current study as the dependent variable has only two possible outcomes, taking the value 1 if small-scale farmers are willing to pay for climate change adaptation strategies and the value of 0 if not willing to pay.

General Binary Logistic Regression Model

$$\text{Logit}(P_i) = \ln\left[\frac{P_i}{1-P_i}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_n X_n + \varepsilon_i \quad (1)$$

Where,

P_i = probability that small-scale farmers are willing to pay given X

$1\text{-}P_i$ = probability that small-scale farmers are not willing to pay given X

β_0 - β_n = parameters to be estimated

X_1 - X_n = explanatory or independent variables

ε_i = disturbance term

$$\frac{\partial P_J}{\partial X_K} = P_J\left(\beta_{JK} - \sum_{J=1}^{J} P_K \beta_{JK}\right) \quad (2)$$

The signs of the marginal effects and respective coefficients may be different, as the former depends on the sign and magnitude of all other coefficients. Table 2 presents the variables that were considered in this analysis of small-scale farmers' willingness to pay for climate change adaptation strategies and their expected signs of the estimated coefficients based on past literature and economic theory. Table 2 also shows variables hypothesised to influence small-scale farmer's willingness to pay for climate change adaptation strategies.

RESULTS AND DISCUSSION

The results attained from the analysis, as shown in Table 3, reveal that mean age and farming experiences of sampled small-scale farmers are 56 and 22 years old, respectively. Out of 456 sampled small-scale farmers, 266 (59%) were found to be male-headed and 192 (41%) female-headed. Results obtained from the survey showed that mean household size and number of adult members of sampled small-scale farmers was 9 and 4, respectively. The two tailed tests' (68.8 and 55.9 t-values) results showed that household size and number of adult members was highly statistically significant at one per-

Table 2: Variables hypothesized to influence small-scale farmer's willingness to pay for climate change adaptation strategies

Variables	*Description on variables and unit measurements*	*Expected sign*
Dependent Variable		
Small-scale farmers' willingness to pay for climate change adaptation strategies	1 if small-scale farmers' is willing to pay for climate change adaptation strategies and 0 otherwise.	
Explanatory Variables		
AGE	Age of the small-scale farmer (years)	+
GENDER	Dummy: 1 if small-scale farmer is male and 0 otherwise	+
MARITAL STATUS	Dummy: 1 if small-scale farmer is married and 0 otherwise	+/-
EDUCATIONAL LEVEL	Number of years small-scale farmer attended school (Years)	+
FARM_EXPERIENCE	Number of years small-scale farmer have been farming (Years)	+
HOUSEHOLD SIZE	Total number of household members living together for six months	+
FREQ_EXTCNTACT	Frequency of annual extension contact (Number)	+
TOTAL_HHINCOME	Total household income of the small-scale farmer (in Rands per year)	+
SOURCES OF INCOME	Total number of sources of income of the small-scale farmer (number)	+
ACC_MARKET	Dummy: 1 if small-scale farmer has access to market and 0 otherwise	+
ACC_CREDIT	Dummy: 1 if small-scale farmer has access to credit and 0 otherwise	+
LAND_OWND	Total land owned by household head (in hectares)	+
CROPFAIL_LIVESTOCK LOSS	Dummy: 1, if the small-scale farmer had any experienced crop failure OR livestock loss due to climate change and 0 otherwise	+
LIVESTOCK VALUE	The value of the livestock owned by small-scale farmer (in Rands)	+
CLIMATE CHANGE INFORMATION	Dummy: 1, if small-scale farmer have access to information about climate change and 0 otherwise	+

Table 3: Continuous variables description of the sampled small-scale farmers under the districts of Limpopo Province, South Africa 2018 (n=456)

Variable definition	*Mean*	*Std. deviation*	*Min.*	*Max.*	*T-test (Sig. 2-tailed)*
Age (years)	56	8.410	31	89	143.5***
Household size	9	2.661	3	16	68.8***
Farming experience	22	10.882	7	43	43.9***
HH adult members	4	1.571	1	8	55.9***
TLand size	28	11.556	9	232	224.3***
Number of income sources of the small-scale farmer	3	1.126	1	6	53.5***
Total household income of sampled scale farmers in year 2017	R139883	9560	R122570	R565560	398.7***
TValue of productive assets	R3343	1136	R14236	R264000	223.3***
TValue of livestock	R28600	8132	R17450	R440882	321.2***
TFarm income in 2017	R14754	16.115	R8598	R179320	24.9***
Distant to the output market	51.37	25.013	6	210	43.8***
Distance to the input market	50.29	23.642	6	190	45.2***
TFarm labourers	22	1.245	7	321	15.7***

Source: Survey data (Mid-March to Mid-June 2018)
Notes: *** means statistically significant at the 1% level

cent (1%) level of significance. This implies that the household size and number of adult members in each sampled household differ.

