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Paddy farmers in Kerala are willing to pay more for a modified crop insurance product

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Abstract We study paddy farmers in Kerala and analyse the factors affecting their willingness to pay for crop insurance and for a hypothetical crop insurance product. The farmers are willing to pay higher premium rates if claims are settled based on the procurement price, instead of cultivation cost, and promptly; and individual losses are accounted for. A farmer's willingness to pay more is influenced positively by their landholding size and negatively by age. Infrastructural support, and efficient implementation, will help to resolve the design-–reality gaps in insurance schemes. Designing popular schemes will reduce the subsidy burden on the public exchequer.

Keywords Willingness to pay, crop insurance, contingent valuation, dichotomous choice method

JEL codes Q14, Q18, G22, C21

Paddy is the staple food of the people of Kerala, the southernmost Indian state; it accounts for 98.50% of the area cultivated with food grains. Paddy cultivation is affected by variations in the weather pattern, and abrupt changes—in the distribution of monsoon spells, untimely rain, extended dry periods, and floods—have led to crop loss and financial crises. But only a few farmers in Kerala voluntarily opted for crop insurance (Anirudh 2019). The growth and coverage of crop insurance schemes in the state, at less than 6% per annum, lags far behind the other states in the country (Mukherjee and Pal 2017). Most farmers depend on government interventions (such as disaster relief funds), gold loans, borrowings, and dissaving to ensure consumption and continue farming during periods of crop loss.

We study the opinions paddy farmers in Kerala have of existing crop insurance products and the factors affecting their willingness to pay. Our study proposes a hypothetical crop insurance product that uses the procurement price to calculate claims—instead of the conventionally used cost of cultivation. The product considers localized damages eligible for claims and guarantees timely settlement of claims. And we try to estimate the farmers' willingness to pay for the product. That understanding will aid policymakers to decide how much of the additional expenditure can be transferred to farmers without escalating the premium cost to an unrealistic level.

Study area

Among all the districts of Kerala, Palakkad has the largest area under paddy cultivation and the maximum sum insured for paddy cultivation under any of the crop insurance schemes. We collected our primary data from Palakkad.

We purposively selected two blocks, Kollangode and Nenmara, because these raised the most crop insurance claims for paddy during 2016-17; for the same reason, we chose two panchayats from Nenmara block,

Elevencherry and Pallasana, and two from Kollangode block, Kollangode and Pattanchery.

From each of these four panchayats, we randomly selected 45 farmers who had subscribed to a crop insurance scheme, thus constituting a sample size of 180. We obtained the list of farmers from the Krishi Bhavans (Department of Agriculture and Farmers' Welfare) of the respective panchayats and also from the regional office of the Agricultural Insurance Company of India.

Materials and methods

We used a pre-tested and structured interview schedule to collect the data from farm households. We interviewed the farmers on production constraints, risk management strategies, the drawbacks of the existing crop insurance policies, and their willingness to pay. We also profiled the farmers socio-economically in detail.

Contingent valuation of willingness to pay

Contingent valuation methods use the subjects' responses to calculate their willingness to pay (O'Doherty 1998; Aditya et al. 2018; Subash, Aditya, and Srinivas 2018). Researchers create a hypothetical market and explain it to the subject using the questionnaire and, therefore, elicit their willingness to pay for products not existing at the time of interview. They must clearly explain the reference (status quo) and target levels of every characteristic of interest to the respondents so that the estimate of their willingness to pay is realistic (Horton et al. 2003). Several researchers have employed contingent valuation methods to find the willingness to pay for improvements in water quality (Carson, Flores, and Meade 2001; Alberini and Cooper 2000; Korman 2002).

To elicit farmers' willingness to pay for the proposed crop insurance scheme, we used the single bound contingent valuation method, the probit model, and the maximum likelihood estimation procedure, because the estimates are better than those of direct elicitation. We employed a dichotomous choice method of elicitation: we asked the respondents if they would be willing to pay a particular amount. They may accept the amount (yes) or reject it (no), similar to making market decisions every day based on the price (Freeman 1992). We had to ensure that we explained the hypothetical crop insurance product well to the respondents because the accuracy of our estimate of the willingness to pay would depend on how well we explained the new product and the respondent understood it.

