Willingness to Pay for Crop Insurance Premium- A Study on Maize Farmers in India

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\textbf{Abstract}

Agricultural activity is subject to a wide range of risks due to the variable economic and biophysical environment in which farming operates. Agriculture risks arise due to uncertainty over factors determining returns to agricultural production. Crop insurance is one of the risk mitigating strategies for farmers. The objective of the study was to estimate WTP by the rainfed maize farmers to crop insurance premium and also factors influencing their WTP. The study revealed that farmers were willing to pay 0.34 per cent more premium than the prevailing rate to insure their crop. The average probability of WTP of farmers for crop insurance premium was 0.53. Age was the important factor influencing their WTP. It was observed that farmers’ awareness about the products and procedures of crop insurance was poor. Hence, efforts should be made to increase the awareness and help farmers to take advantage of crop insurance.

\textbf{Key words:} Risk, Crop insurance, Premium, Willingness to pay
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1. Introduction

Agricultural activity is subject to a wide range of risks due to the variable economic and biophysical environment in which farming operates. Agriculture risks arise due to uncertainty over factors determining returns to agricultural production. Uncertainty in agriculture reflects the nature of most farm production systems, which is influenced by ever-changing economic and biophysical conditions. The natural lag between when production decisions are made and when returns to farming can be realised exposes agricultural enterprises to the variability, in the intervening period, of a range of factors that determine the value of production. These include weather, animal and plant health, changes in agricultural markets and a range of macroeconomic factors. Variability in these factors results in uncertainty over key determinants of farm income like output price, yield, and input costs - with implications for farmers’ economic welfare and effects on the economic (allocative) and technical efficiency of farm production.

Maize (*Zea mays* L.) is one of the important staple food crops of the world and ranks next only to wheat and rice. It is third most important cereal crop in India occupying about 8.26 million hectare of area, producing 16.72 million tonnes with an average productivity of 2024 kg per hectare (2009-10). The major area under maize is rainfed and there is no substitute for this crop during rainy season. Maize is considered as crop with minimal level of risk, but its spread over large areas in recent years has increased its risk level. Since it is mostly grown under rainfed situation in Karnataka, rainfall is one among the major limiting factors. Maize is gaining more importance in recent year and area under its cultivation is increasing. In recent past, incidences of pest and diseases have also increased and started making serious impact on maize output. Thus, crop insurance is very much required and necessary to share the risk of farmers and help them to a greater extent.
Insurance is the transfer of risk between the insured and the insurer at a cost which reduces the intensity of loss that would have otherwise been suffered by the insured. Insurance not only reduces the uncertainty faced by the insured, but it evens out the burden of a loss especially if the loss is of large scale one.

Ray (1960) defines insurance as a “social device which aims at reducing the uncertainties of loss through combination of a large number of similar uncertainties and through the use of accumulated funds, distributing the burden of loss, should there be any over space and time”.

Insurance of crops is regarded as an essential part of well rounded agricultural programme designed to provide protection to farmers against physical failure of crops due to weather and other unavoidable natural hazards. Crop insurance advances the process of stabilizing the agricultural industry to a stage of production, making such a process more comprehensive, effective and useful.

Knight (1971) brought out the difference between risk and uncertainties. He indicated that in case of risk the distribution of outcome in a group of instance is known while in case of uncertainty this is not true. Ray (1960) in his paper reviewed the need and importance of crop insurance in minimizing risk and also examined the countries operating crop insurance programmes. Crawford (1979) excerpts some of the problems faced by the developing countries in the operation of crop insurance programme which seriously limit the probability of success and decreases the level of benefits realized.

With this background, this study is an attempt to estimate farmers’ willingness to pay additional premium for crop insurance. In economics, the willingness to pay (WTP) is the maximum amount a person would be willing to pay, sacrifice or exchange in order to receive a good or to avoid something undesired. In the present study, it refers to farmers WTP to pay for crop
insurance premium to receive benefit from it. Beside study also makes an attempt to identify factors that influence the farmers’ WTP for crop insurance.

2. Methodology

Purposive sampling technique was adopted for the selection of study area and random sampling technique was adopted in the selection of sample respondents for collection of data required for the study.

Karnataka state was selected purposively for the study as it is a major maize growing state in India. The study was conducted in major rainfed maize growing areas of Karnataka (Haveri and Shimoga districts). To address the objective of the study, primary data from rainfed maize growers (300) was considered. A structured schedule was prepared and it was pre-tested before data collection. Primary data was collected through personal interview from rainfed maize growers on various aspects of maize production and their willingness to pay towards crop insurance premium. The data pertain to the agriculture production year 2011-12.

