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Research Article

# Determinants of Khat Farmers' Willingness to Pay for Agricultural Insurance

**David Muraya**[1], **Samwel Chege**[2,*], **Shelmith Munyiri**[3]

[1]Department of Agricultural Economics, Agribusiness Management and Agricultural Education, Chuka University, Nairobi, Kenya

[2]Department of Business Administration, Chuka University, Nairobi, Kenya

[3]Department of Plant Science, Chuka University, Nairobi, Kenya

## Abstract

Khat farming is an important source of revenue and a possible source of potential investment in Kenya. Despite the benefits, various production and marketing risks, which negatively influence productivity, profitability, economic growth and farmers' livelihood, remains a challenge. Insurance for agricultural enterprises has the ability to open up access to essential services that boost productivity and marketing. This study aimed at determining the effect of socio-economic and institutional factors on khat farmers' willingness to pay for agricultural insurance. The data used in this study was obtained from khat farmers in Meru County, Kenya, from a sample of 323 farmers. The study employed the utility maximization theory and the double-bounded dichotomous choice model. Empirical results propose that the household size, size of land owned, awareness of agricultural insurance, credit access and the amount of khat bushes possessed by the family positively and significantly affected willingness to pay. The farmer's age and income earned from khat production negatively and significantly influenced willingness to pay. This study concluded that awareness of agricultural insurance and credit access greatly influence khat farmers' willingness to pay. The study recommends improving farmers' credit facilities to allow them access more financial capability since the study showed that the willingness to pay for insurance was proportional to credit access. The study further recommends strengthening on awareness on the importance of agricultural insurance to enhance khat farmers' involvement in agricultural insurance scheme. The results of this study will equip decision-makers with evidence-based tools to excellently market and establish demand-driven insurance products to meet the demands of khat farmers.

## Keywords

Insurance, Farmers, Khat, Access to Credit, Awareness

## 1. Introduction

Globally, khat farming is done in selected world regions, including Israel, Yemen, the Saudi Peninsula, Ethiopia, Kenya and Madagascar. It is estimated that over 20 million people worldwide consume khat daily, with East African nations and Southwestern Arabia having the highest number of users [20]. Khat is Ethiopia's greatest export cash crop and the country's

*Corresponding author: samuelchege34@gmail.com (Samwel Chege)

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economic backbone. In Ethiopia, khat is cultivated for both the local and export markets since it is one of the most incredible crops there in terms of growing area and a crucial source of income for millions of farmers [14]. Khat grows in various part of Kenya but is mainly grown in Meru, Tharaka Nithi, and Embu Counties [8]. Khat farming is the most treasured economic activity, for it is the primary spring of revenue and livelihood for farmers in Meru County [6]. Despite its income generation, khat production and marketing face various risks and uncertainties [19]. The perils encountered by farmers particularly in rain-fed agricultural systems are greater than ever before, owing to a rise in the frequency of variable rainfall regimes as an effect of climate change [2]. Providing insurance is one strategy to lessen the impact of economic loss caused by risks and uncertainties [11].

Agricultural insurance as a risk mitigation technique is widely accepted worldwide as a new method of protecting agribusinesses [24]. In most developed countries, the choice and diversity of insurance products offered to producers have grown intensely [24]. Most of this increase is attributable to various government subsidies, including subsidized payments, delivery and loss adjustment costs, and the public supply of protection services [25]. Insurance of crops and livestock has been available in a number of African countries since the dawn of the twentieth century although the market is still relatively small. However, there is a limited agricultural insurance market in Africa due to the slow development of the agricultural industry, which is also inadequately capitalized [27]. Hess *et al.* stated that approximately 653,000 farmers have some protection, and a current scheme coverage indicates that nearly 2 million African smallholder farmers have insurance [18].

