Experimental Evidence of Risk Attitude of Farmers from Risk-Preference Elicitation in India

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Covariate production risks are some of the central features of the agriculture sector especially in developing countries that merit further economic research. Risk attitudes of the farmers play a crucial role in designing and targeting mechanisms to mitigate risks. As a part of our larger research project towards developing a comprehensive crop insurance product, we conduct risk preferences elicitation experiment with rice-growing farmers in eastern India. The experiment is relatively unique in that it introduces a minimum entry fee which help in eliciting risk preferences that are close to their behaviour in real decision makings. Using zero-inflated ordered probit mode, we analysed the experimental data. The results show that small and marginal farmers tend to opt for options associated with high risk aversion. As majority of the farmers in the sampled states have small and marginal landholdings, in general farmers tend to be risk averse. In addition, compared to young farmers, elder farmers are found to be more risk averse. Education and household size of respondents have also positive effect on riskier options and negative effect on risk averse options. Farmers who belong to minority caste/social class (SC and ST) are more likely to opt the risk aversion strategy.

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Keywords: agriculture, experiment, India, risk behaviour, zero inflated probit

1. Introduction

Covariate production risks are some of the central features of the agriculture sector especially in developing countries that merit further economic research (Barrett, 2011). Variation of rainfall (drought and flood) is the frequently recurring covariate risk followed by pest and disease outbreaks, and other extreme weather events like cyclone, hailstorms, hurricanes, strong winds, etc. (Barrett, 2011, Cole et al., 2017). Increased intensity and frequency of any or combination of these risks especially since past few decades has led to increased risk of yield loss. A major concern of various governments, researchers, policy makers, and associated organizations is how well adverse effects of these production risks can be mitigated. Risk sharing strategies become crucial when there is a limited scope of other risk coping and management strategies towards mitigating agricultural production risks. Location and weather specific farm lands, and farmer level constraints limit the scope for risk management strategies like crop and field diversification and diverse portfolio of occupations respectively. Coastal and low lying areas have limited options other than rice crop especially in khairf season. Given these situations, sustainable production requires instruments to help farmers mitigate the risks effectively and stabilize their income. Hence, crop insurance mechanism is one such risk sharing strategy that plays an important role in agriculture production for risk mitigation, farm investment and technology adoption, income stabilization, and improvement of farm livelihoods.

Literature theoretically and empirically has asserted that risk attitude of the farmers play a crucial role in designing and targeting mechanisms to mitigate risks (Barrett, 2011, Charness and Viceisza, 2015, De Brauw and Eozenou, 2014, Harrison, 2011). Therefore, behavioural responses of the farmers to risk should be taken into account in order for evaluation and clear policy recommendations towards an effective crop insurance scheme. The risk attitudes of the farmers affect their risk management decision-making associated with production and also influence their investment and technology adoption behaviour (Boucher et al., 2008, Dercon and Christiaensen, 2011). In addition, distribution of risk attitudes (homogeneity or heterogeneity) among the farmers could also provide further policy insights. Hence, understanding what type of risk attitudes farmers have in general, what is their distribution, and what influences those risk attitudes could yield important policy pointers towards an effective mechanism of risk mitigation. As a part of our larger research project towards developing a comprehensive crop insurance product, as the first step, we therefore conduct an experiment to elicit risk preferences of rice-growing farmers in four eastern states of India.

A large body of literature exemplify risk preferences of producers using various methods such as questionnaire, computer simulation method, different experiments with or without initial

endowments and real monetary payoffs[1]. Among these, experimental methods of risk preference elicitation especially in developing countries have proven effective and are widely applied methods. Some literature used experimental methods without real payoffs and whereas majority of the literature used experiments with real payoffs for risk preference elicitation. Among the experiments with real payoffs, majority provide initial endowment to the participants or pay real payoffs at the end of the game. However, such provisions face the risk of inducing bias due to 'house money' effect[2]. Few literatures attempted to minimize the house money effect but without much clarity (Eckel and Grossman, 2003). Therefore, we introduce minimum entry fee to participate so that participants' risk preference broadly reflects their risk behaviour in real decision makings.

In this paper, we adopt a method of eliciting risk preference developed by Eckel and Grossman (2002). This method is simple and easy to comprehend which is more appropriate particularly in the context of rural households. In addition, as compared to more complex elicitation methods, it is found that this method produces significantly less noisy estimates of risk preferences especially in the context where participants have lower cognitive abilities (Dave et al., 2010). Moreover, risk preferences elicited by the method are found to be correlated with other widely used methods (Reynaud and Couture, 2012).