First, we explained the schemes available at the time of the survey. To estimate crop loss, the Weather Based Crop Insurance Scheme (WBCIS) uses changes in weather variables as a proxy for actual crop loss and predetermines the trigger limit—the minimum or maximum value of a weather variable that does not harm the crop—so that a farmer becomes eligible for compensation whenever a particular weather variable crosses the trigger limit. The farmer has to pay 2% of the sum insured or the actuarial rate, whichever is less. The difference between the actuarial premium rate and the rate of insurance charges payable by farmers is the rate of normal premium subsidy, which is shared equally by the centre and the state.

For crop insurance products based on yield, the loss in yield is estimated directly through crop-cutting experiments; and the compensation is calculated on the basis of the sum insured, indemnity level, and yield loss. The sum insured depends on the scale of finance, derived from the crop cultivation cost, and the claim amount is transferred automatically to the farmer's bank account.

Then, we explained the details of the proposed insurance scheme. The exact phrasing of the scheme posed to farmers was: a new crop insurance scheme is being introduced, in which the compensation would be calculated based on the procurement price of the produce—unlike the existing scheme, in which the compensation covered only the cost of cultivation. Crop loss will be assessed using drones and satellite imagery, and claims will be transferred automatically to the farmers' bank account within 45 days of the reporting of the crop loss. The new scheme will take the area-based approach, but it will provide for accommodating individual losses. All the changes in the proposed scheme are advantages over the existing one and based on the recommendations from the previous studies.

After we explained the scheme, we asked the farmers to pick a lot, each containing the amount INR 300 (USD 4.11), INR 400 (USD 5.49), INR 500 (USD 6.86), INR 600 (USD 8.23), INR 700 (USD 9.60), and INR 800 (USD 10.98). We selected

these amounts because farmers paid a premium of INR 400 per acre during the period of our survey and we intended to assess the range of premiums that farmers would be willing to pay for the new scheme. We recorded the farmer's response (yes/no).

To elicit the willingness to pay, Suresh, Gupta, and Mann (2010) use a similar method for a participatory pasture development programme, Subash, Aditya, and Srinivas (2018) use contingent evaluation for a community-driven seed production programme, and Aditya et al. (2018) use contingent evaluation for a crop insurance scheme among the farmers of Punjab.

Inherent in estimating the willingness to pay are several biases: starting point bias, information bias, hypothetical bias, interviewer bias and respondent bias, and the anchoring effect.

In the starting point bias, the initial numbers or range given by the interviewer as an example influences the respondent. The lot is randomly selected in single-bound contingent evaluation, so there is no starting point bias.

If a respondent does not have adequate information on the scheme, they may develop information bias. To avoid it, we explained the proposed scheme to the farmers in detail.

A respondent exhibits hypothetical bias if they behave differently in a hypothetical situation than in a similar real-life situation. Hypothetical bias could be eliminated by emphasizing the consequentiality of the survey and farmer responses (Carson and Groves 2007). The chance that the respondents might overstate their willingness to pay is limited because they may need to pay more in the future and also because we asked them to choose between binary responses, and not state their willingness to pay (Vossler, Doyon, and Rondeau 2012).

Respondents may answer questions in a way that they consider socially acceptable instead of saying what they think. That is the respondent bias. The interviewer's belief, prejudice, or interpretations may affect the response. That is the interviewer bias. Phrasing the questions in a neutral manner would eliminate the respondent bias. Phrasing the information about the new insurance product without expressing the interviewer's belief or assumptions and providing complete neutral sentences where the sentence describes the product without any interpretations would eliminate the interviewer bias. Therefore, we created a neutral statement regarding the new insurance product to avoid both the respondent bias and the interviewer bias.

If farmers are aware of the existing schemes, they would compare their premiums, and terms and conditions, with the proposed scheme; their answers would be based on experience and the existing situation. That is the anchoring effect. To avoid it, we told the farmers that the new scheme was entirely independent of the existing scheme.

