Understanding farmers' low uptake of crop insurance in India: A discrete choice experiment approach

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Abstract

Crop insurance helps farmers decouple climate risks, stabilize income and encourage them to invest in new technologies and improve their livelihoods. However, despite such potential benefits and public intervention with heavy subsidies in India and elsewhere in developing countries, insurance services are facing a major issue of [s]low take-up rate. The Government of India is promoting different approaches to increase crop insurance coverage and has set a target to achieve 10% annual incremental increase in coverage of insurance take-up for its flagship program, Prime Minister Fasal Bima Yojana (PMFBY). However, in order to increase the coverage through improvement in the product design, it is also important to understand a key enablers and constraints of insurance take-up from the perspective of farmers. Taking a random sample of 3000 farmers from Odisha state, a discrete choice experiment was employed to analyze the relative importance of factors influencing farmers’ decisions towards accepting crop insurance and their willingness to pay for different crop insurance attributes. Results highlight the importance of accounting farmers' preferences in product design.

Key words: Crop insurance, farmers’ preferences, discrete choice experiment, India

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1. Introduction

Agriculture in India, relied heavily on monsoon rainfall, is often facing covariate production risks due to aberrations in rainfall. On average, every year drought and flood events affect 39 per cent (62 million ha) and 2 per cent (3.56 million ha) of the total cultivable land in India respectively (Das et al., 2007). It experiences major drought, on average, at least once in six years. Such risk events carry crop production losses affecting farmers' income and livelihood. Besides, these risks can also have indirect effects through perceived threats. Elbers et al. (2007) finds that such ex ante effects constitute two-third of the impact of risk. As a result of these ex ante and ex post risk burdens, farmers often tend to reduce investment and thus restrict their port-folio decisions in agriculture to subsistence or low-cost low-return farming practices.

One of the financial services, crop insurance, is considered to be a potential intervention that protects farmers from the impacts of such covariate production risks and encourages them to invest in technology and other improved practices for higher production. Carter et al. (2016) in their theoretical modelling state that area index insurance can influence improved technology adoption by small farmers if it is designed properly and implemented in an environment of covariate risks. Cole et al. (2017) test the impact of risk management on farmers' production decisions in India and find that farmers tend to invest more in high-return crops as a result of insurance provision. It is found that insurance has a positive impact on crop choice and crop rotation (Claassen et al. 2017). In the similar line, Cai (2016) finds that the provision of insurance generated positive influence on crop production and investment. Cai et al. (2015) also find such positive impact of insurance on production of sows. Hill et al. (2019) conducted an experiment to test the ex ante and ex post effects of insurance adoption and find the significant ex ante effect on increase in cultivated area and input use and ex post effect on intensive rice production in subsequent dry season. Bulte et al. (2019) also find that the subsidised insurance has significant influence on adoption of modern varieties and demand for fertilizer, machinery, hired labor and land.

However, despite such potential benefits and public intervention with heavy subsidies in India and elsewhere in developing countries, insurance services are facing a major issue of [s]low take-up rate (Carter et al., 2017, Cole et al., 2013, Cole et al., 2017). Since the friction of high prices/low affordability is overcome to a large extent in the current insurance scheme in India through premium subsidy of up to 90 per cent, improving insurance product design can have a potential of removing non-price frictions and thus, increase take-up rates (Carter et al., 2017, Cole et al., 2013, Flatnes et al., 2018). It is therefore, before one thinks of redesigning the crop insurance product and/or related policies, important for a better understanding of the factors that explain farmers' behaviour towards accepting the crop insurance. In this study, taking advantage of some of the factors that are considered to be the gaps in the current crop insurance product in India, we developed crop insurance attributes and test whether - 1) there is a mismatch in aligning the current insurance attributes with farmers' preferences and 2) any other factors that explain low adoption of crop insurance. The study aims to contribute to the literature by measuring the relative importance of factors that influence farmers' decisions towards accepting crop insurance.

Our study contributes to the current literature improving over certain aspects. Firstly, we elicit farmers' preferences for crop insurance, which is less explored in crop insurance up-take research. Secondly, we measure cognitive abilities and other psychological factors of farmers through well-established measures and test their effect on farmer' preferences for crop insurance as very few studies focus on these aspects. Our findings with these aspects in the context of developing countries could yield a novel contribution to the current literature. Rest of the paper is constructed as follows: We do a detailed review of literature on crop insurance adoption in Section 2. We then discuss the agricultural insurance scenario in India in Section 3. In Section 4, we describe our methods, including the experimental design, sampling and data collection, and the selected econometric models (a random parameter logit). Section 5 presents the results of MNL and RPL models with and without interactions with case-specific variables and WTP estimates. Lastly, we discuss and conclude with policy implications in Section 6.

2. Literature on crop insurance adoption

Despite having potential benefits and public intervention with heavy subsidies in India and elsewhere in developing countries, insurance services are facing a major issue of [s]low take-up rate (Carter et al., 2017, Cole et al., 2013, Cole et al., 2017). But insurance works on the principle of risk pooling and diversifying, for which high take-up rates across the diverse risk areas is an essential criteria in order to sustain in the long run and generate significant welfare effects. Several studies have examined the barriers and motivations to the adoption of crop insurance services by farmers. Cole et al. (2013) find that the factors such as higher prices, lack of trust or low understanding of the product, no experience with insurance and payout, liquidity constraints, and salience influence low-take. Whereas Cai and Song (2017), in their study, find that changes in perceived disaster probability, learnings on insurance benefits, and risk attitudes have no impact on insurance take-up but the experience and provision of information on payout probability have significant impact on the take-up. Belissa et al. (2019) find the increase in insurance uptake by removing - liquidity constraints through delayed premium payment, and trust and information problems through promotion of insurance via informal risk-sharing institutions. Few other studies indicate that the demand of crop insurance is highly price sensitive (Clarke et al., 2015, Hill et al., 2019). Since the friction of high prices/low affordability is overcome to a large extent in the current insurance scheme in India through premium subsidy of up to 90 per cent, improving insurance product design can have a potential of removing non-price frictions and thus, increase take-up rates (Carter et al., 2017, Cole et al., 2013, Flatnes et al., 2018).