3. Analytical tools and techniques employed

3.1 Double Bounded Dichotomous Choice (DBDC) method of Contingent Valuation (CV)

Single bound and double-bound dichotomous choice formats are the most frequently used question formats to estimate willingness to pay (WTP). Single bounded dichotomous choice CV method was pioneered by Bishop and Heberlein (1979) and only one dichotomous question is asked with a threshold amount and the respondent is expected to answer either ‘yes’ or ‘no’ to that amount. In this format, each respondent is asked once whether he/she would be willing to pay a specified bid amount. But in Double-bound format, after the single-bound question, he/she is asked once again whether he/she would be willing to pay another bid amount. The basic idea of dichotomous choice contingent valuation was given by Hanemann (1984). The single-bound format is incentive and compatible theoretically and has the advantage of making the
responses easy since it is similar to our real purchase actions. Although the double-bound format has no such advantages, it is more efficient in estimating willingness to pay (WTP) since it makes the respondent’s WTP more restrictive.

The first question is a simple yes or no question “Are you willing to pay an amount X?” If the answer is yes (or no), another question followed to elicit a maximum (or minimum) value. Hence, the respondents identified two amounts that limited their maximum WTP. (Bateman et al. 2001).

There are three ways why DBDC is more efficient than single bounded (Haab and McConnell, 2002). First, the yes-no and no-yes provides a clear bound of WTP, second the ‘no-no’ and ‘yes-yes’ estimate efficiency gains, and third the number of responses is substantially increased, especially for larger sample sizes. To avoid initial bid biases, the initial bids were randomly assigned to respondents.

3.2 Contingent Valuation Approach

Double Bounded Dichotomous Choice (DBDC) method of CV was employed to examine the factors affecting farmers’ additional willingness to pay for crop insurance premium. For this, a hypothetical situation of insurance market (subsidies given to small and marginal farmers was not considered) in which the farmers have to pay a definite amount of money to purchase products (insurance) in respective markets and their willingness to pay (WTP) was elicited. As mentioned above initial bid was asked to the consumers (farmers) and depending upon the answer a second bid was proposed, which was higher than the first bid for a “yes” response and lower for a “no” response for the initial bid. We denoted the first bid with $P^*$ and the second bid with $PH$ if it was higher, and with $PL$, if it was lower than $P^*$. Accordingly, there were four possible response groups: (G1) respondents who said “yes” to both the bids, so that WTP $\geq PH$; (G2) those who said “yes” to the first bid, but “no” to the second bid so that $P^* \leq$ WTP $< PH$; (G3) those who said “no” to the first, but “yes” to the second bid, so that $PL \leq$ WTP $< P^*$; and (G4) those who said “no” to
both bids, so that WTP < PL. The bids were distributed randomly in the survey schedules to get the desired variation.

3.3 Double Bounded Logit

To analyze the data double bounded Logit model was used in which, we observe two dichotomous variables, i.e. the answers to the first question and its follow-up. There are four possible outcomes i.e. ‘YES YES’ (YY), ‘YES NO’ (YN), ‘NO YES’ (NY), and ‘NO NO’ (NN).

Following Hanemann et al (1991), the following response probabilities were obtained for the Logit model.

\[ P_{iYY} = \frac{1}{1 + e^{-(\alpha + \beta \text{HIGH BID})}} \]  
\[ P_{iNN} = 1 - \frac{1}{1 + e^{-(\alpha + \beta \text{LOW BID})}} \]  
\[ P_{iYN} = \frac{1}{1 + e^{-(\alpha + \beta \text{HIGH BID})}} - \frac{1}{1 + e^{-(\alpha + \beta \text{FIRST BID})}} \]  
\[ P_{iNY} = \frac{1}{1 + e^{-(\alpha + \beta \text{FIRST BID})}} - \frac{1}{1 + e^{-(\alpha + \beta \text{LOW BID})}} \]

Where
FIRST BID – Starting bid value
LOW BID – Follow-up Low bid value
HIGHER BID – Follow-up High bid value

The double bound log-likelihood function is

\[ L_{DB} = \sum I_{iYY} \log P_{iYY} + \sum I_{iYN} \log P_{iYN} + \sum I_{iNY} \log P_{iNY} + \sum I_{iNN} \log P_{iNN} \]  

Where, \( I_i \) indicates the response category of each respondent i.