For each observation t, we assume that the net gains from subscribing to crop insurance is *U*R, which is related to a set of exogenous variables *x*K.

Next, we use the coefficient β to describe the relation in the probit model and the latent model, assuming the error term, μt, which follows the standard normal distribution, μt~N(0,1) μt~N(0,1),

$$U_t^* = x_t' \beta + u_i \quad \ldots(1)$$

similar to the probit model,

$$Y_t^* = x_t' \beta + u_i \quad \ldots(2)$$

when U_t^* and Y^t, satisfies:

y_t= (1, if U_t^*>, 0 otherwise)

where

U_t^* is the latent utility variable, and

Y^t is the observable response (0/1) variable of whether a farmer would subscribe to crop insurance.

To develop this regression model in addition to the normally distributed error terms, we assumed that the conditional probability takes the normal form:

$$\Pr(y_t=1|xt) = \Phi(x't\beta) \quad \ldots(3)$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function.

The probit model is of the form

$$Y = \alpha + \beta_1 X + \beta_2 B + \varepsilon \quad \ldots(4)$$

where

Y is the yes/no response,

X is a vector of variables reflecting household, area or other characteristics,

B is the bid price and

ε is an error term.

The mean willingness to pay is estimated as

$$WTP = (\alpha + \Sigma(\beta_1 * X^a)/ \beta_2) * -1 \quad \ldots(5)$$

where,

X^a is the mean value of X variables.

This study considers the variables age, sex, education, farming experience, and the area under cultivation of each farmer (Table 1). The area under cultivation, and farmer experience and education, will be positively correlated to a farmer's probability for opting for crop insurance, while age is expected to have a negative relationship (Falola, Ayinde, and Agboola 2013; Afroz, Akhtar, and Farhana 2017; Abebe and Bogale 2014; Aditya, Kishore, and Khan 2020).

Results

We study the socio-economic characteristics of farmers to analyse the factors affecting their willingness to pay for crop insurance (Table 2). All the farmers we surveyed had been educated to primary school level at least. This result coincides with Kerala's high literacy. Over 80% of the farmers in the sample earned less than INR 200,000 per annum.

Willingness to pay for crop insurance scheme and factors affecting willingness to pay

At the time of our survey, the WBCIS premium was INR 400. We offered six bids, from INR 300 to INR 800, with a INR 100 difference between successive bids, to avoid the anchoring effect and get a better spread of values to both sides of the existing rate.

We drew the lots, using the random chit method, in front of the farmers. We checked the frequency of distribution of initial bid amounts; all the initial bids were picked at almost similar frequencies, which ensured the randomization of the initial bids (Table 3).

By demand theory, as the price increases, the demand should decrease; Carson, Flores, and Meade (2001) propose the 'price test' of the robustness of the elicitation process. We tabulated the initial bid offer and the frequency of acceptances (recorded as dummy; 1 = yes, 0 = no) (Figure 1). The model parameters showed that the model fit is good (LR chi2(9) = 33.98, Prob> chi2 = 0.0001, Pseudo R2 = 0.1463) (Table 4).

Landholding size was positively correlated with a farmer's chance of subscribing to a crop insurance scheme, in line with Aditya, Khan, and Kishore (2018), which had shown also that a farmer's chance of subscribing to a crop insurance scheme was negatively correlated with a farmer's age and positively correlated with their experience and area under cultivation. As their age increases, farmers become reluctant to participate in insurance schemes because they consider that the settlement will be inadequate and delayed; they rely on conventional measures to cover crop loss and expect the government to institute relief schemes to compensate for the large-scale loss. The demand for crop insurance is negatively correlated with age and positively correlated with the cultivated area also in Ethiopia (Abebe and Bogale 2014) and the European Union (Liesivaara and Myyrä 2014).