Unlike in credit services where farmers have to earn trust of the bank in order for receiving the credit from the bank, the insurance services require farmers to trust their product/companies issuing them in order to accept and take it up. Therefore, lack of trust and poor understanding are the major demand side issues evidenced in the literature (Cole et al., 2013, Gaurav et al., 2011, Gine et al., 2008). Gine et al. (2008) find in their study that farmers' trust in the insurance service increases the adoption. They also find that take-up is low due to product uncertainty due to basis risk. Few studies have tested the impact of reducing trust related issues through promoting insurance via informal risk-sharing institutions or trusted local agents, whether they have received payouts previously, whether the insurance provider pre-established in the area, etc. (Belissa et al., 2019, Cai and Song, 2017, Cole et al., 2013). In addition, design related issues such as product uncertainty due to basis risk (Carter et al., 2017) and about the expected returns (Cai and Song, 2017) can directly influence farmers' trust in the product. However, in addition to these, lack of process transparency and delay in claim payment as tail-end risks are not well explored, which can have a direct bearing on trust. A timely payment of payouts and process transparency could effectively increase a sense of trust among the farmers on the insurance service, which in turn influences take-up. Taking advantage of these factors, in this study, we design insurance attributes and test farmer preferences for product improvements using a discrete choice experiment.

Besides, farmers' decision makings could be affected when the product by nature is complex and in the context of availability of multiple choices and the associated information. Therefore, poor understanding and inability to process information regarding the financial services affect informed decision making on their adoption (Gaurav and Singh, 2012). The ability to process information and foresee the possible implications of risks with and without financial services in the long run could influence informed decision making on financial services. Literature on financial market participation presents that low cognitive abilities either stifle participation or lead to suboptimal decision makings in financial markets. Agarwal and Mazumder (2013), in their study on financial decisions on new credit card balance transfer and home loan application process, find that cognitive abilities positively influence optimal financial decision making**.** They find that math scores significantly and strongly influence the financial decisions as compared to verbal scores. Consumers with higher math scores are significantly more likely to make optimal financial decisions. Barnes et al. (2015) find that numeracy level significantly influences the consumers' health insurance comprehension, which in turn influences better coverage decisions. Boyer et al. (2019) find that knowledge on annuity products influence their purchase. While few studies use education and/or income as proxies for cognitive abilities and knowledge and find significant positive relation to financial market participation (Cole et al., 2014, Meier and Sprenger, 2013). Others measure cognitive abilities (mathematical and verbal scores and memory functioning) and test their effect on financial market participation such stocks and Medicare supplemental coverage (Chan and Elbel, 2012, Christelis et al., 2010).

With regard to insurance services, literature on health and other general insurances indicate that lack of understanding or cognitive ability could yield suboptimal insurance decisions (Chatterjee and Nielsen, 2010, Cole et al., 2009, Loewenstein et al., 2013). Gine et al. (2008) in their study in India indicate that lack of understanding of the product is the largest self-reported reason for not purchasing rainfall insurance. The lack of understanding is reported due to high cognitive costs of understanding, which is assessed through education level and age of the respondents. In addition, Cole et al. (2011) find a positive relation between cognitive ability and crop insurance use. Evidence shows that increasing product understanding through education has a positive effect on rainfall insurance adoption (Gaurav et al., 2011). We, therefore, also test whether differential cognitive abilities of farmers have any influence on their preferences and willingness to pay for product improvement options.

3. Crop insurance in India

The Government of India (GoI) has started experimenting publicly administered crop insurance services ever since it introduced individual indemnity-based crop insurance in 1972-73, which was experimented for few crops in selected states (Singh, 2010). In a backdrop of low performance and high transaction costs in this approach, GoI launched a Pilot Crop Insurance Scheme (PCIS) in 1979, which was based on area yield approach (Raju and Chand, 2009). Access to PCIS was limited to only credit-availed farmers on a voluntary basis. By making the participation mandate to all the credit-availed farmers, the GoI replaced PCIS with Comprehensive Crop Insurance Scheme (CCIS) in 1985. During a decade-long implementation, the CCIS was criticised for covering only credit-availed farmers, excluding few major crops from the scheme, low coverage and few issues with yield estimation approaches (Jain, 2004).

By taking these issues into consideration, the GoI redesigned the crop insurance scheme as National Agricultural Insurance Scheme (NAIS) and implemented in 1999. The NAIS was made available to both credit-availed and not-availed farmers by covering all major food grains, oilseeds and annual horticultural / commercial crops. The scheme was also designed in such a way that it covered a range of risks including localised calamities along with covariate risks. Even after a decade of implementation (2007-08), the NAIS had achieved the coverage of only around 16 per cent of the farmers (Raju and Chand, 2009). However, an evaluation of the NAIS by an expert committee indicated the problems of poor risk classification, inconsistency, moral hazard, issues with yield estimation and delay in claim settlement (Mahul et al., 2012, Vyas and Singh, 2006). Besides, the majority of the coverage (87 per cent) constituted credit-availed farmers, for whom it was mandated to take-up (Vyas and Singh, 2006). As a result, the GoI relaunched the scheme as Modified National Agricultural Insurance Scheme (MNAIS) in 2010. The major improvements had been brought into the MNAIS, such as involvement of domestic private insurance companies to compete with the public sector, reduce size of insurance unit, premium subsidies, better risk classification, and improved data quality using technologies (Mahul et al., 2012, Nair, 2010). In spite of incorporating these improvements, the scheme was facing low take-up (less than 20 per cent of the farmers), low awareness, low participation of farmers who were not availing credit, and increased transaction cost due to manifold increase in CCEs (Bhushan et al., 2016). In the meanwhile, a weather index-based crop insurance scheme (WBCIS) was taken on pilot basis.

Subsequently, the GoI has launched a mega national level insurance program, Prime Minister Fasal Bima Yojana (PMFBY), from Karif 2016, to protect farmers from production risks and reduce the impact of yield loss. It is a broad scheme that includes both area-index approach and a restructured Weather Based Crop Insurance Scheme (RWBCIS). The scheme covers a set of covariate production risks such as a) yield losses due natural calamities, b) prevented sowing due to adverse weather conditions, c) post-harvest losses due to perils of cyclone / cyclonic rains, and unseasonal rains, and d) localized risks like hailstorm, landslide, and inundation affecting isolated farms, etc. (GoI, 2016). The scheme mainly applies an area-yield index approach for standing crop loss, where village or gram panchayat (lowest administrative unit) is made as a unit of insurance. Currently, the scheme has covered 30 million farmers (25 per cent of the households) and the GoI is aiming to expand its coverage by two fold (60 million farmers) in the next 2-3 years (Aggarwal et al., 2016). However, a major portion of the coverage consists of credit-linked farmers, for whom it is mandated to take up the insurance. In addition to the technical, the scheme is also facing social barriers of implementation. Despite the major revisions, the PMFBY is suffering from low coverage, delayed payments (on average 8-12 months), and issues with yield loss estimations. Recently, the Government has revamped PMFBY including RWBCIS in order to address these challenges in their implementation (GoI, 2020). The major changes are: complete voluntary for both credit availed and not-availed farmers, extended business term with empanelled insurance agencies to three years (from one year), more flexibilities to the State Governments to contextualise as per the need, two-step process for yield (loss) estimation, use of technologies for smart sampling and optimize the number of CCEs, and yield estimation using remote sensing approach, etc.