For input markets, small-scale farmers travelled an average distance of 50.29 km with a maximum distance of 190 km to buy inputs such as seed, chemicals and fertiliser from the nearest towns. The average total income per annum (2017) of sampled small-scale farmers was R139,883 with a minimum and maximum of R122,570 and R565,560, respectively. Moreover, the mean net farm revenue from was R14,754 per annum with a minimum and maximum of R8,598 and R179,320, respectively. The mean source of income was reported as being 3 with a minimum of 1 and maximum of 6. The highly statistical significant t-test results of 53.5 imply that there is a strong mean difference of sources of income of sampled small-scale farmers. Additionally, the mean value of livestock and productive assets values are R14,236 and R28,600, respectively. The highly statistical significant t-test results of 223.3 and 321.2 imply that there is a strong mean difference of livestock and productive assets values owned by sampled small-scale farmers. The result displays that out of 456 sampled small-scale farmers, only 151 (33%) had access to formal market whilst, 305 (67%) did not have access to formal market. The result also indicated that 347 (76%) sampled small-scale farmers did not have access to credit while 109 (24%) did. About 424 (93%) small-scale farmers reported to have information about climate change whereas 32 (7%) of them mentioned to have lack of or access to climate change information.

Thus, the results also indicated that out of 456 sampled small-scale farmers, 133 (29%) sourced climate change information from extension workers, followed by radio sources (19%) and friends or relatives (17%). It was also mentioned that they acquired information about climate change from the Internet (6%), magazines (7%) and newspaper (14%). The climate has been reported by sampled small-scale farmers to be changing in the last 30 years and may continue to change in the future. The larger percentage (38%) of interviewed small-scale farmers strongly agree and believe that the climate is changing, followed by those who were uncertain (24%). Twenty-three percent (23%) of sampled small-scale farmers agreed that the climate is changing, however, five percent disagreed and ten percent strongly disagreed, respectively.

Generally, the results from the survey as shown in Table 4 depict that 109 (24%) sampled small-scale farmers changed their planting dates. Other climate change adaptation strategies reported by sampled small-scale framers include adopting intercropping system (6%), adopting crop rotation (4%), adopting new crop varieties

Table 4: Actual climate change adaptation strategies practised by sampled small-scale farmers under the districts of Limpopo Province, South Africa 2018 (n=456)

Small-scale farmer's actual adaptation strategies to cope with climatic conditions		
Types of climate change adaptive strategies	*Frequency*	*Percentage (%)*
Adopting intercropping system	26	6
Changing planting dates	109	24
Adopting crop rotation	19	4
Adopting new crop varieties	13	3
Farm insurance : Diversification of production (livestock and crop insurances)	40	9
Changing irrigation scheduling	31	7
Reducing number of livestock	34	7
Spraying more fertilizers/ pesticides minerals	19	4
Implementing soil conservation techniques	19	4
Planting trees for shading (reforestation)	20	4
Finding off/non-farm economic activities	85	19
No adaptation strategy at all	41	9
Total	456	100

Source: Survey data (Mid-March to Mid-June 2018)

(3%), farm insurance (9%), changing irrigation scheduling (7%), reducing number of livestock (7%), spraying more fertilisers or pesticides minerals (4%), implementing soil conservation techniques (4%), and planting trees for shading (4%).

Sampled small-scale farmers were also asked to rate their actual adaptation strategies on the Likert-scale based on their importance. About thirty-seven percent and thirty-four percent of sampled small-scale farmers perceived climate change adaptation strategies as being important and very important. However, thirteen percent were uncertain, eleven percent and five percent perceived climate change adaptation strategies as not important and not very important, respectively. The larger percentage (74%) of sampled small-scale farmers were willing to pay for climate change adaptation strategies irrespective of whether they were adapting within or out of the agricultural sector. This implies that sampled small-scale farmers in the study area understand and value their initiated and implemented climate change adaptation strategies.