But farmers that have larger landholdings stand to incur loss on a larger scale. Because they are well off and can afford insurance, they use crop insurance products and consider the premium a part of their production cost. The demand for insurance is higher among these farmers, therefore. The additional spending on the crop

Table 1 Summary statistics of variables

Variable	Unit	Description
Age	Years	Age of the farmer
Education	Dummy	Dummy = 1 if the farmer has primary education, 2 if upper primary education, 3 for high school and higher secondary, and 4 for graduate level and above
Experience in farming	Dummy	Dummy = 1 if farmer experience < 30 years, 2 if if farmer experience 10–30 years and 3 if farmer experience > 30 years.
Area	Acres	Total area cultivated by the farmer
Sex	Dummy	Dummy = 1 if the farmer is female 0 otherwise.

Table 2 Socio-economic profile of farmers with crop insurance

Characteristics	Nenmara Block	Kollangode Block	Average
Total households	90	90	
Age (Years)			
30–49	21	29	53.89
50–69	67	60	
Above 70	2	1	
Gender (Dummy = 1 if the farmer is female 0 otherwise)			
Female	22	20	0.23
Male	68	70	
Educational Qualification (Dummy = 1 if the farmer has primary education, 2 if for upper primary education, 3 for high school and higher secondary and 4 for graduate level and above)			
Primary/Upper primary	41	32	2.58
High school/ Higher secondary	34	40	
Degree and above	15	18	
Experience in farming (Dummy = 1 if the farmer has an experience of less than 30 years, 2 if the farmer has an experience between 10 and 30 years and 3 if experience is above 30 years**)**			
Less than 10 years	11.11	21.11	2.52
10–30 years	17.78	13.33	
Above 30 years	71.11	65.56	
Land Holding Pattern (Total area cultivated by the farmer**)**			
Less than 1 ha	64.44	66.67	2.74
1–2 ha	22.22	27.78	
2–5 ha	6.66	5.55	
More than 5 ha	6.68	0.00	

Source Field survey

Table 3 Distribution of initial bid

Initial bid amount	Frequency	Percentage
300	33	18.33
400	28	15.56
500	32	17.78
600	27	15.00
700	32	17.78
800	28	15.56
Total	180	100

Source Field survey

insurance premium accounts for only a meagre portion of their total expenses.

We used the coefficient estimates (Model 1) to estimate the farmers' willingness to pay for the new insurance product: INR 710 (USD 9.74) per acre, or INR 1,753 (USD 24.06) per hectare (Table 5).

The estimates were statistically significant (Table 5). The farmers paid INR 400 (USD 5.49) per acre, or INR 1,000 (USD 13.72) per hectare, in insurance premium during the study period. The actuarial rate for paddy in Palakkad was INR 8,250 (USD 113.24) per acre, 16.5% of the sum insured (INR 50,000 or USD 686.44) per acre. The farmer's share was 2% of the sum insured (INR 1,000 or USD 13.72). The rest of the premium amount (INR 7,250 or USD 99.52) was shared equally by the state and central governments. The farmers were willing to pay an additional INR 310 (USD 4.25) for the hypothetical crop insurance scheme, which can be considered as an upgradation of the existing scheme.

Conclusions

In developing countries, product design and implementation determine the popularity of, and voluntary subscription to, insurance schemes. Many