One of the aims of the Kenyan government in Vision 2030 is to provide access, efficiency, and stability of insurance as a foundation for the country's economic transition. In Kenya, agricultural insurance adoption and penetration have not made much headway and remain extremely low, with less than 1% of farmers and pastoralists acquiring insurance [30]. Agricultural insurance accounts for less than 1% of overall insurance premiums [23]. A few companies offer agricultural insurance in Kenya. Every type of insurance company is permitted to write agriculture insurance, but by 2020, only eight companies were doing so [24]. Crop and Livestock Insurance are a few agricultural insurance products offered on the Kenyan market. Crop insurance protects crops from physical loss or damage and includes coverage against drought, unmanageable pests and diseases, windstorm, extreme rainfall, and fire. Livestock insurance offers protection from the whims of nature, biological perils (such as pests and diseases), idiosyncratic/individual unique risks (such as fire, hail, and theft), and systemic risks that affect a vast region, such as Tsetse, armyworm, and fall-worm [31]. In Kenya, agriculture insurance is divided into two broad categories: indemnity-based and index-based insurance. Several pilot initiatives to introduce agricultural insurance in Kenya have been carried out with technical support from the World Bank and other development agencies. Kilimo Salama, developed by the Syngenta Foundation for Sustainable Agriculture, is the most prominent and effective of such initiatives, followed by Kilimo Salama Plus and Ngao ya Mkulima. [22].

Insurance can help mitigate the financial impact of a lot of unfortunate circumstances, but it doesn't make a farmer feel any less anxious about whether the event will happen or alter its likelihood. Instead, it reduces the likelihood of economic loss associated with the occurrence [13]. A few conditions need to be met for an agricultural insurance scheme to succeed. Farmers should be able to pay premiums, demand for the agricultural insurance be at a level they can accept and the underwriter be able and willing to pay claims from farmers [30]. This necessitates that all parties, including the government and insurance providers, clearly grasp how farmers' demands impact their willingness to take part in and pay for crop insurance. This understanding will assist the decision-makers in structuring insurance policies to correspond with people's demands [34]. Willingness to pay (WTP) is the maximum portion of income a farmer is ready to pay. It might be impacted by prior experiences for instance, farmers are more likely to report a high desire for insurance if there has been recent poor weather as well as by personal preferences, income, risk attitudes, perception, household demographics, and institutional features. [10]. Studies have revealed that, with a few exceptions, a significant number of farmers in Africa are willing to pay for agricultural insurance schemes [9, 15, 26].

## 2. Materials and Methods

### 2.1. Study Area and Data Collection

This study was conducted in Igembe North Sub-County, one of Meru County's nine sub-counties. Meru County is situated between latitudes 37 ° west and 38 ° east, within 0 ° 6' of the North Pole and about 0 ° 1' of the South Pole [12]. The County has 6,936.2 square kilometers in total. The gazetted forest cover of the County is 972.3 square kilometers, accounting for 14.02% of the total county area [33]. Igembe North Sub-County is 1172.83 sq km and inhabited by 186,656 people [12]. Igembe North Sub-County is located in the higher regions of Meru County and has an average precipitation of 700 mm to 1000 mm per annum with a mean annual temperature of between 15 °-17 ℃ [12]. The altitude is between 2000 and 2500 meters above sea level. Igembe North has the highest area under khat production and the most outstanding khat output. Agriculture is mainly rainfed what results to low production during the dry seasons hence, farmers' encounters a lot of losses. The study obtained a sample size of 323 respondents. A face-to-face interview was used to collect data using a semi-structured questionnaire.