The risk preference data was collected from 3,517 rice-growing farmers in four eastern states of India. As indicated above, the experiment is relatively unique in that we introduced a minimum entry fee which could elicit risk preferences which are close to their behaviour in real decision makings. We analysed the data basically to profile farmers' risk preference, to understand general distribution of risk preferences and their influencing factors so that these results can be useful in drawing policy suggestions and for our further research on crop insurance. We find that farmers largely opted for options that are associated with risk aversion. Wealth in terms of landholding, education, social class, primary occupation, age of the respondents significantly influence their participation decision and risk associated options.

The paper is constructed as follows: The next section will discuss the experimental design of risk elicitation, sampling framework and location details. Section 3 presents and discusses the method used and the results. The final section concludes by summing up and pointing a way forward.

[1] For more details on the elicitation methods see Charness et al. (2013) and Hurley (2010).

[2] Often in experiments, subjects are given some initial endowments to play the games, which they may not feel their own money and make riskier choices than they would if playing with their own money, which is termed as house money effect (Eckel and Grossman, 2003). The entry fee of some minimum amount could make farmers feel that they invest their own money in decision making in the game which makes them to take an appropriate decision that broadly reflects their risk preference in real decision makings.

2. Research Design

2.1. Background

Farmers in the eastern region of India have been facing production risks of frequent abiotic stresses like climate events and biotic like pest and disease outbreak, often causing downward movement of their economic status and wellbeing. Agriculture is one of the major sectors in the states having more than 60 per cent of its population involved in agriculture and associated sectors and around 35 per cent of the its geographical area under cultivation. Major portion of the cultivable land is prone to flood, drought, and salinity. In addition, majority of the farming community (more than 80 per cent) in the region is constituted by small, marginal and landless farmers and rice is the main crop covering 75-80 per cent of the cultivated area.

To protect the farmers from the production risks and stabilise their income, the respective state governments with assistance of various local, national and international organisations have been undertaking several programs at various levels. One of the major projects to bring system level changes through innovative interventions in key thematic areas is the Odisha government's collaboration with International Rice Research Institute (IRRI) resulting to implement the project, "Increasing Productivity of Rice-Based Cropping Systems and Farmers' Income in Odisha (2016-2020)" with five major subprojects. One of its subprojects explores ways to support a science based crop insurance system using remote sensing and economics approaches which addresses social and technical constraints of implementation. The remote sensing approach aims for timely estimation of rice area and yield under normal and stressed environments and the economics approach aims to test farmers' acceptance of different ways of integrating stress reducing technologies / crop management practices with the crop insurance scheme. As farmers' risk taking behaviour play significant role in adoption of new technologies and undertaking other farm related investments, understanding risk attitudes of the farmers and their driving factors could be the first step towards assessing the farmers' acceptance. Totally, 348 villages were randomly selected from 48 selected administrative units (districts) across 4 eastern states of India for the study where risk preference elicitation experiments were conducted with around 3,517 farmers.

2.2. Experimental design

To study risk attitudes of farmers, we used a risk preference elicitation experiment, where individual decisions are framed as simple choices with two alternative payoffs. The experiment consists of two parts – a survey and an experiment. In the former part, face-to-face interviews

were conducted for detailed information on household and socio-economic characteristics, and cropping pattern. The primary survey was followed by the later part, an experiment, where farmers were explained about the game and a set of five choices and then asked them their willingness participate in the game. They had options either to opt out of the game or to participate. If they were willing to participate, they were asked to opt one among the five options that was most preferred by them.

Each choice option has two possible outcomes with different payoffs and risks. Each outcome has an equal likelihood of occurrence (50 per cent). The set of choices and payoff details of outcomes of each of the choices are presented in **Error! Reference source not found.**. A minimum entry fee of rupees (Rs.) 20 was introduced to participate in the game and farmers were asked to select the most preferred choice among the set. The entry fee was mainly introduced to minimise "house money" effect, which experimental research is rarely addressed. As the standard deviation is set to increase linearly from choice-1 to choice-5 which indicates increase in risk, the choice selected is then used as the measure of risk preferences. All the payoffs are designed in such way that the maximum payoff one can receive was Rs. 180 and the worst possible payoff was Rs.0 (zero)[3].

[3] Net gain in case of maximum payoff (maximum payoff – entry fee) and net loss in case of the worst payoff (the worst payoff – entry fee) are Rs. 160 and Rs. 20 respectively.