About twenty-three percent, nineteen percent, and nineteen percent of sampled small-scale farmers who were willing to pay for climate change adaptation strategies charted within the category of R1,001 to R1,500, R1 to R500, and R501 to R1,000, respectively. Only few sampled small-scale farmers (4%) were reported to pay more than R2,000 and ten percent within R1,501 to R2,000. The result in Table 4 shows that the mean payment for climate change adaptation strategies reported by sampled small-scale farmers was R709.82 with a minimum and maximum of R0 and R3,100, respectively. The extent to which small-scale farmers are willing to pay for the strategies depends on the availability of financial resources and benefits to be derived from adaptive measures. All sampled small-scale farmers who reported not to adapt due to various reasons were categorised under not willing to pay. Since sampled small-scale farmers were willing to pay through different levels in relation to their own adaptive measures, their payment levels were categorised. Table 5 depicts reasons for willingness to pay for climate change adaptation strategies by sampled small-scale farmers, meanwhile Table 6 depicts the reasons for not willing to pay for climate change adaptation strategies by sampled small-scale farmers.

Table 5: Depict reasons for willingness to pay for climate change adaptation strategies by sampled small-scale farmers

Reasons	*Frequency*	*Percentage (%)*
No reason because small-scale farmer was not willing to pay	116	26
I feel responsible for my contribution to climate change impacts	15	3
I care about the environment in general	27	6
To avoid future natural disasters	31	7
To reduce future economic damage costs	60	13
To protect and sustain agriculture development	107	24
To prevent negative climate change impacts on agricultural production	92	20
The environment has the right to be protected	8	1
Total	456	100

Source: Survey data (Mid-March to Mid-June 2018)

Table 6: Reasons for not willing to pay for climate change adaptation strategies by sampled small-scale farmers

Reasons	*Frequency*	*Percentage (%)*
No reason because small-scale farmer was willing to pay	338	74
I do not believe in climate change	9	2
My income level is too low	18	4
Climate change does not affect me or my economic activity	11	2
I prefer to spend my money on other things	8	1
I do not believe that such adaptation strategies would have any positive impact	31	8
It is government's responsibility and not area of my interest	30	7
Climate change issue is not important	11	2
Total	456	100

Source: Survey data (Mid-March to Mid-June 2018)

The majority (24%) of the sampled small-scale farmers who were willing to pay, believed that their adaptation measures will protect and sustain their agricultural development and prevent negative climate change effects on agricultural production (20%) (for rationale see Table 5).

The Determinants of Small-Scale Farmers' Willingness to Pay for Climate Change Adaptation Strategies

This section presents the determinants of small-scale farmers' willingness to pay for climate change adaptation strategies in the districts of Limpopo Province. The results of the Binary Logistic Regression Model are presented and discussed from a sample of 456 small-scale farmers. Table 7 reports the results for multi-collinearity using Variance Inflation Factors (VIFs) and its inverse of the respective explanatory variables.

Additionally, an Ordinary Least Square model was run to test for multi-collinearity and heteroscedasticity using the VIF, the inverse variance inflation factor and Breusch-Pagan/Cook-Weisberg test. As a rule of thumb, if the VIF of a variable exceeds 10, there is a multi-collinearity problem. The VIFs for all variables are less than 10 with an average of 2.03 with an inverse variance inflation factor of 0.51, which shows that multi-collinearity is not a serious problem in this model (Gujarati and Porter 2009). There was no heteroscedasticity since the calculated χ^2 value (2.89) was smaller than the tabulated χ^2 value (3.38) at the five percent significance level and one degree of freedom (see Table 8). The results shown in Table 9 depict that sixteen (16) hypothesised socio-economic factors of sampled small-scale farmers have potential to influence their willingness to pay for climate change adaptation strategies. Moreover, these variables were empirically tested. The goodness-of-fit of the model is relatively well with an estimated Cox and Snell, and Nagelkerke R squares of the model with seventy-one percent and sixty-nine percent, respectively. This is satisfactory since it shows that the model was of good fit because

Table 7: Diagnostics to assess the degree of multi-collinearity (n=456)