4. Methods

4.1. Discrete choice experiment

The Choice Experiment (CE) is a stated preference approach widely used for testing consumer preference for products and eliciting their value so as to design a new product or redesign an existing product. In the CE, alternative product options are constructed using different attributes of the product having varied levels. Attributes with two or more levels could represent either a qualitative or a quantitative variable and at least one attribute represents monetary value of an option. Respondents are asked to state their most preferred option among the alternatives of a choice set. Most widely, choice sets consisting of 2-3 alternatives are used along with an opt-out option that relaxes the forced choice decisions and improves reality in the choices. A series of preferences are taken by presenting a block of such choice sets to each respondent. Such preferences for different options generates more information, which is useful in estimating the value a respondent places on different attributes and their levels. In this study, crop insurance product profiles are constructed and presented to the rice-growing farmers from Odisha and their preferences for crop insurance profiles with varied attribute levels are recorded. While some attributes represent technical aspects of the crop insurance and other process and prices aspects. The attribute levels indicate product improvements over the current crop insurance scheme (PMFBY). Each choice set comprises two alternative options and an option indicating “not preferring the crop insurance”.

4.1.1. Insurance option attributes and their levels

The foremost step in CE is to select attributes and their levels of a good of interest. The adoption of crop insurance has several benefits but with some cost. Several indicators could influence farmers’ preference for crop insurance. We identified the list of attributes of crop insurance based on extensive literature review, focus group discussions with farmers and meetings with key stakeholders[1]. By taking into account the importance and scope for improvement, five attributes are validated with the key stakeholders and are selected for the experiment. They are namely insurance unit, risk coverage, yield assessment method, claim

[1] Insurance companies, the concerned government officials of the state, credit institutions, and other facilitators.

settlement time and transparency of the insurance system. Table 1 presents the details of these five attributes with their levels.

i. The ***Unit of Insurance (IU)***: In the current crop insurance scheme (PMFBY), as area yield approach, a particular defined area is considered as an Insurance Unit (IU) for a particular crop for which average yield loss for that area is estimated for claim settlement using the current and threshold yields. Depending on the crop, either village or Gram Panchayat (GP) is considered as a unit of insurance in the current crop insurance scheme. In Odisha, GP is the IU for the rice crop. By considering these units and our discussions with experts and farmers, IU was given the four levels namely, Individual plot, Village, GP and Block.

Table 1: Insurance attributes and their levels

Attribute	Description	Levels
Unit of Insurance (IU)	In area yield index approach, a particular defined area is considered as Insurance Unit (IU) for a particular crop to which average yield loss is estimated for claim settlement.	Individual plot; Village; GP; Block
Risk Coverage (RC)	Types of risks covered under a particular insurance product	Prevented sowing; Full crop coverage (FCC); FCC + market price risk
Yield Estimation Process (YEP)	Method/approach used to estimate crop yield(loss) in a notified insurance unit, based on which indemnity amount is decided.	Crop Cut Experiment (CCE); Remote sensing (RS); Self-reporting
Claim Settlement Time (CST)	Time taken to settle indemnity amount since inception of the risk/crop loss in case the IU is notified as loss.	Within 3 months from the time of crop loss; Within 6 months; More than 6 months
Process Transparency (PT)	A Transparent system that provides clear information on status of an application to policyholders, YEP, estimated yield (loss), comparison with respect to the threshold yield, eligibility for claim settlement, and claim settlement details through SMS.	Transparent; No transparency
Premium and Sum Insured	An amount to be paid at the beginning of crop season to protect a crop from specified risks for specified sum insured amount. Sum insured is a maximum amount a policyholder receives in case of complete crop loss.	Premium and sum insured amounts in each insurance option is estimated by using reference amounts and loadings considered for product improvements

ii. The ***Risk Coverage (RC)***: This attribute indicates the types of risks covered under a particular insurance option. The premium amount increases with the number of risks covered in a product. Given this, depending on the context and other criteria, farmers may want only selected risks to be covered for their crops. In this regard, based on our discussion with insurance companies and government officials on product profiling, three levels were formed to this attribute, which are prevented sowing, full crop coverage (FCC) and FCC + market price risk. In the first level, prevented or pre sowing, the insured area is prevented from sowing or planting or germination due to deficit rainfall or adverse seasonal/weather conditions. The second level, full crop coverage, includes risks such as a) prevented swing, b) standing crop (sowing to harvesting) loss due to drought, dry spell, flood, inundation, widespread pests and disease attack, landslides, fire due to natural causes, lightening, storm, hailstorm and cyclone, and localized calamities like landslides, cyclone, hailstorms, etc., c) Post-harvest losses, when the produce is still in the field for drying, due to specific perils of hailstorm, cyclone, cyclonic rains and unseasonal rains, and d) crop loss due to localized calamities such as hailstorm, landslide, inundation, cloud burst and natural fire due to lightning affecting isolated farms in the notified area. The third level includes FCC plus market price risks.

iii. The ***Yield Estimation Process (YEP)***: Method/approach used to estimate crop yield loss in a notified insurance unit, based on which indemnity amount is decided. The yield loss in an IU is estimated by comparing the current season average yield with the threshold yield, which is usually 5 previous normal year average. In the current crop insurance scheme, the current season average yield is estimated by conducting Crop Cut Experiments (CCEs) in the randomly selected sites in an IU and extrapolating it to that entire IU. Due to time taking process, high transaction cost and higher probability of basis risk in the CCE approach, efforts are being made towards development of technologies such as Remote Sensing (RS) approach. Hence, along with the CCE, we used RS, and self-reporting levels for the YEP attribute. Self-reporting indicates that farmers have to state their yield or yield loss, based-on which indemnity is paid.

iv. The ***Claim Settlement Time (CST)***: Time taken to settle indemnity amount since inception of the risk/crop loss. Currently, in case of PMFBY in the study area, it takes on average 8-12 months to settle the claim to the insured farmers in the notified IUs.

While many farmers may require money immediately to take up the next crop by utilizing residual moisture and thus, may prefer the claim to be settled as soon as possible in the event of loss. Some farmers may keep their land fallow/uncultivated or have capability to make alternative arrangements till they get claim during the loss. Taking these possibilities into account and following our discussion with the farmers and experts on this aspect, we designed three levels for this attribute namely, within 3 months from the time of crop loss, 3-6 months and more than 6 months.

v. The ***Process Transparency (PT)***: Consumers may not trust a product if they are not given clear information about it. Literature have shown that consumers are willing to pay a premium for added information on the product. Like way, in case of insurance, clear information on the product indicates transparency that could influence farmers' trust on the product. Therefore, we introduced two levels for the process transparency - transparent and not transparent. A Transparent system provides clear information on status of an application to policyholders, YEP, estimated yield loss, comparison with respect to the threshold yield, eligibility for claim settlement, and claim settlement details through SMS. Whereas, this information is not provided clearly to the farmers in case of the system that is not transparent.

vi. The ***Premium and Sum Insured***: Premium is an amount to be paid at the beginning of crop season to protect a crop from specified risks for specified sum insured amount. Sum insured is a maximum amount a policyholder receives in case of complete crop loss. We assigned premium and sum insured based on the risks covered and products improvements made in the alternatives (The details are provided in the appendix Table A1).