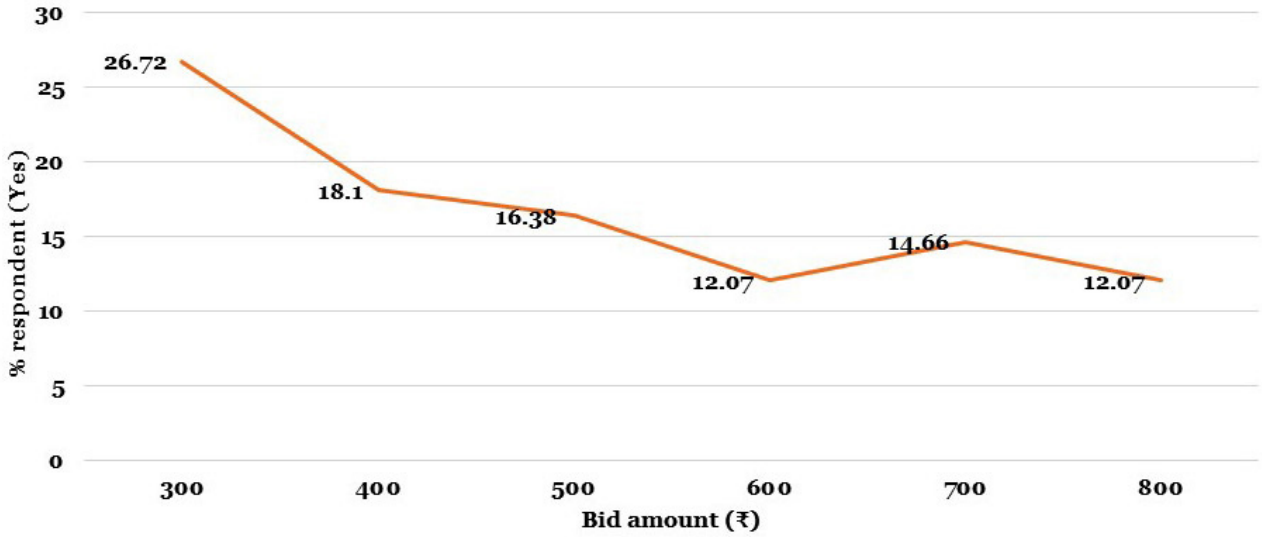

Figure 1 Distribution of initial bids and corresponding answers to estimate farmers' willingness to pay
Source Estimated from the field survey

Table 4 Results of the probit model for estimating WTP for the proposed crop insurance scheme

Variables	Model 1			Model 2		
	Coefficient	Standarderror	P value	Coefficient	Standard Error	P value
Bid	–0.003	<0.000	0.000	–0.003	0.001	<0.001
Age (years)	0.009	0.012	0.456	–0.010	0.020	0.604
Sex (male/female)				–0.400	0.258	0.120
Education						
Upper primary				0.380	0.326	0.243
High school/ pre-degree				0.236	0.301	0.431
Degree holders				0.489	0.444	0.270
Farming experience						
10–30 years				0.079	0.389	0.84
>30 years				0.648	0.419	0.122
Area cultivated (in acre)	0.072	0.039	0.066	0.084	0.047	0.071
Constant	1.163633	.7230632	0.108	1.519	1.139	0.182

Source Field survey

Table 5 Estimated willingness to pay for new crop insurance scheme

	Coefficient	Std. Err.	Z	P>z	[95% Conf.	Interval]
WTP	710.0685	50.98718	13.93	0	610.1354	810.0015

Source Field survey

designs of crop insurance schemes have been experimented with in India, but the coverage is lower than expected (Dey and Maitra 2017)—farmers are reluctant to subscribe to existing crop insurance schemes, because the compensation is inadequate, the existing products do not compensate for localized calamities, and settlements are delayed. However, they are willing to pay a higher-than-current premium for the hypothetical insurance product, because it guarantees that claims will be settled based on the procurement price, instead of cultivation cost, and promptly; and individual losses will be accounted for.

Farmer experience is negatively correlated with their willingness to pay; therefore, their reluctance to subscribe to existing crop insurance schemes indicates prior unsatisfactory experience. Especially when large amounts of public money from the exchequer is channelized for providing subsidies, any crop insurance scheme should ensure foolproof implementation at the ground level because any gap between design and reality leads to farmer dissatisfaction and a reluctance to adopt.

Modifying the existing schemes would enhance subscriptions (Mukherjee and Pal 2017; Nair 2010), but it would also require investment (Soner et al. 2020) in infrastructure—referral weather stations, GPS-tagged handheld transmitters of data from crop-cutting experiments, advanced computers, and cloud capturing and processing of weather and/or yield data. This infrastructure is needed for implementation; it should be considered a component of the product design.

Adoption will improve if the provision to accommodate individual losses is introduced and drones and satellite imagery are used to assess crop loss faster. If crop insurance products are dynamic, and they evolve constantly and protect farmers from income fluctuations, farmers will find these products useful, adopt them, and pay more.

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