Explanatory variables	*Collinearity statistics*	
	VIF	*1/VIF*
EDUC_LVL	2.86	0.35
AGE	2.73	0.37
GENDER	2.55	0.39
MARITAL STATUS	2.40	0.42
FARM_EXPERIENCE	2.34	0.43
HOUSEHOLD SIZE	1.98	0.51
FREQ_EXTCNTACT	1.97	0.51
TOTAL_HHINCOME	1.91	0.52
HOUSEHOLD EXPENDITURE	1.88	0.53
SOURCES OF INCOME	1.81	0.55
ACC_MARKET	1.77	0.56
ACC_CREDIT	1.71	0.58
LAND_SZEOWND	1.69	0.59
CROPFAIL_LIVESTOCK LOSS	1.67	0.60
LIVESTOCK VALUE	1.64	0.61
CLIMATE CHANGE INFORMATION	1.58	0.63
Mean VIF	2.03	0.51

Source: Survey data 2018

Table 8: The Breusch-Pagan/Cook-Weisberg test result for heteroscedasticity of sampled small-scale farmers under the districts of Limpopo Province, South Africa 2018 (n=456)

Variable	χ^2 *(1)*	*Prob* > χ^2	*Tabulated* χ^2 *value*
Willingness to pay	2.89	0.8512	3.84

Source: Survey data 2018

Table 9: Binary Logistic Regression Model results and marginal effect

Variables	*Estimated coefficient*	*Standard error*	*Marginal effects (dy/dx)*	*t-value*
Constant	4.951***	0.548		-9.03
EDUC_LVL	-1.171	1.116	0.001	1.05
AGE	4.394***	1.106	-0.185	3.97
GENDER	1.101***	0.250	-0.158	4.40
MARIT_ STATUS	0.781*	0.375	-0.052	2.08
FARM_EXPRNCE	0.420**	0.190	0.016	2.21
HHLD_SIZE	0.815***	0.158	-0.121	5.16
FREQ_EXTCNTACT	-0.155	0.134	0.129	1.16
TTAL_HHINCME	14.102**	6.067	0.367	2.32
HHLD EXPND	-10.601**	4.369	0.207	2.43
N_SRCES_INCME	2.031*	0.958	0.134	2.12
ACC_MARKET	-1.788	1.608	-0.017	1.11
ACC_CREDIT	2.119***	0.320	-0.408	6.62
LAND_SZEOWND	10.114**	4.596	0.057	2.20
LVSTOCK_VALUE	4.391***	1.208	0.148	3.63
AC_CC_ INFRMATION	3.211**	1.309	0.033	2.45
EXP_CRPFAIL_LIVSTK LOSS	1.829*	0.910	0.014	2.00

Cox and Snell R^2 = 0.716;
Nagelkerke R^2 = 0.691;
Log likelihood χ^2 = -429.21;
Probability (LR Statistic) 0.00001;
Sampled small-scale farmer's willingness to pay for climate change adaptation strategies = 74%; Those not willing to pay for climate change adaptation strategies = 26%;
dy/dx is for discrete change of dummy variable from 0 to 1;
Standard errors are in parentheses;
Notes: *, **, *** means statistically significant at the 10%, 5% and 1% level1s, respectively;
Number of observations = 456

Source: Survey data 2018

seventy-one percent and sixty-nine percent explain the change in the dependent variable whereas the remaining twenty-nine percent and thirty-one percent are not explained in the model. Table 9 shows the results of BLRM coefficient and marginal effect estimates. Furthermore, Table 9 shows Binary Logistic Regression Model results and marginal effect estimates of sampled small-scale farmers.

The overall classification accuracy of the model is relatively well at approximately eighty-five percent, with sampled small-scale farmers' willingness to pay for climate change adaptation strategies, which were classified very well at seventy-four percent and those not willing to pay at twenty-six percent. The estimated log likelihood ratio statistics of 429.21 is highly statistically significant ($p<0.0000$), and LR χ^2 was significant at one percent level of significance, indicating the robustness of the variables included in the model. As can be seen from Table 9, thirteen (13) of sixteen (16) variables in the model specification were found to be positively and negatively statistically significant when associated with sampled small-scale farmers' willingness to pay for climate change adaptation strategies at one percent, five percent and ten percent, respectively. These variables include age of the sampled small-scale farmer, gender, marital status, farming experience, total household income, household size, total household expenditure, number of sources of income, access to credit, livestock value, land size owned, experienced of crop failure and livestock loss, access to climate change information.