The current insurance scheme (PMFBY) for rice crop in Odisha is considered as the base insurance profile in the study, where the unit of insurance is GP, risk covered is FCC, yield estimation process is done using CCE, time to settle the claim is more than 6 months, and the process is not transparent. Using the five selected attributes and their associated levels, we constructed our choice experimental design and presented in detail in the next sub-section.

4.1.2. Experimental design

Out of the total number of possible combinations, 32 most efficient combinations of choice sets were identified using D-efficient design and were formed into eight blocks with each having four choice sets. Each farmer faced four choice sets and in each card he chose his most preferred option amongst three alternatives - two alternative crop insurance products and an option indicating "not preferring the crop insurance". Following between-subject design, an incentive treatment was randomly introduced at the village level. In the incentivized CE (ICE), farmers have to purchase the insurance product from the endowment provided in the experiment. An equal number of farmers (1500) faced non-incentivized CE (NICE) and ICE in 300 villages. The payoff of farmers depends on the decisions they made and risk events they face.

Before starting the actual experiments, a detailed protocol was read aloud by the enumerators. By allowing farmers to play an example round, the enumerators confirmed whether the farmers got a clear understanding of the experiment. Besides, along with the details of the options, choice cards were designed with simplified visual representations of the details of all the insurance attributes. Figure 1 presents an example of a choice set, which shows pictorial representation of attribute levels along with their details. The second and the third rows present two alternative insurance profiles and the third option in the fourth row indicating "not preferring the crop insurance". Before farmers made their decision in each of the four rounds, enumerators explained the details of all three options in a card by showing the choice cards. The enumerators then recorded the decisions made by the farmers in each round. In case of ICE treated farmers, at the end of the fourth round, farmers were asked to randomly pick-up a chit from a set of chits labelled 1-4 numbers (indicating 4 rounds farmers faced). The decision made in the choice card of the selected round was considered for further incentive payment process. Then weather and market risks were introduced. Depending on the option selection and occurrence of weather and market risks, an incentive amount is estimated and paid to the farmers at the end of the experiment.

ଚୟନ କାର୍ଡ ସଂଖ୍ୟା – ୧ (Choice Card No. 1)

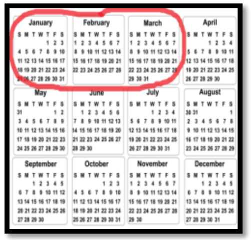
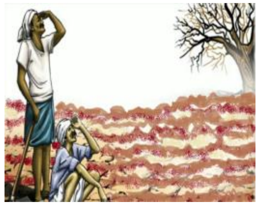
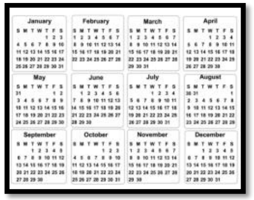
ବିକଳ୍ପ (Options)	ବୀମା ଏକକ (Insurance Unit)	ବିପଦ କଭରେଜ୍ (Risk Coverage)	ଉପଜ/ଅମଳ ନିରୂପଣ ପ୍ରକ୍ରିୟାରେ (YEP)	ଦାବି ପୂରଣ ସମୟ (CST)	ପ୍ରକ୍ରିୟାରେ ସ୍ୱଚ୍ଛତା (Process Transparency)	ବୀମା-କିସ୍ତି ଓ ବୀମା-ରାଶି (Premium and Sum Insured)
ବୀମା ଯୋଜନା ପସନ୍ଦ/ବିକଳ୍ପ ୧ (Insurance Scheme Option 1)	 ବ୍ୟକ୍ତିଗତ ପ୍ଲଟ୍ (Individual plot)	 ପୂର୍ଣ୍ଣ ଫସଲ କଭରେଜ୍ (FCC)	 ରିମୋଟ ସେନସିଙ୍ଗ (ଉପଗ୍ରହ) (RS)	 ୩ ମାସ ମଧ୍ୟରେ (Within 3 months)	 ସ୍ୱଚ୍ଛତା ନାହିଁ (No transparency)	 ବୀମା-କିସ୍ତି ଟ ୯୨୦/ଏକର ବୀମା-ରାଶି ଟ ୧୧୫୦୦/ଏକର (Premium ₹920/Acre Sum Insured ₹11500/Acre)
ବୀମା ଯୋଜନା ପସନ୍ଦ/ବିକଳ୍ପ ୨ (Insurance Scheme Option 2)	 ଗ୍ରାମ (Village)	 ଫସଲ ଲଗେଇ ନ ପାରିବା (Prevented Sowing)	 ଫସଲ କଟା ପରୀକ୍ଷଣ (CCE)	 ୬ ମାସ ପରେ (After 6 months)	 ସ୍ୱଚ୍ଛତା ଅଛି (Transparency)	 ଟ ୪୮୦/ଏକର ବୀମା-ରାଶି ଟ ୬୦୦୦/ଏକର (Premium ₹480/Acre Sum Insured 6000/Acre)
ବୀମା ନୁହେଁ **ପସନ୍ଦ/ବିକଳ୍ପ ୩** (Insurance Scheme Option 3)	କୃଷକ ଉପରୋକ୍ତ କୌଣସି ବୀମା ଯୋଜନାକୁ କିଣିବାକୁ ଚାହୁଁ ନାହାନ୍ତି (Don't want to purchase any insurance scheme)					ବୀମା-କିସ୍ତି ନାହିଁ ବୀମା-ରାଶି ନାହିଁ (No Premium No Sum Insured)

Figure 1: Choice set example presented to farmers

4.1.3. Choice modelling and empirical strategy

Choice experiments (CEs) are modelled especially for understanding how individuals make their choice among a finite set of alternatives. CEs are based on two strong footholds of economic theory - 1) theory of value by Lancaster (1966) that states that utility is derived not directly from goods but from their characteristics and 2) Random Utility Theory (McFadden, 1973) that states that a consumer chooses an alternative that provides him the highest utility, which is a function of observed attributes of the individual, the alternatives, random coefficients, and a random component (StataCorp, 2019). Suppose an individual *i,* having S vector of his characteristics, faces *J* alternatives (j=1, ….., J), which are described by a vectors of attributes X_j, then the individual's utility (U_i) function is expressed as -

$$U_{ij} = V(X, S) + \varepsilon\,(X, S)$$

Where, V and ε are non-stochastic and stochastic components of the utility function respectively. The individual chooses an alternative that maximizes his utility. We analyzed our choice experimental data using a Random Parameters Logit (RPL) model, which is widely applied additive random-utility model (ARUM) for its better performance as compared to Conditional Logit (CLM) and Multinomial Logit (MNL) models. RPL relaxes the independence of irrelevant alternatives (IIA) assumption by allowing random coefficients (Cameron and Trivedi, 2009) and estimates the parameters by maximum simulated likelihood (MSL). In the RPL model, the probability that the individual chooses alternative j is estimated by the standard logistic probabilities integrating over the distribution of density function ($f(\beta)$) of random coefficients.