Table 1: Choice options with associated payoffs and risk

Sl. No	Choice	Event	Probability	Payoff (Rs.)	Expected Payoff	Risk
1	Choice_0	-	-	0	00	0.00
2	Choice_1	-	-	40	40	0.00
3	Choice_2	A (Gain)	0.5	30	45	10.60
		B (Loss)	0.5	60		
4	Choice_3	A (Gain)	0.5	20	60	28.30
		B (Loss)	0.5	100		
5	Choice_4	A (Gain)	0.5	10	75	46.00
		B (Loss)	0.5	140		
6	Choice_5	A (Gain)	0.5	00	90	63.60
		B (Loss)	0.5	180		

2.3. Potential driving factors of risk attitude

In this subsection, we discuss potential driving factors of farmers' risk attitudes (risk aversion, risk neutral, and risk taking) from the literature and identify the hypothesis. Existing evidence from risk preference elicitation experiments shows that factors like demographic and socio-economic conditions, emotions and subjective feelings, health and other indicators influence risk attitude (Andersen et al., 2008, Bonsang and Dohmen, 2015, De Brauw and Eozenou, 2014, Guiso et al., 2013, Meraner and Finger, 2017, Roe, 2015, Sahm, 2012, Vollmer et al., 2017, Weber et al., 2012).

While some literature show that socio-economic and demographic indicators such as age, education, household size, gender wealth and income have positive or no influence on risk aversion (Binswanger, 1980, 1981, Bonsang and Dohmen, 2015, Iqbal et al., 2016, Mosley and Verschoor, 2005, Nooteboom, 2015, Roe, 2015, Sahm, 2012, Saqib et al., 2016, Yesuf and Bluffstone, 2009), some other show the negative influence of some these factors (Andersen et al., 2008, Bonsang and Dohmen, 2015, De Brauw and Eozenou, 2014, Iqbal et al., 2016, Outreville, 2015, Roe, 2015, Sahm, 2012, Saqib et al., 2016, Yesuf and Bluffstone, 2009). Proportion of rented land, experience, location specific risk types, and ethnicity could be other factors that influence farmers' risk attitude.

2.4. The experiments

From four eastern Indian states, 48 districts were randomly selected. Using Geographic Information System (GIS) and remote-sensing techniques, all the villages in the selected districts were classified into stress-prone and no-stress villages (Figure 1). In each of the selected districts, 7-8 villages were randomly selected from the Village Census data of 2011, totalling to 348 villages. In each district, villages were selected in such a way that 70 per cent were stress-prone and the rest 30 per cent for no-stress. The experiment was conducted with 3,517 farmers in 348 villages across 4 major rice growing eastern states of India, which are Odisha, West Bengal, Bihar and Uttar Pradesh, in the year 2017.