Age of the Sampled Small-scale Farmers (AGE)

As per *prior expectations*, the empirical result indicates that the sign coefficient parameter for the age variable is positive and highly statistical significant at one percent level of signifi-

cance. This implies that there is enough or sufficient evidence to suggest that a one-year increase of sampled small-scale farmers' age increases their probability to pay for climate change adaptive measures by the marginal effect of 0.185 (19%). This could be because older small-scale farmers perceive more of the benefits from climate change adaptation strategies and would have developed superior market contacts and trust, which would permit the farmers to trade at lesser transaction costs for their sustainable livelihoods. The results are in line with the previous studies of Akhter (2013) and Kong et al. (2014) regarding willingness to pay for index based crop insurance and ecological compensation of the Poyang Lake Wetland area in Pakistan and China. This finding contradicts with results from previous studies of Ghazanfar et al. (2015) and Tadesse and Bishu (2018) who found age to be negatively associated with the willingness to pay for crop insurance and dairy cow insurance. Moreover, contradicts with the findings of Horna et al. (2005) who noted that age has a negative and significant influence on farmers' willingness to pay for agricultural inputs.

Gender of the Sampled Small-scale Farmers (GENDER)

The sign coefficient parameter for variable of gender is positive and highly statistical significant at one percent level of significance. Therefore, the estimated marginal effect results for variable of gender implies that a unit increase in the number of male-headed as compared to female-headed small-scale farmers in the study area increases their probability of willingness to pay for climate change adaptation strategies by 0.158 (16%) with all other factors held constant. This result concurs in alliance with the study conducted by Haghjou et al. (2013) and Anemut (2006) who postulate similar results at five percent level of significance. The positive empirical result is supported by the results of Kong et al. (2014), however, in that study, the variable for gender was not statistically significant. Therefore, with this sentiment, there was not enough evidence as for to what extent the gender variable influenced the capacity of small-scale farmers' willingness to pay for ecological compensation of the Poyang Lake Wetland area in China. In addition, the assumption was that male sampled small-scale farmers would be more likely to pay for climate change adaptation measures with their advantages in bargaining, negotiating, resource endowments ownership and enforcement of market contracts for their sustainable livelihoods.

Marital Status of the Sampled Small-scale Farmers (MARIT_ STATUS)

The estimated marginal effect results for variable for marital status or MARIT_STATUS implies that a unit increase in the number of sampled small-scale farmers who get married as compared to single, widowed or divorced small-scale farmers in the study area, increases their probability of willingness to pay for climate change adaptation strategies by 0.052 (5.2%), all other factors held constant. This research finding is not supported by that of Aydogdu and Bilgic (2016) in Turkey who found that marital status was negatively and statistically significant when related to the willingness to pay for efficient irrigation for sustainable usage of resources in the face of climate change. The result is in line with the previous results of a study conducted by Haghjou et al. (2013) who found that marital status was positively associated and statistically significant with consumers' potential willingness to pay for organic food products in Tabriz, Iran. Moreover, the finding concurs with that of Ayedun et al. (2017) who found that the marital status of maize and groundnut farmers was positively associated with their willingness to pay for Aflatoxin Biocontrol Products in northern Nigeria. However, there was no sufficient evidence of information since the variable was not statistically significant and therefore, the present study closed this research information gap. This research result might have ascribed to the fact that married sampled small-scale farmers make co-joint decisions and stick together to achieve common farming goals for their sustainable livelihoods.

Farming Experience (FARM_EXPRNCE)

The findings confirm *prior expectations* as indicated that there is a positive and statistically significant relationship between farming experience of sampled small-scale farmers and their willingness to pay for climate change adapta-

tion strategies. The estimated marginal effect results for variable FARM_EXPRNCE implies that an increase in the farming experience of sampled small-scale farmers by one year increases the probability of their willingness to pay for climate change adaptation strategies by 0.016 (16%), all other factors held constant. This finding corresponds with that of Ayedun et al. (2017) who found that farm experience of maize and groundnut farmers was positively associated with their willingness to pay for Aflatoxin Biocontrol Product in northern Nigeria. However, there was not enough evidence to suggest the extent to which this variable FARM_EXPRNCE influenced the dependent variable since the variable was statistically insignificant. The finding varies with that of Haghjou et al. (2013) and Aydogdu and Bilgic (2016) who did not show any relationship between farm experience and willingness to pay for organic food products and efficient irrigation for sustainable usage of resources, respectively.