$$P_{ij} = \int \; P_{ij}(\beta)\, f(\beta) d\beta$$

Where, $P_{ij}(\beta) = \frac{e^{\beta X_{ij} + \alpha W_{ij} + \delta_j z_i}}{\sum_{\alpha=1}^{J} \, e^{\beta X_{ij} + \alpha W_{ij} + \delta_j z_i}}$,

β_i are random coefficients of X_{ia} vector of alternative specific variables. α are fixed coefficients of W_{ia} vector of alternative-specific variables. δ_a are coefficients of Z_i vector of case-specific variables (Individual characteristics). ε_{ia} is a random term.

With this approach, a farmer *i* choosing alternative crop insurance option *j* in the choice set *n* is modelled as -

$$Y_{ijn} = \beta X_{ijn} + \alpha P_{ijn} + \varepsilon_{ijn}$$

Where Y takes 1 if the farmer chooses alternative crop insurance option j in choice set n. X is a vector of non-price attributes such as Unit of Insurance (IU), Risk Coverage (RC), Yield Estimation Process (YEP), Claim Settlement Time (CST), and Process Transparency (PT). β is a vector of coefficients of the non-price attributes. Whereas P is premium attribute and α is its coefficient. ε is the random error term. This is a basic model with only attributes. In addition to this base model, model is also tested with interactions with socioeconomics variables that could influence the choice.

In order for better interpretation and comparison, a monetary measure, Willingness to Pay (WTP), for each attribute level is estimated as the marginal rate of substitution between attribute and price attribute. That is, the ratio between the coefficients of an attribute level and price attribute. The corresponding value of an attribute level presents the WTP to prefer that attribute level as compared to the base category of the attribute.

$$WTP_{aij} = \frac{\beta_{aij}}{\alpha_{aij}}$$

4.2. Sampling and data

Data for this study come from face-to-face interviews with rice-growing farmers from the State of Odisha, India (Figure 2), which were conducted during June-December 2018. We conducted a choice experiment followed by a detailed survey on farmer’s socio-economics, demographic, farm and off-farms details, behavioral and cognitive abilities, and insurance details. Odisha is one of the highly vulnerable Indian States to climatic stressors. Per capita income per year in the State is 1200 USD, while it is 1800 USD at the national level (GoO, 2018). Literacy rate in the State is 72.9 per cent, which is not significantly different from the national level rate (India Census, 2011). Whereas poverty ratio is 32.59 per cent, as against 21.92 per cent at the national level. Agriculture is one of the major sectors in the State having more than 60 per cent of its population involved in agriculture and allied activities (GoO, 2018). Around 35 per cent (5.42 mha) of the its geographical area (15.6 mha) is under cultivation, of which, 40 per cent (2.55 mha) of the cultivable land is prone to flood, drought, and salinity and the frequency of these risk events has increased affecting sustainability of farmers' income and livelihood. Majority of the farming community (more than 83 per cent) in the State is constituted by small, marginal and landless farmers. Rice is the principal crop in the State covering a major portion of cultivated area (75-80 per cent) and producing 90 per cent of the total food grain production. However, it is characterized by low and vulnerable productivity and production due to various limiting factors. The state has diverse agro-climatic conditions with varied ecosystems and weather risks in terms of their types and intensities. Considering these conditions, the Government of Odisha has formed six clusters for implementing the crop insurance scheme - Pradhan Mantri Fasal Bima Yojana (PMFBY)[2].