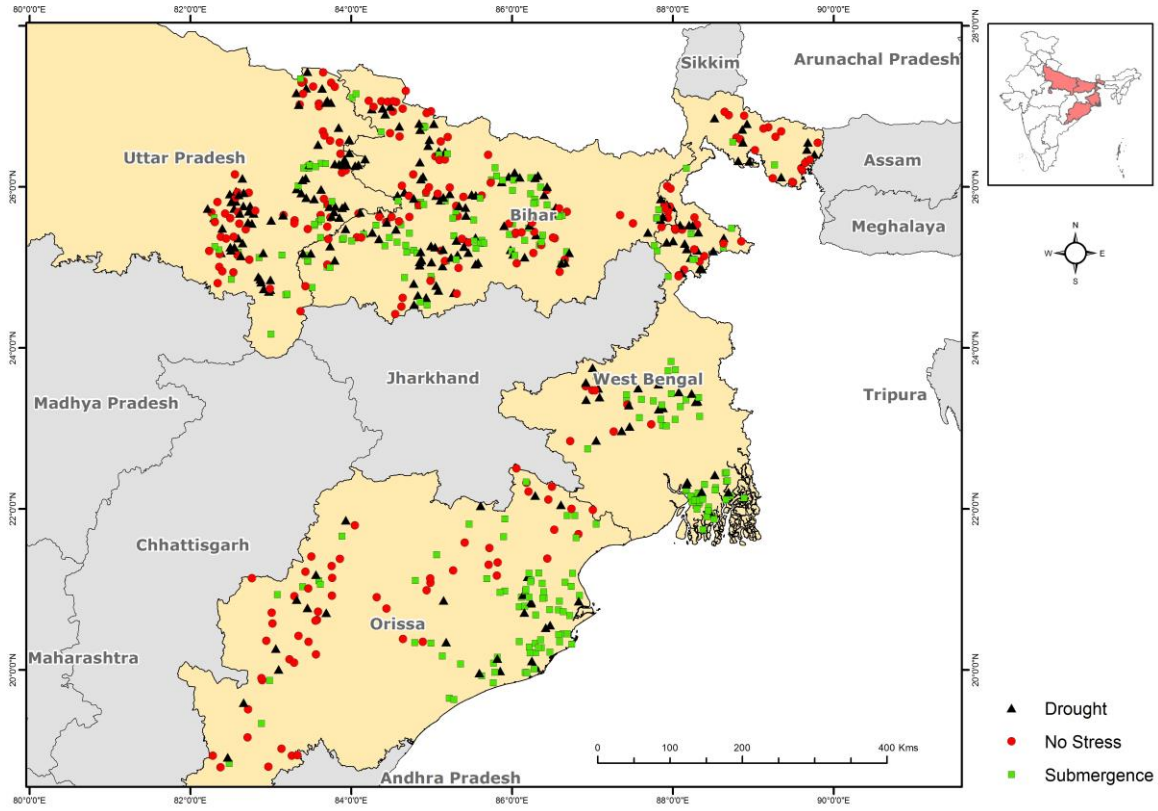

Figure 1. Map of the study area indicating the sample points

Post-survey, the experimenters read the instructions and explained farmers in detail about the risk preference elicitation experiment, entry fee, all the choices, respective outcomes and payoffs, and earnings. In order for clear understanding visual depictions of payoffs on posters were presented to farmers to help explain the payoffs of alternative outcomes of all the choices and make appropriate choice decisions. Once the farmers were clear about the game, they were asked for their willingness to play the game. In case of those who opted out, they were not required to pay the entry fee of Rs. 20 and roll the dice, which indicates that they were either just not willing to invest in the game which could be due to ethical and cultural reasons or

they were very high risk averse. In case of those who were willing to participate in the game, they were asked to pay the entry fee and select their most preferred choice among the set. Once they selected the option, they were asked to roll a six-sided dice to determine one of the two outcomes of the choice they made, where odd numbers indicated outcome A and even numbers indicated outcome B. Even within the game, in option_1 is selected, farmers were not required to roll the dice as the option indicate high risk averse and singly payment of Rs. 40. As showed in Table 1, depending on the outcome of particular choice, farmers were paid earnings by the enumerator. Our design is an advancement over the existing experimental studies by addressing "housing money" effect through introduction of entry fee. While the entry fee to play the game reflected a real context of investment and decision making, it made farmers elicit a more efficient risk preference that was close to their actual risk attitude.

3. Methods and Results

3.1. Econometric Specification

As indicated in the previous section, there are two decisions farmers made in the game (first being participation decision (yes/no) and the second, the choice preference). The collected data set has a discrete ordered outcome which is characterised by a high fraction of zeros, called zero inflation, mainly due to opt out decision observations. The zeros relate to two distinct sources as the opt out option (option_0) could be either because of very high risk aversion or because of some ethical and cultural considerations.

Conventional ordered probit may not capture this distinction and could produce biased or inefficient results. Therefore, a zero-inflated ordered probit (ZIOP) model as an extension of ordered probit can handle such data sets and produce efficient results (Harris and Zhao, 2007). The model splits into two latent equations, a probit selection for participation decision and an ordered probit models for choice preference decision of the game. That is, a farmer overcome two hurdles, one whether to participate in the game followed by another, conditional on participation, which choice option to select as his/her most preferred. Let y_1 denote binary discrete choice variable (= 1 if participated in the game and 0 otherwise (those who opted out)). This is a latent variable that represents the probability of participation.

$$Decision\ to\ participate\ in\ the\ game\ (y_1) = \alpha_1 + \beta X + \varepsilon \qquad (1)$$

Where, α_1 is a constant, β, is a vector of unknown parameters that influence farmers' participation in the game, and $\mathcal{E}$ is the residual term. The probability that a farmer participates

in the game is defined by the cumulative distribution function (CDF) (Φ) of the univariate standard normal distribution, participation = 1 if farmer opt to play the game; and 0 otherwise:

$$\Pr(Participation = 1 \mid X) = \Phi(\beta X) \quad (2)$$

Conditional on the fact that a farmer participates in the game, most choice options are presented by a discrete variable y_2 (= 1, 2, …*J*), which is the second latent variable of the ZIOP model and is estimated by ordered probit model.