3.4 Tobit Model

Tobit model was suggested by James Tobin, the Nobel laureate (Gujarati, 1995) and it uses maximum likelihood method to estimate coefficients. In the
present study Tobit model was used to estimate mean additional willingness to pay for insurance premium.

Mathematically the Tobit model is expressed as

\[ Y_i = \beta_0 + \beta_i X_i + \mu_i ; \text{ if RHS} > 0 \]

\[ = 0 \text{ otherwise.} \]

Where, \( Y_i = \text{WTP}_i \)

The model employed in the study for crop insurance premium was

\[ \text{WTP}_i = \text{willingness to pay (Tick or Cross) of } i^{\text{th}} \text{ respondent} \]

\[ Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu \] \hspace{1cm} \text{.......................... (6)}

Where,

\( X_1 \) – Age in years.

\( X_2 \) – Area under maize cultivation in acres.

\( X_3 \) – Household average annual income in rupees.

\( X_4 \) – Sum amount insured as crop insurance in rupees.

\( \mu \) – Error term

4. Results and Discussion

As discussed earlier, a hypothetical market was taken for crop insurance and prevailing premium rate was considered for all farmers irrespective of subsidies or any others facilities from the government. In general 2.5 and 2 per cent of sum insured is collected as premium in kharif and rabi, respectively (Table 2). The study result revealed that on average farmers were willing to pay 0.34 per cent more premium than the prevailing rate to insuring their crop.
Table 1: Tobit model result for the willingness to pay (WTP) more premium for crop insurance

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Co-efficient</th>
<th>Standard error</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Yrs)</td>
<td>-0.0711 *</td>
<td>0.040</td>
<td>-1.77</td>
</tr>
<tr>
<td>Area under maize (ac)</td>
<td>0.0572</td>
<td>0.059</td>
<td>0.97</td>
</tr>
<tr>
<td>Income (Rs)</td>
<td>-0.0003</td>
<td>0.004</td>
<td>-0.71</td>
</tr>
<tr>
<td>Sum insured (Rs)</td>
<td>0.0007**</td>
<td>0.003</td>
<td>1.96</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.4678</td>
<td>1.947</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

Log likelihood = -397.377
Pseudo R2 = 0.0102

Note: **, * denotes significant at 5 and 10 per cent respectively
Additional willingness to pay for crop insurance is 0.34 per cent

Age (at 10%) and sum insured (at 5%), two variables which were statistically significant (Table 1). Area under maize and income were found to be non significant. One year increase in the age of farmer above mean level leads to decrease his/her WTP insurance premium by 0.0711 per cent. Sum insured by farmers has positive impact on the WTP insurance premium. An addition of Rs.1000 insured by the farmer, his/her WTP premium increases by 0.7 per cent.

A significant number of respondents (41 %) were willing to pay more premium for crop insurance. In a study by Griffith and Nesheim (2008) on WTP for organic food, 80 per cent of households were willing to pay at least some positive amount. Majority of the farmers (16 %) indicated that their WTP for insurance premium was more than 100 per cent (Table 3). Farmers not willing to pay were 59 per cent. Similar kind of results was obtained by Dipeolu et al.

**Table 2: Summary of willingness to pay (WTP) for crop insurance premium**

<table>
<thead>
<tr>
<th>Season</th>
<th>Prevailing premium rate</th>
<th>Farmers WTP</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kharif</td>
<td>2.5</td>
<td>2.84</td>
<td>0.34</td>
</tr>
<tr>
<td>Rabi</td>
<td>2.0</td>
<td>2.34</td>
<td>0.34</td>
</tr>
</tbody>
</table>

**Table 3: Distribution of maize farmers by WTP more premium for crop insurance**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Premium (%)</th>
<th>Number of farmers</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>up to 25</td>
<td>35</td>
<td>11.67</td>
<td>11.67</td>
</tr>
<tr>
<td>2</td>
<td>25-50</td>
<td>23</td>
<td>07.67</td>
<td>19.33</td>
</tr>
<tr>
<td>3</td>
<td>50-75</td>
<td>13</td>
<td>04.33</td>
<td>23.67</td>
</tr>
<tr>
<td>4</td>
<td>75-100</td>
<td>4</td>
<td>01.33</td>
<td>25.00</td>
</tr>
<tr>
<td>5</td>
<td>&gt;100</td>
<td>48</td>
<td>16.00</td>
<td>41.00</td>
</tr>
<tr>
<td>Sub total</td>
<td></td>
<td>123</td>
<td>41.00</td>
<td>41.00</td>
</tr>
<tr>
<td>6</td>
<td>Unwilling to pay</td>
<td>177</td>
<td>59.00</td>
<td>59.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>300</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Farmers WTP were influenced by different factors. To have a clear view on the factors which influence the WTP of the farmers, a double bounded logit model was estimated. The average probability of WTP (Table 4) of farmers for crop insurance premium was 0.53 and average probability of non WTP was 0.47. Bid value, age and sum insured were the variables having significant influence of farmers WTP for insurance premium.
### Table 4: Double bounded logit regression result of WTP more for crop insurance premium