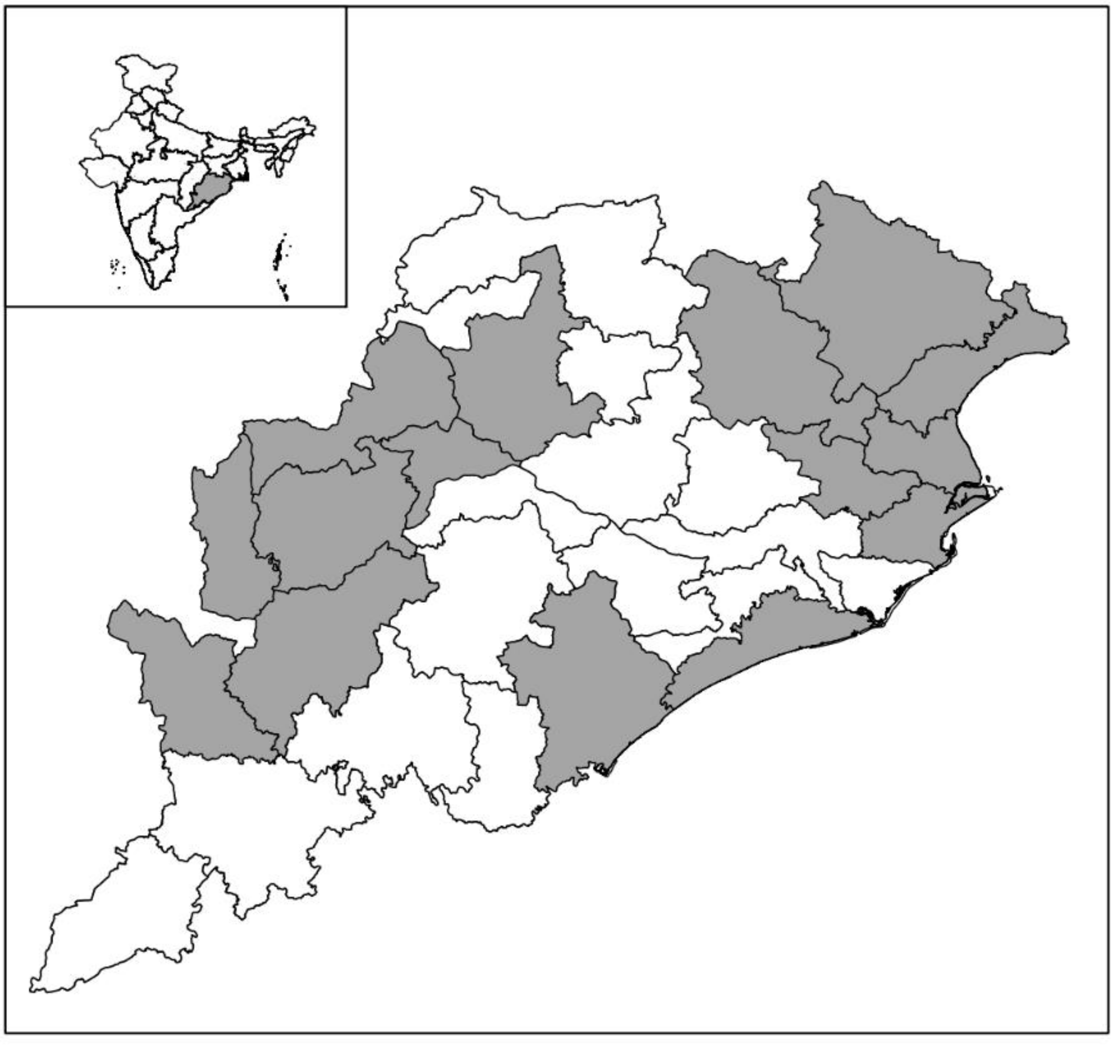


Figure 2: Location of sample districts of Odisha State, India

[2] For further details, refer: http://www.coopodisha.in/extra/Policies/PMFBY.pdf

Taking into account the diverse conditions of the state, 15 representative districts were selected by taking into account the factors such as weather risk, gross cropped area under rice, agro-climatic zones and, insurance clusters classified by the government of Odisha. These districts provide heterogeneity with regard to agro-ecology, geography, risk types and intensity and insurance clusters developed by the Government of Odisha.

Using probability proportional to size (PPS) sampling approach, 300 villages were randomly selected from the 15 selected districts. The details of the sampling strategy of the study is presented in appendix (Table A2). Prior to sampling of farm households, a village census was conducted in these selected villages to gather basic information about the farming households and crop insurance status. Only rice-cultivating farmers were considered while sampling the farmers as the rice crop was major crop in the state and accordingly, the choice experiment was designed to elicit farmers' preferences for rice crop insurance. Using village census data, 10 farmers were randomly selected from each of these 300 sample villages. We carried out a detailed household survey with household heads and elicited their preferences for crop insurance.

5. Results

5.1. Description of the sample

In total, 3000 farmers participated in the choice experiment and 2997 observations remained for analysis after data cleaning. Before implementing the choice experiment, we collected a detailed socio-economic information of the households and measured different behavioral and psychological characteristics of the respondent farmers such as time preference, risk preference, skills on understanding probability, mathematical skills, financial literacy, insurance literacy, and logical understanding as a part of the survey. The survey was administered with CAPI (computer assisted personal interview) using *surveybe*. Descriptive statistics of the variable are presented in Table 2.

The average age of the respondent farmer was around 50 years. Their education levels were low as the average number of years of schooling completed (six) indicates that the majority did not even complete primary schooling. The majority of the respondents were male (94 per cent). The average size of the households was around 5. The mean cultivated land of the households was 2.8 acre, which indicates that the majority were small and marginal farmers. The average proportion of total landholding irrigated was around 20 per cent.

Table 2: Descriptive statistics of respondent-specific variables

Variable	Description	Mean (SD)
AGE	Household head's age	50.87 (12.89)
EDUCATION	Household head's Education	5.94 (4.65)
GENDER	Household head's Gender (1=Male and 2= Female)	1.06 (0.24)
HH_SIZE	Number of members in household	4.59 (2.44)
TOTALCULTIVATED_AREA	Total cultivated area in acre	2.79 (3.63)
TOTALOWN_AREA	Total own area in acre	2.54 (5.84)
PROPIRRIK_TCULTAREA	Proportion of irrigated area in Kharif (%)	21.43 (39.50)
INCOME	Total household income (Rs.)	134289 (138018)
LIVESTOCK_MAJOR	Total number of Larger livestock (Cows, Bullocks, Buffaloes)	1.41 (2.63)
LIVESTOCK_MINOR	Total number of small Livestock (sheep, goats, pigs, calves)	2.48 (36.67)
INS_AWARENESS	Insurance Awareness Index	0.34 (0.34)
INS_LITERACY	Insurance Literacy score (0=lowest to 1=highest),	0.29 (0.29)
INCENTIVE_TREATMENT	Incentive treatment (=1 if incentivised and 0 otherwise)	0.50 (0.50)
RISK_PREFERENCE	The number of safe choices. Higher safe choices indicate higher risk aversion	3.94 (1.82)
DISTANCE_MARKET	Distance to nearest market (kilometre)	4.35 (4.32)
CREDIT_STATUS	Credit status (=1 if yes and 0 otherwise)	
BIGGEST_THREAT	Biggest perceived threat (1= drought, 2=flood / cyclone / unexpected rainfall, 3=pest disease animals and others)	1.67 (0.71)
CA_MATH SCORE	Cognitive ability Math Score	0.63 (0.35)
CA_LOGICAL SCORE	Cognitive ability Logical Score	0.30 (0.24)
TIMES_AFFECTED_DROUGHT	Number of times affected by Droughtin the last 10 years	1.85 (1.65)
TIMES_AFFECTED_FLOOD	Number of times affected by Flood in the last 10 years	0.62 (1.39)
TIMES_AFFECTED_CYCLONE	Number of times affected by Cyclone in the last 10 years	1.30 (1.05)
EXP_CROPINSURANCE	Ever registered for crop insurance program (1=yes and 0 otherwise)	0.09 (0.28)

Note: Figures in the parentheses indicate Standard deviation

Households' average annual gross income was Rs. 134, 289 (~$1840). The households on average possessed at least 1-2 big livestock animals (Cows, Bullocks, and Buffaloes) and 2-3 small livestock animals Livestock (sheep, goats, pigs, and calves). The average insurance awareness index and insurance literacy score of the respondents were 0.34 and 0.29. In terms of cognitive ability, the mean math and logical scores of the respondents were 0.63 and 0.30 respectively. Around 47 per cent of the respondents perceived drought as their biggest threat, around 39 per cent perceived flood and the rest 14 per cent perceived pest, disease, animals and others as their biggest threat to the rice cultivation. On average, the respondents were affected by drought two times in the last 10 years and whereas they were affected one time by flood. Whereas, they were affected by cyclone on average 1 time in the last 10 years. The majority of the respondents did not have previous experience of crop insurance take (91 per cent).

5.2. General preferences for crop insurance attributes

Looking at the farmer preferences, the rate of choosing the option of 'do not want to purchase any insurance option' is very low with only 5 per cent of the total choices made. It is expected that such choices were made when the farmers' expected benefit of choosing an insurance option in a particular choice situation would be less than that of their current cultivation practices. However, lower rate of choosing the option of do not want to purchase any insurance indicates that farmers, in general, derived higher utility from choosing the crop insurance options.