$$Preference\ of\ the\ choice\ options\ (y_2) = \alpha_2 + \mu Z + u \quad (3)$$

Where α_2 is a constant, Z is a vector of parameters with unknown weights μ that influence farmer preference, and u is a residual term. The full probabilities of both the regimes are given by[4]

$$P_r(Y) = \begin{cases} \Pr(Y = 0|z,x) = [1 - \Phi(X\beta)] + \Phi(X\beta)\Phi(-Z\mu) \\ \Pr(Y = j|z,x) = \Phi(X\beta)[\Phi(\gamma_j - Z\mu) - \Phi(\gamma_{j-1} - Z\mu)] \quad (j = 1,2,,,J-1) \\ \Pr(Y = J|z,x) = \Phi(X\beta)[1 - \Phi(\gamma_{j-1} - Z\mu)] \end{cases} \quad (4)$$

Where, γ_j (j= 1, 2, …., J - 1) are the boundary parameters to be estimated in addition to μ. By this process, the probability of a zero observation has been inflated by combining the probability of complete risk averse from the ordered probit model and the probability of non-participation in the risk preference game from the binary probit model. Once the full set of probabilities has been specified, the parameters of the complete model M = (β, μ, γ) is estimated using maximum likelihood approach. The log-likelihood function is as below.

$$\ln(M) = \sum_{i=1}^{N}\sum_{j=1}^{J} h_{ij} ln[\Pr(y_i = j|X_i, Z_i, M)], \quad (5)$$

Where h_{ij} is the indicator function, =1 if individual chooses j[th] outcome and 0, otherwise.

3.2. Descriptive Statistics

Table 2 describes of dependent and independent variables. As described in section 2.2, RISK_PREFERENCE is the dependent variable having six ordinal outcomes. The independent variables comprise important socio-economic characteristics of farmers and other factors that could influence their decision on risk preference. The independent variables such as CASTE_CATEGORY (base-general category), RICE_PRODUCER, STATE_LOC (base-Bihar state),

[4] For detailed process see Harris and Zhao (2007) and StataCorp (2017)

PRIM_OCCU (base- Agriculture & Allied), and RELIGION are categorical variables. The standard deviation of continuous variables indicate that sample has good variations.

Figure 2 presents details of the preferred risk intensity options. Around 30% of sample farmers opted out of the game, which include very high risk averse farmers as well as those who opted out due to some ethical and cultural considerations or incomplete understanding of the options and the game. Considering this, participation decision of farmers could be influenced by their religion, caste, wealth, education level and other socio-economic characteristics. Whereas those who opted to play the game had to pass two hurdles, one being participation in the game and another their decision on most preferred option. In addition, the choice options are ordered from low to high risk. Therefore, ZIOP model would be an ideal model which handles the data generated by such conditions and produces comparatively efficient estimates as compared to ordered probit model.

Table 2: Descriptive Statistics of the variables

Variable_Name	Description	Mean	SD
RISK_PREFERENCE (Dependent variable)	Farmers risk Preference (=0 option_0 (complete risk aversion), 1 if option_1 (high risk aversion), 2 if option_2 (medium risk aversion), 3 if option_3 (low risk averse/taking), 4 if option_4 (medium risk taker), and option_5 (high risk taking))	-	-
LAND_HOLDING	Land holding in Hectare (ha)	0.87	1.37
LIVESTOCK_HOLDINGS	Total Livestock holdings (count)	4.55	6.88
HH_EDUCATION	Education of the household head (years)	6.21	4.75
HH_AGE	Age of the household head (years)	52.82	13.15
HH_SIZE	Household Size (count)	5.02	2.42
CASTE_CATEGORY	Caste Category (1= General, 2=SC, 3=ST, and 4=OBC)	-	-
DIST_INPUTM	Distance from house to the nearest input market (km)	3.45	3.28
DIST_OUTPUTM	Distance from house to the nearest output market (km)	3.59	4.01
RICE_PRODUCER	Whether household plant rice in the last 12 months (=1 if yes and 0 otherwise)	-	-
RELIGION	Religion (=1 if Muslim, and =0 Others)	-	-
TOTAL_PLOTS	Total number of plots (owned and rented in)	3.43	3.36