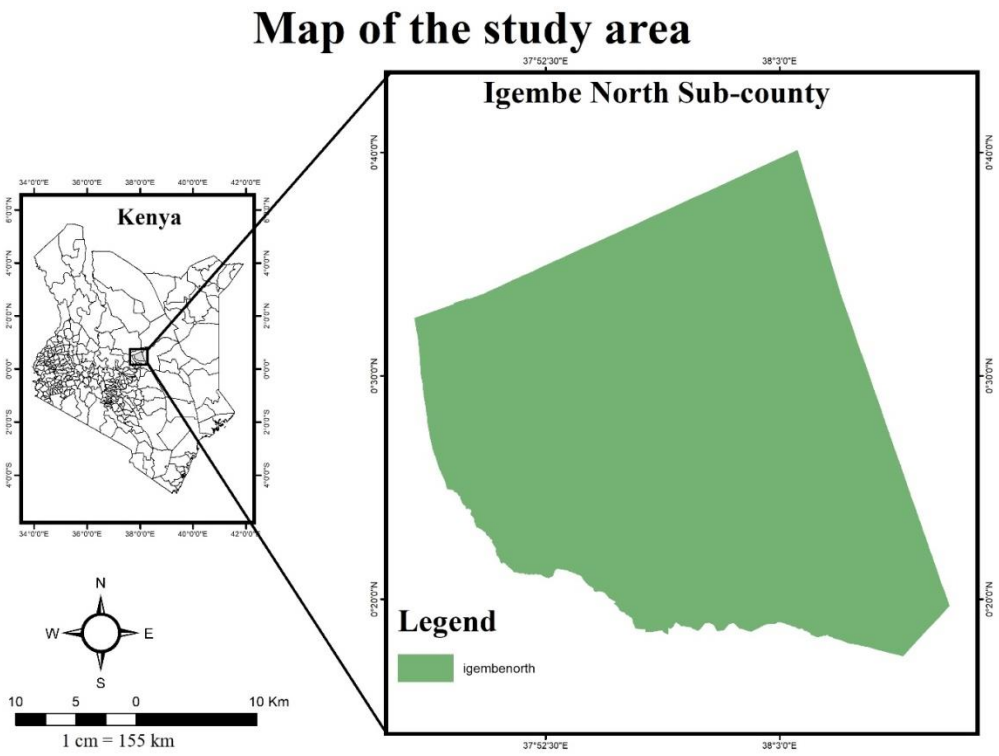


***Figure 1.*** *Map of the study area.*

## 2.2. Analytical Model

The double-bounded dichotomous choice contingent valuation model was used to examine WTP. The model makes use of bid levels for insurance, which serve as the foundation for calculating the mean WTP. The double-bounded dichotomous choice model outperforms the single-bounded model because it provides the respondent with a second bid, which can be greater or lower depending on the first response [17]. The respondents were given an initial bid, followed by follow-up bids. The second bid's level is determined by the response to the first bid. If the reply was positive, the second bid level was higher than the first bid level; if the response was negative, the second bid level was lower than the first bid level. The second bid is essential because it sets an upper and lower constraint on the unobserved actual WTP of the responders [5].

The double-bounded dichotomous choice shown in interval has four alternative outcomes: yy meaning that both responses were "yes," WTP is higher than the upper bid; yn implying that the first answer was "yes" followed by "no," WTP is between the initial bid and the upper bid; ny implying a "no" answer followed by "yes," WTP is between the initial bid and the upper bid; nn where both answers are"n" WTP is between zero and the lower bid [17]. The probabilities of those outcomes may be expressed as in equations;

$$\pi_{yy}(B_{i1}B_{i2}) = Pr(B_{i2} \leq Max\ WTP) = 1 - G(B_{i2};\theta) \quad (1)$$

$$\pi_{yn}(B_{i1}B_{i2}) = Pr(B_{i1} \leq Max\ WTP \leq B_{i2}) = G(B_{i2};\theta) - G(B_{i1};\theta) \quad (2)$$

$$\pi_{ny}(B_{i1}B_{i0}) = Pr(B_{i1} \geq Max\ WTP \geq B_{i2}) = G(B_{i1};\theta) - G(B_{i0};\theta) \quad (3)$$

$$\pi_{nn}(B_{i1}B_{i0}) = Pr(B_{i1} > Max\ WTP\ and\ B_{i0} > Max\ WTP) = (G(B_{i0};\theta) \quad (4)$$

Where G (B,) denotes the cumulative distribution factor (CDF), and variable vector is to be calculated [17]. With a sample size of N where B is;

$$L(\theta) = \sum\{N_i d_{iyy}.\pi_{yy}(B_{i1}B_{i2}) + d_{iyn}.\pi_{yn}(B_{i1}B_{i2}) + d_{iny}.\pi_{ny}(B_{i1}B_{i0}) + d_{inn}.\pi_{nn}(B_{i1}B_{i0})\} \quad (5)$$

Where $d_{iyy}$, $d_{iyn}$, $d_{iny}$ *and* $d_{inn}$ are binary-valued indicator variables, where $d_{iyy}$= 1 for yes-yes response 0 otherwise, $d_{iyn}$ = 1 for the yes-no response; otherwise, 0; $d_{iny}$= 1 for no –yes response, otherwise 0; and $d_{inn}$ = 1 for no- no

response, 0 otherwise.