The choice data from the DCE is analyzed using different models such as MNL and RPL with and without interactions with socio-economic variables. The attribute levels gram panchayat (GP), full crop coverage (FCC), crop cut experiment (CCE), more than 6 months from the time of crop loss and No transparency are kept as base categories for their respective attributes - unit of insurance (IU), risk coverage (RC), yield estimation process (YEP), claim settlement time (CST), and process transparency (PT). These base categories are in line with the attributes of the current PMFBY scheme. Results of the MNL and RPL models are presented in Table 3. As the RPL model indicates relatively more consistent, henceforth we use its estimates with interactions with socio-economic variables, which are presented in the fifth column of Table 3. The strongly significant standard deviations of the coefficients indicate that the RPL model provides a significantly better representation of the choices and also farmers' preferences are heterogeneous.

All attributes and levels are statistically strongly significant. The farmers preferred several of the improved attribute levels as compared to those of the current PMFBY. Statistically positive and significant coefficient of premium variable and negative and significant coefficient of square of the same show that the respondent farmers' utility in choosing an insurance option increased with increase in premium for insurance product improvement up to a certain level after which the utility decreased indicating the requirement of subsidies for further improvements. With regard to the risk coverage attribute, prevented sowing and full crop coverage with market risks have significant and positive coefficients, which show that the prevented sowing was preferred highest and full crop coverage with market risks the higher, as compared to risk coverage of the current PMFBY scheme, the full crop coverage.

In case of unit of insurance attribute, as expected, block unit was preferred least but surprisingly also village as compared to GP. The coefficient of plot level is insignificant, indicating that preference for this level was not different to that of the currently practiced unit, GP. In case of yield estimation process attribute, the most preferred method was self-reporting, whereas remote sensing method was the least preferred as compared the currently practices CCE method. The fact that the farmers did not prefer remote sensing method over the CCE could be because the technology is relatively new and perceived lack of trust on the accuracy of the estimates. With regard to claim settlement time attribute, as can be expected, the settlement within 3 months is significant and positive, meaning that it was most preferred. Whereas, the claim settlement in 3 to 6 months is significant and surprisingly negative as compared to more than 6 months level. With regard to the process transparency attribute, as expected, transparency was preferred over the non-transparent system.

Table 3: Choice experiment results (coefficients) of different models (Observations 11,988)

	M1: MNL without SE	M2:MNL with SE	M3: RPL without SE	M3: SD	M4: RPL with SE	M4: SD
PREMIUM	0.003***	0.001***	0.010***	0.011***	0.003***	0.003***
	(0.0004)	(0.0004)	(0.0005)	(0.0002)	(0.001)	(0.0001)
PREMIUM^2	-0.000	-0.000	-0.000***		-0.000	
	(0.000)	(0.000)	(0.000)		(0.000)	
Risk Coverage (IU) (Base level: Full Crop Coverage (FCC))						
PREVENTED SOWING	0.990***	0.092	2.198***	0.036	0.419**	-0.979***
	(0.091)	(0.126)	(0.121)	(0.157)	(0.197)	(0.106)
FCC + MARKET RISKS	-0.096*	0.126**	-0.343***	-0.110	0.160*	0.175
	(0.053)	(0.057)	(0.066)	(0.178)	(0.085)	(0.149)
Unit of Insurance (IU) (Base level: Gram Panchayat (GP))						
PLOT	-0.201***	0.023	-0.492***	0.032	-0.031	-1.119***
	(0.050)	(0.055)	(0.061)	(0.187)	(0.080)	(0.115)
VILLAGE	-0.377***	-0.229***	-0.495***	0.024	-0.350***	-0.118
	(0.070)	(0.071)	(0.085)	(0.159)	(0.101)	(0.138)
BLOCK	-0.242***	-0.391***	-0.435***	0.165	-0.647***	1.247***
	(0.038)	(0.041)	(0.048)	(0.152)	(0.068)	(0.114)
Yield Estimation Process (YEP) (Base level: Crop Cutting Experiments (CCEs))						
REMOTE SENSING	-0.079**	-0.078**	-0.079	-0.188*	-0.138**	-0.640***
	(0.039)	(0.039)	(0.050)	(0.101)	(0.060)	(0.090)
SELF-REPORTING	0.133***	0.132***	0.109***	0.010	0.157***	0.305***
	(0.029)	(0.029)	(0.035)	(0.136)	(0.043)	(0.110)
Claim Settlement Process (CST) (Base level: More than 6 months)						
WITHIN 3 MONTHS	0.070**	0.071**	0.162***	-0.084	0.118***	-0.546***
	(0.029)	(0.029)	(0.035)	(0.132)	(0.042)	(0.098)
3 TO 6 MONTHS	-0.058*	-0.058*	-0.072*	0.021	-0.144***	0.518***
	(0.034)	(0.034)	(0.042)	(0.120)	(0.051)	(0.095)
Process Transparency (TP) (Base level: No Transparency)						
TRANSPARENCY_YES	-0.059**	0.091***	-0.109***	0.079	0.150***	0.486***
	(0.025)	(0.029)	(0.030)	(0.098)	(0.044)	(0.075)
Interactions with Socioeconomics Variables						
ASCCA_MATH SCORE		0.305**			0.220	
		(0.129)			(0.225)	
ASCCA_LOGICAL SCORE		1.206***			1.282***	

		(0.212)		(0.314)
ASCINCENTIVE_TREATMENT		0.640***		0.759***
		(0.086)		(0.143)
ASCINS_AWARENESS		0.592***		0.681***
		(0.115)		(0.172)
ASCTIMES_AFFECTED_DROUGHT		0.137***		0.198***
		(0.035)		(0.056)
ASCTIMES_AFFECTED_FLOOD		0.066*		0.105*
		(0.034)		(0.058)
ASCTIMES_AFFECTED_CYCLONE		0.148***		0.228***
		(0.044)		(0.071)
ASC_BIGGEST_THREAT_DROUGHT		0.478***		0.626***
		(0.134)		(0.212)
ASC_BIGGEST_THREAT_FLOOD		0.054		0.033
		(0.118)		(0.192)
ASCEDUCATION		-0.0004		0.0002
		(0.002)		(0.013)
ASCINCOME		-0.000***		-0.000
		(0.000)		(0.000)
ASCGENDER		-0.475***		-0.476**
		(0.134)		(0.237)
ASCRISK_PREFERENCE		-0.007		0.012
		(0.012)		(0.023)
ASCDISTANCE_MARKET		-0.000		0.00003
		(0.00003)		(0.0001)
ASCCREDIT_STATUS		0.277***		0.473***
		(0.088)		(0.140)
Log Likelihood	-10,046.540	-9,905.193	-10,393.640	-9,182.416

Note: Standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1.