Household Size (HHLD_SIZE)

The result of the marginal effects showed that a one-member increase within the household of sampled small-scale farmer increases the probability of willingness to pay for climate change adaptation strategies by 0.121 (12.1%), all other factors held constant. This can be ascribed to the fact that a household that is composed of more adult members equipped with access to high level education is empowered with the marketing skill and knowledge that spur individuals to have access to job opportunities and higher relative income. This finding is in-line with findings of previous studies such of Ghazanfar et al. (2015), Masud et al. (2015) and Tadesse and Bishu (2018) who found household size positively associated with willingness to pay for crop insurance, climate change adaptation and dairy cow insurance, respectively. Moreover, this contradicts with the findings of Ayedun et al. (2017) who found that household size negatively and significantly influenced the maize and groundnut farmers' willingness to pay for Aflatoxin Biocontrol Product in northern Nigeria.

Total Household Income (TTAL_HHINCME)

As prior expectations, the empirical results indicate that the sign coefficient parameter for variable TTAL_HHINCME or total household income is positive and has a statistical significant at five percent level of significance. This implies that a one-Rand increase of small-scale farmer increases their probability to pay for climate change adaptive measures by the marginal effect of 0.367 (37%), holding other factors constant. The justification behind this is that more than fifty percent of sampled small-scale farmers reported to have more than one source of income. In addition, the greater the possibility to make use of different available income sources would lead to the betterment of sustainable livelihood with more opportunities and engagement on economic activities. In support of the study findings, Birara and Beneberu (2019) and Masud et al. (2015) also found similar empirical results that the net income of the households positively and significantly influenced their willingness to pay for conservation of church forests and climate change adaptation strategies in north-western Ethiopia and Malaysia, respectively. However, the result is not common to that of Zhu et al. (2016) conducted in China who found that farmer's income negatively influenced their willingness to participate in wetland restoration.

Total Household Expenditure (HHLD EXPND)

The sign of the coefficient parameter for HHLD EXPND or total household expenditure of the sampled small-scale farmer is negative and statistically significant at five percent level of significance. This implies that the likelihood of the willingness to pay for climate change adaptation strategies by sampled small-scale farmers' decreases with an increase in the household's total expenditure. The negative marginal effect for household expenditure of the household head shows that a unit increase in this variable reduces the probability of willingness to pay by 0.207 (21%) as opposed to not paying. This result finding is in-line with findings of previous studies such as that of Nkoana et al. (2019) who found that total household expenditure was negatively associated with the willingness to pay for water and electricity services in the Limpopo province of South Africa. This basically makes economic sense ascribed to the fact that the more the expenditures attached to the household reduces the purchasing power of house-

hold members for their relatively sustainable livelihoods. Households with better opportunities to allocate human capital will not invest in low return economic activities.

Number of Sources of Income (N_SRCES_INCME)

The sign coefficient parameter for variable N_SRCES_INCME or number of sources of income is positive and statistically significant at ten percent level of significance. This implies that a unit increase in the number of sources of income by sampled small-scale farmers increases the likelihood of their willingness to pay for climate change adaptation strategies by the marginal effect of 0.134 (13.4%). Numerous studies have shown that number of income sources is associated with access to credit by respective households. These findings confirm to prior expectations and support evidences from other studies showing that an increase in income sources decreases the dependence on natural forest products (Mamo et al. 2007; Heubach et al. 2011; Hogarth, 2012). The study conducted by Heubach et al. (2011) has shown that the greater the possibility to make use of different available income sources, the lower the share of the forest income activity in total household economy. On the other hand, Mamo et al. (2007) have demonstrated that improved off-farm employment opportunities and access to credit may reduce forest clearance and farming activities as a gap-filling activity. However, according to Hogarth (2012), the conventional economic theory suggests that unearned incomes undermine labour force by reducing the opportunity cost of engaging in the farming activities. Moreover, Hogarth (2012) has also argued that socio-economic factors such as the easy availability of subsidies, social grants and related unearned incomes negatively affect the farming activities in rural communities, and such arguments do not necessarily promote social grants for sustainable livelihoods.