ELECTRICITY	Access to Electricity (=1 if yes and 0 otherwise)	-	-
HH_GENDER	Respondents gender (=1 if female and 0 male)	-	-
PRIM_OCCU	Primary occupation of household head (=1 Agriculture & Allied; =2 labour; =3 Others; = 4 Salaried Employment; and =5 Self Employment)	-	-
STATE_LOC	States (=1 if Bihar; =2 if Odisha, =3 if Uttar Pradesh; and =4 if West Bengal)	-	-

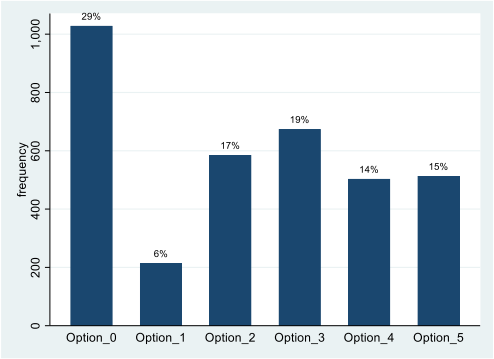

Figure 2: Summary of frequencies of risk preferences

3.3. Results and Discussion

Table 3 presents results of the zero-inflated ordered probit regression model, which indicate the direction and significance of coefficients. Farmers' decision to participate in the risk preference elicitation experiment is found to be influenced by household size (HH_SIZE), location (STATE_LOC), and primary occupation of the respondents (PRIM_OCCU). Increase in household size increases the likelihood of participation in the experiment. As compared to farmers in the state of Bihar, the farmers who belong to Odisha and Uttar Pradesh states are less likely to participate in the experiment and those who belong to West Bengal are more likely to participate. As compared to those farmers whose primary occupation is agriculture and allied, those whose primary occupation is labour (agriculture/non-agriculture) or salaried or any other occupation is found to be less likely to participate in the experiment.

The estimates of levels of risky options is conditional on the participation in the experiment. The effects of landholding (LAND_HOLDING_HECTARE), education (HH_EDUCATION), respondent age (HH_AGE), social class (CASTE_CATEGORY), location (STATE_LOC), and primary occupation (PRIM_OCCU) on decisions of most preferred risk options are significant. Increase in land holding and education increases the likelihood of choosing the riskier choice option. Whereas increase in respondents' age and those who were belonged to scheduled caste and scheduled tribes decreases the likelihood of choosing the riskier choice option. Those who belong

to Odisha and West Bengal are more likely choose riskier options and those who belong to Uttar Pradesh are less likely to opt for riskier options as compared those who belong to the state of Bihar. Those farmers whose primary occupation is other than labour, salaried or self-employment are more likely to opt for riskier options than those whose primary occupation is agriculture and allied.

Table 3: Zero-inflated ordered probit model (Obs. = 3,517; Wald chi2(18)=76.71; Prob > chi2= 0.0000)

VARIABLES	**PARTICIPATION_PROBIT**	**RISK_PREFERENCE(OPROBIT)**
LAND_HOLDING_HECTARE	0.00609	0.0334*
	(0.0185)	(0.0177)
LIVESTOCK_HOLDINGS	-0.00298	0.00209
	(0.00357)	(0.00385)
HH_EDUCATION	-0.00621	0.0210***
	(0.00587)	(0.00519)
HH_AGE	-0.00285	-0.00393**
	(0.00207)	(0.00188)
HH_SIZE	0.0544***	0.0148
	(0.0107)	(0.00955)
SC_CASTE_CATEGORY	0.0902	-0.177***
	(0.0748)	(0.0562)
ST_CASTE_CATEGORY	-0.000900	-0.216***
	(0.0917)	(0.0816)
OBC_CASTE_CATEGORY	0.00960	0.0555
	(0.0645)	(0.0596)
OTHERS_CASTE_CATEGORY	-0.326	-0.192
	(0.305)	(0.340)
DIST_INPUTM	-0.00557	0.0117
	(0.00889)	(0.00854)
DIST_OUTPUTM	0.00706	-0.00376
	(0.00759)	(0.00626)
ODISHA_STATE_LOC	-0.575***	0.180**
	(0.0791)	(0.0780)
UP_STATE_LOC	-0.277***	-0.154*
	(0.0894)	(0.0856)

WB_STATE_LOC	0.765***	0.199***
	(0.0882)	(0.0751)
LABOUR_PRIM_OCCU	-0.124*	-0.0206
	(0.0743)	(0.0636)
OTHERS_PRIM_OCCU	-0.457***	0.156*
	(0.0924)	(0.0937)
SALARY_PRIM_OCCU	-0.314***	-0.0383
	(0.118)	(0.112)
SELF_EMP_PRIM_OCCU	-0.0434	-0.0674
	(0.0756)	(0.0640)
MUSLIM_RELIGION	-0.0471	
	(0.0931)	
Constant	0.551***	
	(0.166)	