The final model, chosen to investigate the relationship between WTP and socioeconomic and institutional factors, is depicted in equation below.

$$WTP = \beta_0 + \beta_1 \text{Gender} + \beta_2 \text{Occupation} + \beta_3 \text{Age} + \beta_4 \text{Years of experience} + \beta_5 \text{Household size} + \beta_6 \text{Members earning income} + \beta_7 \text{Size of land owned} + \beta_8 \text{Distance to the market} + \beta_9 \text{Awareness} + \beta_{10} \text{Credit access} + \beta_{11} \text{Group membership} + \beta_{12} \text{Income} + \beta_{13} \text{Schooling years} + \beta_{14} \text{Khat bushes owned} + e \quad (6)$$

## 3. Results and Discussion

The results indicate that 34.37% of the respondent farmers were willing to pay for crop insurance, whereas 65.63% of the respondent khat farmers were not. This study's results are consistent with the findings of [9, 15] who reported that most farmers were unwilling to join Weather Index Insurance (WII) programs. The study finding contradicts [1, 4, 3, 7, 26] who reported that most farmers were willing to pay for agricultural insurance. Khat farmers willing to pay for agricultural insurance were younger, highly educated individuals with large families, residing near khat markets, owned extensive khat bushes, depended on agriculture as their primary source of income, had access to credit, were active members of agricultural groups, and possessed awareness about agricultural insurance, as shown in Table 1 below.

***Table 1.*** *Descriptive statistics for determinants of khat farmers' WTP for agricultural insurance.*

| | **Overall** | | **Willing to pay** | | **Unwilling to pay** | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Mean | Sd | Mean | Sd | Mean | Sd | t-Stat | p-value |
| Age | 43.483 | 11.007 | 40.829 | 10.196 | 44.877 | 11.182 | 3.179 | 0.0008*** |
| Schooling years | 9.737 | 5.786 | 10.729 | 8.243 | 9.217 | 3.855 | -2.246 | 0.0127** |
| Years of farming experience | 18.322 | 10.098 | 18.234 | 9.445 | 18.368 | 10.444 | 0.113 | 0.4551 |
| Size of the household | 5.161 | 2.282 | 5.162 | 2.238 | 5.161 | 2.309 | -0.007 | 0.4973 |
| Earning members | 1.526 | 0.753 | 1.712 | 0.755 | 1.429 | 0.735 | -3.249 | 0.0006*** |
| Income from Khat | 79516.72 | 107035.4 | 83594.59 | 115551.6 | 77381.6 | 102515 | -0.495 | 0.3105 |
| Size of land owned | 1.629 | 1.749 | 1.838 | 2.264 | 1.5196 | 1.401 | -1.557 | 0.0603 |
| Market distance | 4.437 | 2.959 | 3.779 | 0.256 | 4.781 | 3.038 | 2.921 | 0.0019*** |
| Khat bushes owned | 360.774 | 500.311 | 433.108 | 692.018 | 322.901 | 357.965 | -1.887 | 0.0300** |
| Gender | 0.953 | 0.210 | 0.954 | 0.208 | 0.953 | 0.213 | -0.084 | 0.4658 |
| Occupation | 0.727 | 0.445 | 0.792 | 0.407 | 0.693 | 0.462 | -1.911 | 0.0285** |
| Access to credit | 0.049 | 0.217 | 0.117 | 0.323 | 0.014 | 0.118 | -4.144 | 0.0000*** |
| Group membership | 0.136 | 0.343 | 0.216 | 0.414 | 0.094 | 0.293 | -3.067 | 0.0012*** |
| Awareness | 0.433 | 0.496 | 0.496 | 0.431 | 0.264 | 0.441 | -9.595 | 0.0000*** |

Sd= Standard deviation *** Significant at 1%; ** significant at 5%

The determinants influencing farmers' willingness to pay for crop insurance were estimated using a double-bounded dichotomous choice model. Double-bounded dichotomous choice questions broaden the knowledge base of WTP estimations and allow for more efficient assessment than single-bounded dichotomous choice questions [17]. The results of the double-bounded dichotomous choice model are presented in Table 2 below. The results of the model chi-square tests using appropriate degrees of freedom show that the model's overall goodness of fit was statistically significant. Prob > chi2 0.000 combined with a log-likelihood of -224.38406 show that the double-bounded dichotomous choice model produced a decisive outcome. A mean VIF OF 1.93, with independent variables having a VIF ranging from 1.11 to 3.40. The VIF for independent variables is less than five, implying no multicollinearity.