Access to Credit (ACC_CREDIT)

The result of the marginal effect showed that a unit increase in sampled small-scale farmers' access to credit would yield a 0.408 (41%) increase in their probability to pay for climate change adaptation strategies. This result finding concurs with that of Akhter (2013) who found that access to credit was positively and statistically significant when associated with the farmers' willingness to pay for Index Based Crop Insurance in Pakistan. However, the result is dissimilar to that of Ayedun et al. (2017) who indicated that access to credit of maize and groundnut farmers was negatively associated with their willingness to pay for Aflatoxin Biocontrol Product in northern Nigeria. Moreover, there was insufficient evidence to suggest the extent to which this variable (ACC_CREDIT) influenced the dependent variable since the variable was statistically not significant. Access to farm credit was also found out by Nhemachena and Hassan (2009) increasing financial resources of farmers and their ability to meet transaction costs associated with various adaptation options they might want to take for sustainable livelihoods. For instance, financial resources and access to markets enables farmers to buy new crop varieties, new irrigation technologies and other important inputs they may need to change their practices to suit the forecasted climate changes. On the other hand, it would have been expected that market access in the present study would influence sampled small-scale farmers' willingness to pay for climate change adaptation strategies but the results are otherwise. This result may also be attributed to their different sources of income.

Land Size Owned (LAND_SZEOWND)

The sign coefficient parameter for variable land size owned (LAND_SZEOWND) had a positive and statistical significant ($p<0.05$) relationship with the decision of willingness to pay for climate change adaptation strategies. The result of marginal effects on farm size indicated that a one-unit increase in farm holdings (in hectares) of the sampled small-scale farmers would lead to a 0.057(6%) increase in the probability of willingness to pay climate change adaptation strategies as opposed to not paying. This result finding is supported by the study conducted by Akhter (2013) who found that landholdings were positively and highly statistical significant associated with their willingness to pay for Index

Based Crop Insurance in Pakistan. A similar finding was by Masud et al. (2015) in Malaysia by showing a positive relationship between the variable (LAND_SZEOWND) and the farmers' willingness to pay for climate change adaptation measures. However, there was not enough evidence to suggest the extent to which this variable influenced the dependent variable since the variable was not statistically significant.

Value of Livestock (LVSTOCK_VALUE)

The sign coefficient parameter for variable LVSTOCK_VALUE or value of livestock is positively and highly statistical significant at one percent level of significance for willingness to pay for climate change adaptation strategies The result of marginal effect of livestock value indicated that a one-unit increase in the value of livestock (in Rands) owned by sampled small-scale farmers would lead to a 0.148 (15%) increase in the probability of willingness to pay climate change adaptation strategies as opposed to not paying. The finding is in-line with that of Zhu et al. (2016) conducted in China who found a positive relationship between variable number of livestock and farmers' willingness to pay for climate change adaptation. This result finding is not common with a study conducted by Ghazanfar et al. (2015) in Pakistan. The study found that the number of livestock owned was negatively associated with farmers' willingness to pay for crop insurance. However, there was not enough evidence to suggest the extent to which this variable influenced the dependent variable since the variable was not statistically significant. This finding suggests the potential of interventions that enable small-scale farmers to build and invest more in livestock production for sustainable livelihoods.

Access to Climate Change Information (AC_CC_ INFRMATION)

Access to climate change information (ACC_INFORMATION) is positively associated with small-scale farmers' willingness to pay for climate change adaptation strategies. The variable ACC_INFORMATION is statistically significant at five percent level of significance. This implies that there is enough evidence to suggest that access to climate change information by sampled small-scale farmers positively influences their willingness to pay climate change adaptation strategies as opposed to not paying. The result of the marginal effect showed that a unit increase in sampled small-scale farmers' access to climate change information increases their probability to pay for climate change adaptation strategies by 0.033 (3.3%) as opposed to not paying. It can still be concluded that the availability of better climate information helps small-scale farmers to make comparative decisions among alternative adaptation practices to cope better with changes in climate. Farmers with access to climate change information are far better than farmers who do not have such information at all. Agabi (2012) and Amusa et al. (2015) reveal that media played an important role in informing livestock farmers about climate change as this increased the tendency of adapting to climate change.