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; base categories: General - CASTE_CATEGORY, Bihar - STATE_LOC, Agriculture - PRIM_OCCU, Others - RELIGION

Unlike in linear regression models, individual coefficients do not convey the information on magnitude of effect on dependent variable for small change in explanatory variables. Hence, marginal effects of explanatory variables at sample means are estimated to interpret the likelihood of risky levels, presented in Table 4. Estimates in ME_0 column present the marginal effects on participation decision. A member increase in household size of the farmers decreases the probability of non-participation in the experiment by 0.016. As compared to those who belong to the state of Bihar, the probabilities of non-participation of those who belong to Odisha and Uttar Pradesh are found to be more by 0.214 and 0.0985 respectively. Whereas, the probabilities of non-participation of those who belong to West Bengal are found to be more by 0.192. The probabilities of those whose primary occupation is salaried or other than labour and self-employment are more by 0.141 and 0.095 respectively.

Table 4: Marginal effects for risk levels

VARIABLES	**ME_0**	**ME_1**	**ME_2**	**ME_3**	**ME_4**	**ME_5**
LAND_HOLDING_HECTARE	-0.00177	-0.00349*	-0.00427	-0.000216	0.00274	0.00700*
	(0.00538)	(0.00203)	(0.00279)	(0.00150)	(0.00167)	(0.00369)
LIVESTOCK_HOLDINGS	0.000866	-0.000303	-0.000497	-0.000277	-2.47e-05	0.000235
	(0.00104)	(0.00043)	(0.00059)	(0.00029)	(0.0004)	(0.000794)
HH_EDUCATION_C	0.00181	-0.0024***	-0.0034***	-0.0009*	0.00114**	0.00379***

	(0.00171)	(0.00065)	(0.0008)	(0.00047)	(0.0005)	(0.00109)
HH_AGE	0.000828	0.000357*	0.000356	-0.000142	-0.00045**	-0.00095**
	(0.00060)	(0.00022)	(0.00028)	(0.000168)	(0.000181)	(0.000393)
HH_SIZE	-0.0158***	-0.000238	0.00167	0.00396***	0.00423***	0.00620***
	(0.00309)	(0.00107)	(0.00152)	(0.000867)	(0.000930)	(0.00200)
SC_CASTE_CATEGORY	-0.0260	0.0229***	0.0313***	0.00961	-0.00842	-0.0294**
	(0.0214)	(0.00708)	(0.00959)	(0.00593)	(0.00610)	(0.0116)
ST_CASTE_CATEGORY	0.000265	0.0250**	0.0296**	0.00227	-0.0166**	-0.0406***
	(0.0270)	(0.0107)	(0.0130)	(0.00742)	(0.00842)	(0.0154)
OBC_CASTE_CATEGORY	-0.00282	-0.00516	-0.00727	-0.00117	0.00411	0.0123
	(0.0189)	(0.00591)	(0.00947)	(0.00550)	(0.00543)	(0.0133)
OTHERS_CASTE_CATEGORY	0.101	0.0107	-0.000390	-0.0251	-0.0333	-0.0534
	(0.0993)	(0.0390)	(0.0470)	(0.0271)	(0.0305)	(0.0538)
DIST_INPUTM	0.00162	-0.00142	-0.00203	-0.000680	0.000515	0.00200
	(0.00259)	(0.000970)	(0.00135)	(0.000721)	(0.000802)	(0.00178)
DIST_OUTPUTM	-0.00205	0.000587	0.00101	0.000632	0.000144	-0.000321
	(0.00221)	(0.000711)	(0.00102)	(0.000610)	(0.000630)	(0.00132)
ODISHA_STATE_LOC	0.214***	-0.0370***	-0.0730***	-0.0601***	-0.0309***	-0.0127
	(0.0277)	(0.00924)	(0.0121)	(0.00782)	(0.00786)	(0.0143)
UP_STATE_LOC	0.0985***	0.00825	-0.00838	-0.0286***	-0.0301***	-0.0396***
	(0.0316)	(0.0118)	(0.0135)	(0.00871)	(0.00896)	(0.0145)
WB_STATE_LOC	-0.192***	-0.00827	0.0143	0.0477***	0.0547***	0.0834***
	(0.0248)	(0.00984)	(0.0127)	(0.00707)	(0.00796)	(0.0162)
LABOUR_PRIM_OCCU	0.0359	-0.000897	-0.00566	-0.00929	-0.00867	-0.0114
	(0.0219)	(0.00725)	(0.0103)	(0.00605)	(0.00634)	(0.0131)
OTHERS_PRIM_OCCU	0.141***	-0.0249***	-0.0518***	-0.0426***	-0.0202***	-0.00164
	(0.0299)	(0.00750)	(0.0130)	(0.00877)	(0.00783)	(0.0191)
SALARY_PRIM_OCCU	0.0947**	-0.00438	-0.0176	-0.0249**	-0.0215**	-0.0263
	(0.0373)	(0.0120)	(0.0168)	(0.0102)	(0.0106)	(0.0210)
+SELF_EMP_PRIM_OCCU	0.0124	0.00668	0.00659	-0.00228	-0.00757	-0.0158
	(0.0217)	(0.00787)	(0.0105)	(0.00594)	(0.00653)	(0.0131)
MUSLIM_RELIGION	0.0138					
	(0.0274)					
Observations	3,517	3,517	3,517	3,517	3,517	3,517