***Table 2.*** *Estimation results of the Probit and double bounded choice model for determinants of khat farmers' WTP for agricultural insurance.*

| Variables | Probit Model | | | The double-bounded choice model | | |
|---|---|---|---|---|---|---|
| | Marginal effect | Robust Std. Err. | P>z | Coefficient | Std. Err. | P>z |
| Beta | | | | | | |
| Gender | 0.0631 | 0.126 | 0.619 | 382.86 | 3217.138 | 0.905 |
| Occupation | 0.1463** | 0.068 | 0.032 | 2480.679 | 1759.743 | 0.159 |
| Age | -0.0268*** | 0.005 | 0 | -510.005*** | 133.427 | 0 |
| Years of experience | 0.0122*** | 0.005 | 0.022 | 163.466 | 118.191 | 0.167 |
| Household size | 0.0593** | 0.023 | 0.004 | 1777.179*** | 455.198 | 0 |
| Members earning income | 0.0661 | 0.043 | 0.128 | 542.489 | 912.469 | 0.552 |
| Size of land owned | 0.0688** | 0.027 | 0.014 | 1858.697*** | 592.962 | 0.002 |
| Distance to the market | -0.0184 | 0.012 | 0.135 | -264.501 | 268.529 | 0.325 |
| Awareness | 0.3922*** | 0.059 | 0 | 8392.754*** | 1494.573 | 0 |
| Credit access | 0.5225*** | 0.143 | 0 | 6472.44** | 2884.074 | 0.025 |
| Group membership | 0.1144 | 0.099 | 0.25 | 2071.092 | 1923.425 | 0.282 |
| Income | -0.0001 | 0 | 0.079 | -0.012** | 0.011 | 0.014 |
| Schooling years | 0.0141 | 0.009 | 0.128 | 63.688 | 101.681 | 0.531 |
| Khat bushes owned | 0.0001 | 0.001 | 0.272 | 7.003*** | 2.323 | 0.003 |
| _cons | | | | 14899.16 | 5460.223 | 0.006 |
| Sigma | | | | | | |
| _cons | | | | 8680.319 | 730.877 | 0 |
| Mean VIF | 1.93 | | | | | |

*** Significant at 1%; ** significant at 5%

The results from the Probit model indicate that occupation, age, years of experience, household size, size of land owned, awareness and credit access significantly influenced khat farmers' willingness to pay for agricultural insurance (Table 2). The Double bounded dichotomous choice model results indicate that age, household size, income, land owned, awareness, credit access and khat bushes owned significantly influenced khat farmers' willingness to pay for agricultural insurance (Table 2).

The log-likelihood findings of this study depict that age had a negative and significant effect on willingness to pay among khat farmers. An increase in the age of khat household heads by one year decreases the likelihood of their willingness to pay by Ksh 510. This result implies that younger khat farmers are more willing to pay for agricultural insurance than older khat farmers. These results are consistent with [21], who found that farmer's age was negatively significant, implying that their willingness to pay for the Weather Based Crop Insurance Scheme (WBCIS) will decrease with an increase in age. An increase in the farmer's age reduced the log-likelihood of their willingness to pay by INR 24.48 which was significant at a 1% level.

The variable for household size had a positive and significant effect on willingness to pay among khat farmers. This result implies that the larger the household, the more the willingness to pay. An increase in the household size by one member increases willingness to pay with Ksh 1,777. These results are consistent with the findings of [28], which revealed that household size positively influences farmers' WTP for crop insurance. However, the study results contradict [26], who found a negative and significant effect on the insurance premium farmers were willing to pay.

The variable size of land owned positively and significantly affected the willingness to pay among khat farmers. This indicates that the larger the land under khat production, the more likely willing to pay for agricultural insurance than those with smaller land. An increase in land ownership by one acre increases willingness to pay by Ksh 1,858. The results are

consistent with [2, 16, 26] found farm size had a positive and significant influence on willingness to pay for crop insurance. However, the results contradict [29], who revealed that farm size negatively influences WTI and WTP amounts for rainfall insurance products in rural India.