Experience in Crop Failure and Livestock Loss (EXP_CRPFAIL_LIVSTK LOSS)

As prior expected, empirical results indicate that the variable EXP_CRPFAIL_LIVSTK LOSS is positive and statistically significant at ten percent level of significance. This implies that one-unit increase in the experience of crop failure as well as livestock loss by sampled small-scale farmers due to climate change increases the probability of their willingness to pay for climate change adaptive measures as opposed to not paying. The results depict that small-scale farmers who experienced loss of livestock and crop failure in the past 30 years were more likely to pay for climate change adaptive measures than those who did not experience. The marginal effects for the estimated coefficient of experience of livestock loss as well as crop failure indicated that the likelihood of small-scale farmers who experienced loss of livestock and crop failure increased by 1.4 percentage point for paying. Small-scale farmers who have a relatively large number of livestock enterprises may have lower income variability. For instance, income loss as a result of livestock loss from one enterprise may be compensated for by another enterprise with higher income. Agabi (2012) suggests that insurance should be targeted as a form of col-

lateral to small-scale farmers that are not diversified, as diversification acts as an alternative risk management strategy resulting in diversified farmers to have a lower probability of participating in insurance.

CONCLUSION

The findings from the study clearly revealed that a majority of sampled small-scale farmers expressed willingness to pay for climate change adaptive measures. However, there are sampled small-scale farmers who did not show any interest to pay. The study further examined the determinants of small-scale farmers' willingness to pay for climate change adaptation strategies by employing the 456 sampled small-scale farmers cross-sectional survey data. The Binary Logistic Regression Model was deployed to determine factors affecting small-scale farmers' decision of willingness to pay for climate change adaptation strategies. The overall classification accuracy of the model was relatively well at approximately eighty-five percent, with sampled small-scale farmers' willingness to pay for climate change adaptation strategies classified very well at seventy-four percent and those not willing to pay at twenty-six percent. The null hypothesis stated that socio-economic factors do not influence the decision of small-scale farmers' willingness to pay for climate change adaptation strategies. This hypothesis should be rejected because the results from the Binary Logistic Regression Model showed that age, gender, marital status, farming experience, total household income, household size, number of sources of income, access to credit, livestock value, land size owned, experienced of crop failure and livestock loss, access to climate change information and total household expenditure have significant effects on small-scale farmers' willingness to pay for climate change adaptation strategies. Results from the analysis generally indicate that greater priority should be put into promoting programmes to better educate small-scale farmers on how to respond to climate conditions through sustainable adaptation strategies for acceptable livelihoods and development.

POLICY RECOMMENDATIONS

The empirical findings suggest that improving access to improved levels of education, credit and market information, through appropriate sources and making them easier to access, could lower the transaction costs associated with the search for trading partners, contracting and enforcing the contract among small-scale farmers and enhancing market participation. If these strategies are implemented properly by the policymakers, small-scale farmers will surely be able to realise the fruitfulness of specific adaptation strategies, their perceptions will automatically improve, and they will be more willing to pay for some specific climate change adaptation strategies. Collective action between private and public sectors can make this easy to put into practice. Moreover, institutional support from different stakeholders (such as NGOs and government organisations) could improve market participation among small-scale farmers. This can be done through designing appropriate institutional support programs that could better link small-scale farmers to markets such as public–private partnerships. Therefore, the procedures of securing loans should be reviewed to cater or meet the level or ability of rural farmers to be able to acquire them. For example, the Department of Agriculture, Forestry and Fisheries came up with a new programme called Micro Agricultural Finance Schemes of South Africa (MAFISA). However, the procedure of securing credit or grants through this programme is still not clear to most rural farmers. It is then recommended that various relevant stakeholders can collectively mobilise small-scale farmers to form cooperatives or stokvels or group savings as part of investments.

LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

In the pursuit of this paper, several limitations became apparent and a larger sample size should also be used in the future to strengthen the study. Time, language and culture had negative impacts on the collection of data during fieldwork. Furthermore, researchers might also want to consider estimating willingness to pay for the two different seasons (summer and winter), because the level of adaptation towards climate change depends on the season and this might create variations across the different seasons. The researcher may consider conducting

a study on the willingness of other stakeholders (financial institutions, government, and insurance companies) to participate in climate change adaptation strategies. The influence of social capital on small-scale farmers' willingness to pay in this study has not been examined. It would provide further insights if an investigation is conducted on how factors such as trust among group members affect rural small-scale farmers' decisions in the adoption of climate change adaptation strategies.

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