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Estimates</th>
<th>Slope (Probability)</th>
<th>Standard Error</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid value (Premium rate)</td>
<td>-1.8639***</td>
<td>0.190</td>
<td>0.0962</td>
<td>0.000</td>
</tr>
<tr>
<td>Age (Yrs)</td>
<td>-0.01838*</td>
<td>0.004</td>
<td>0.0102</td>
<td>0.072</td>
</tr>
<tr>
<td>Area under maize (ac)</td>
<td>0.0070</td>
<td>0.017</td>
<td>0.0152</td>
<td>0.647</td>
</tr>
<tr>
<td>Income (Rs)</td>
<td>-0.0003</td>
<td>0.001</td>
<td>0.0001</td>
<td>0.713</td>
</tr>
<tr>
<td>Sum insured (Rs)</td>
<td>0.0001*</td>
<td>0.000003</td>
<td>0.0009</td>
<td>0.096</td>
</tr>
<tr>
<td>Constant</td>
<td>0.6533***</td>
<td></td>
<td>0.5391</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Note:** ***, * denotes significant at 1 and 10 per cent respectively

Average probability of WTP for crop insurance: **0.525322 (P)**

The analysis showed that, of the five variables considered, bid value, age of farmer and sum insured by farmer were significant at a probability level of 0.01 and 0.10. For example, unit increase in the bid value leads to decrease in probability of WTP by 0.19.

Results also revealed that, in line with the theory of demand, the bid values had a significant (at 1 % level) negative effect on the WTP for insurance premium. This clearly indicated that the farmers were sensitive to cost aspects while paying for the crop insurance. Age of the farmers and sum insured had significant influence on the WTP and were significant at 10 per cent. Higher the age of the farmers, lower the additional WTP for insurance premium. A unit increase in the age of the farmer leads to decrease in the probability of WTP by 0.004. Increase in sum insured of Rs. 1000 leads to increase in the probability of WTP by 0.003. Area under maize and income of the farmers did not have a significant impact on the WTP for insurance premium.
Distribution of farmers based on their response to first and second bid is presented in table 5. Among the sample farmers, 41 per cent gave positive response to WTP bids and 16 per cent farmers said yes for both bids. Farmers who said yes for first bid and changed their decision when bid value was increased formed 14.67 per cent, while the opposite behavior was seen among 10.33 per cent of farmers.

### Table 5: Distribution of maize farmers by response to WTP more for crop insurance premium

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Response</th>
<th>Numbers</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YY</td>
<td>48</td>
<td>16.00</td>
</tr>
<tr>
<td>2</td>
<td>YN</td>
<td>44</td>
<td>14.67</td>
</tr>
<tr>
<td>3</td>
<td>NY</td>
<td>31</td>
<td>10.33</td>
</tr>
<tr>
<td>4</td>
<td>NN</td>
<td>177</td>
<td>59.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>300</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

### 5. Conclusion

Agriculture is subjected to wider range of risks and crop insurance play a key role in minimizing them to a greater extent. Crop insurance is regarded as an essential part of well rounded agricultural programme designed to provide protection to farmers against physical failure of crops due to weather and other unavoidable natural hazards. Crop insurance advances the process of stabilizing the agricultural industry to a stage of production, making such a process more comprehensive, effective and useful. One of the major findings of the study was the impact of farmers’ age on their WTP, as age increases farmers additional WTP for crop insurance premium decreases. During the study it was observed that farmers’ awareness about the insurance and procedures of crop insurance was poor. Hence, efforts should be made to increase the awareness and help farmers to take better benefit out of it, as they are willing to pay for increased premium. Though crop insurance is known as one of the risk coping strategies among farmers, some of them have
not adopted and some have come out of this programme. Therefore, there is a need to design suitable police to make crop insurance mandatory for all rainfed farmers, considering the area coverage under the crop in a particular area.

**Reference**


HANEMANN, M.W., 1984, Welfare evaluation in contingent valuation