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; marginal effects for categorical variables is the discrete change from the base level.

The probability of opting high risk averse option (option_1) is presented in ME_1 column, which is significantly influenced by landholding, education, age, SC and ST caste categories, location and primary occupation. An increase in one-hectare land decreases the probability of choosing option_1 that is associated with risk aversion, by 0.00349. Similarly, increase in a year of

education reduces the probability by 0.0024. The probability rises by 0.00036 for an increase in one-year age. The probabilities that farmers who belong to SC and ST rise by 0.0229 and 0.025 respectively as compared to those who belong to general caste category. The probability that the farmers in Odisha choose the option_1 decreases by 0.037 as compared to those who belong to the state of Bihar. Similarly, marginal effects for other options are presenting in ME_2, ME_3, ME_4 and ME_5 for options 2 (medium risk averse), 3 (Low risk averse), 4 (medium risk taking), and 5 (high risk taking) respectively.

Overall results show that the likelihood of choosing the riskier options increases with increase in landholding, implying that small and marginal farmers are high risk averse. Education and household size of respondents have also positive effect on riskier options and negative effect on risk averse options. Positive effect of household size could be because of the risk sharing mechanisms through diverse income sources by the members. Age of the respondents has negative effect on choosing the riskier options and positive effect on option associated with high aversion. Farmers who belong to minority caste/social class (SC and ST) are more likely to opt options associated with risk aversion as compared to those who belong to upper caste farmers. Farmers whose primary occupation is agriculture and allied are more likely to opt for riskier options as compared to those who has salaried and other occupation.

4. Conclusion

As risk attitude of the farmers play a crucial role in designing and targeting mechanisms to mitigate risks, understanding what type of risk attitudes farmers have in general, what is their distribution, and what influences those risk attitudes could yield important policy pointers towards an effective mechanism of risk mitigation. As a part of our larger research project towards developing a comprehensive crop insurance product, as the first step, we therefore conducted experiment to elicit risk preferences of rice-growing farmers in four eastern states of India. The experiment is relatively unique in that it introduces minimum entry fee which help in eliciting risk preferences which are close to their behaviour in real decision makings.

Using zero-inflated ordered probit mode, we analysed the data basically to profile farmers risk preference, to understand general distribution of risk preferences and their influencing factors so these results can be useful in drawing policy suggestion and for our further research on crop insurance. The results show that small and marginal farmers tend to opt for options associated with high risk aversion. As majority of the farmers in the sampled states have small and marginal landholdings, in general farmers tend to be risk averse. In addition, compared young farmers, elder farmers are found to be more risk averse. Education and household size

of respondents have also positive effect on riskier options and negative effect on risk averse options. Positive effect of household size could be because of the risk sharing mechanisms through diverse income sources by the members. Age of the respondents has negative effect on choosing the riskier options and positive effect on option associated with high aversion. Farmers who belong to minority caste/social class (SC and ST) are more likely to opt options associated with risk aversion as compared to those who belong to upper caste farmers. Farmers whose primary occupation is agriculture and allied are more likely to opt for riskier options as compared to those who has salaried and other occupation. Though these results are from single round experiment, they could provide important indicators for further research and also policy-relevant insights in building comprehensive mechanisms towards risk mitigation.

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