The results of this study demonstrate that the awareness variable had a positive and significant impact on khat farmers' willingness to pay. This finding depicts that khat farmers are more likely to pay for agricultural insurance the more knowledgeable they are about it. An increase in farmers' knowledge of agricultural insurance by one unit increases willingness to pay by Ksh 8,392. These results are consistent with [2, 16, 29] who found a positive and significant association between WTP and awareness in Northern Ghana, Burkina Faso and Cuttack district, respectively. However, the results contradict [29], who found a significant and negative relationship in Bolangir district.

Credit availability positively and significantly influenced khat farmers' willingness to pay. An increase in credit availability leads to an increase in willingness to pay by Ksh 6,472. Credit is essential for promoting agricultural investment, technological adoption and stabilizing farm income. The results are consistent with [3, 26], who found credit access positively and significantly affected the insurance premium farmers are willing to pay. The total number of khat bushes owned by the household significantly and positively affected khat farmers' willingness to pay for agricultural insurance. An increase in the number of bushes owned translates to an increase in willingness to pay by Ksh 7. As khat plants increase, the harvested amount of khat increases, hence an increase in income.

The amount of income khat earned negatively affected farmers' willingness to pay. These results depict that the more income the household earned from khat farming, the less likely they are to pay for agricultural insurance. An increase in income by a unit leads to a decrease in willingness to pay by Ksh 0.012. The more income farmers earn, the more they can diversify into more income sources; hence, they feel secure and would not be willing to insure and pay for crop insurance. The results are consistent with [28] among cocoa farmers in Ghana. These results contradict [2, 26], who found farmer income had a positive and significant effect, suggesting that higher-income farmers are more willing to pay and participate in crop index insurance.

## 4. Predicted Mean Willingness to Pay

***Table 3.*** *Predicted mean willingness to pay.*

| Variable | Observations | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Willingness to pay | 323 | 15147.77 | 7954.94 | -4901.93 | 68086.65 |

The mean willingness to pay was predicted for khat Farmers in Igembe North sub County, Meru County, Kenya. Mean WTP for the sampled household was estimated to be Ksh 15147.77 or $100.58. The results varied with who established a mean WTP of 7142 FCFA, or US$14.3 a month in Burkina Faso [16]. Further, when compared to Zambia's credit-based crop insurance program, farmers paid US$10 membership fee [32]. This is due to differences in product coverage and the insurance agreements involved.

## 5. Conclusion

Agricultural insurance is a prospective agricultural risk management approach that farmers can employ to offset severe climate hazards and natural disasters encountered while farming. Farmers benefit from agricultural insurance since they can be compensated during a climate shock. Agricultural insurance also provides farmers with the ability to respond to numerous risks and allows them to make substantial investments in agriculture. The study sought to determine the factors affecting farmers' willingness to pay for agricultural insurance. The results indicate that a larger proposition of the respondents were unwilling to pay for agricultural insurance. The reasons for unwillingness to pay valid included the unavailability of insurance sellers, lack of enough information about agricultural insurance, distrust of insurance companies, high premium rates, limited scope of risk coverage, bureaucracy and small land sizes.

The variables khat farmer's age and income negatively and significantly affect willingness to pay among khat farmers. In addition, the variables household size, size of land owned, khat bushes owned by the household, awareness and credit access positively and significantly affect willingness to pay among khat farmers. The results show that awareness of agricultural insurance and credit access largely influence khat farmers' willingness to pay. Creating more awareness of agricultural insurance through reading the newspaper, watching television, and listening to the radio regularly among khat farmers would improve their willingness to pay for insurance. Similarly, strengthening the existing credit facilities and increasing the credit amount available to khat farmers would

help improve the willingness to pay for agricultural insurance.

The study recommends agricultural insurance providers to use the new information technology techniques to disseminate information and create more insurance awareness among khat farmers. The study also recommends that the National and County government improve credit facilities to allow farmers access to more financial capability, as it will boost their willingness to pay for agricultural insurance. More study is required to add to the knowledge base about appropriate contractual designs in specific scenarios.

## Abbreviations

VIF: Variance Inflation Factor
WBCIS: Weather Based Crop Insurance Scheme
WII: Weather Index Insurance
WTI: Willingness to Insure
WTP: Willingness to Pay

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## Conflicts of Interest

The authors declare no conflicts of interest.

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