In addition, the coefficients of socioeconomic variables show their effect on general preference for insurance. We tested these interactions using case-specific socioeconomic, risk perception and cognitive ability variables such as cognitive ability, insurance awareness, incentive treatment, risk perceptions (drought/flood/cyclone), respondent's age, education, gender, risk preference, household income, distance nearest market, and whether the household availed agricultural credit. These results report the factors influencing general preference for insurance. The coefficients of attributes in both models with and without interactions are consistent indicating the robust estimations.

Increase in farmers' cognitive ability (logical score) and awareness about the insurance are shown to be correlated with their general preference for crop insurance. This could be associated with well-informed and foreseeability of the long term expected benefits of taking up insurance. The farmers with incentive treatment are more likely to prefer insurance. The number of times affected by drought and drought as the biggest threat are positive and statistically significant, meaning that increased frequency of drought and drought as the perceived biggest threat positively influenced the farmers for opting insurance. Increased frequency of flood is also positive but weakly significant. Increased number of times affected by cyclone is also positive and significant, indicating increased cyclone frequency influenced the farmers to prefer for insurance. Female farmers were less likely to prefer crop insurance. Those who availed agricultural credit were more likely to prefer insurance. Other factors such as education, distance to market, risk preference and income are not correlated with farmers' general preference for crop insurance.

5.3. Willingness to pay (WTP) estimates

Table 4 reports the WTP for each attribute level for changing it from the base level, which is set to the one that is close to the current PMFBY scheme. WTP estimate for risk coverage of only prevented sowing indicates that the farmers were willing to pay lesser (or required a subsidy) by 230 INR per acre when risk coverage is reduced from full crop coverage to only prevented sowing. However, reference price for this risk coverage was kept to 320 INR that is 28 per cent higher than what the farmers were willing to pay. Therefore, their actual willingness to pay is higher. For market risks to be included to the full crop coverage, the farmers were willing to pay an additional 36 INR per acre. However, the reference price for including market risks to the base category of full crop coverage is expected to 120 INR (10 per cent of the reference premium), which is 2.33 higher than what the farmers were willing to pay. That is, farmers would like to pay around 4 per cent of the premium as additional premium towards increasing the risk coverage from FCC to FCC + market risks, whereas we had considered around 15 per cent of the premium.

Table 4: WTP Estimates of different models (Observations 11,988)

	M1: MNL	***M3: RPL***
Risk Coverage (IU) (Base level: Full Crop Coverage (FCC))		
PREVENTED SOWING	-323.06***	-230.3***
	(65.41)	(22.52)
FCC + MARKET RISKS	31.44	35.91***
	(20.27)	(8.32)
Unit of Insurance (IU) (Base level: Gram Panchayat (GP))		
PLOT	65.51***	51.56***
	(21.01)	(7.76)
VILLAGE	123.09***	51.89***
	(31.95)	(10.18)
BLOCK	78.94***	45.59***
	(11.71)	(4.42)
Yield Estimation Process (YEP) (Base level: Crop Cutting Experiments (CCEs))		
REMOTE SENSING	25.73*	8.32
	(13.36)	(5.26)
SELF-REPORTING	-43.29***	-11.46***
	(10.59)	(3.69)
Claim Settlement Process (CST) (Base level: More than six months)		
WITHIN 3 MONTHS	-22.89**	-17.02***
	(10.14)	(3.92)
3 TO 6 MONTHS	18.89	7.51*
	(11.57)	(4.41)
Process Transparency (TP) (Base level: No Transparency)		
TRANSPARENCY_YES	19.38**	11.38***
	(9.01)	(3.39)

Note: Standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1.

With regard to unit of insurance, the attribute levels plot and village have the same WTP of 52 INR per acre each, indicating that the farmers were willing to pay an additional 52 INR per acre to change the insurance unit from GP to plot or village levels. However, this is 57 per cent lower than what an additional base price (120 INR) was set for changing the unit to plot and 35 per cent lower than what an additional base price (80 INR) was set for changing the unit to village. In contrary to what is expected, the WTP for changing the insurance unit from GP to block is also positive and significant, which is 46 INR per acre. As the accuracy level of yield loss estimation reduces as the unit of insurance increases the size both in case of CCE and remote sensing yield estimation, the base price for changing the unit of insurance from GP to block was reduced by 80 INR per acre (10 per cent of the reference premium amount). Accordingly, WTP for block unit was expected to be reduced.

As per as yield estimation process attribute is concerned, WTP for remote sensing method is positive but not significant. Whereas, it negative and significant for self-reporting method (-11.46 INR per acre), meaning that the farmers were willing to pay lesser (requiring a subsidy) by 12 INR per acre for changing the yield estimation process from CCE to self-reporting. Farmers anticipated the reduced cost of conducting CCE when switched to self-reporting, which requires much lesser cost of implementation. In case of claim settlement time attribute, farmers were demanding a subsidy of 17 INR per acre for changing the claim settlement in more than 6 months to within 3 months of risk occurrence. This could be because they would anticipate that claiming settlement within 3 months would not be practical in a given context. Whereas, they were willing to pay 8 INR per acre from changing claim settlement to 3-6 months, which is not strongly significant.

WTP for the process transparency attribute is positive and significant (12 INR per acre), indicating that farmers were willing to pay 12 INR per acre for bringing transparency in the process of implementation of the insurance scheme. That is, farmers would want to receive clear information with regard to status of an application to policyholders, YEP, estimated yield (loss), comparison with respect to the threshold yield, eligibility for claim settlement, and claim settlement details via SMSs. However, the reference price for making the process transparent was kept to 80 INR per acre (10 per cent of reference premium price), which implies that farmers would like to pay much lesser than this amount.

6. Discussion and final remarks

We investigate farmers' low uptake of the crop insurance and their preferences for crop insurance improvements. Using a discrete choice experiment, we analyzed the relative importance of factors influencing farmers' decisions towards accepting crop insurance. We estimate farmers' WTP for different crop insurance attributes and their levels such as units of insurance, risk coverages, yield estimation methods, claim settlement time, and process transparency. We expected that delayed claim settlement, lack of process transparency, inefficiencies in yield estimation process and basis risk due to large unit of insurance would be the major factors behind farmers' low update of crop insurance. We expected that farmers would prefer reduced units of insurance such as plot and village levels as compared to the currently practiced GP unit. In case of risk coverage, depending on the context, it was expected that farmers would prefer any of the levels presented to them. As CCE yield estimation method is facing criticism for its delay, lack of representation of insurance unit, and other biases, we expected that farmers would expect either remote sensing or self-reporting methods as compared to CCEs. As majority of farmers during our focus group discussions emphasized the delayed claim settlement, it was expected that farmers would prefer either less than 3 months or 3-6 months for claim settlement over the time currently being taken (more than 6 months). We expected that farmers would prefer process transparency as it increases their trust in the crop insurance.

We find that farmers' preferences are heterogeneous towards many of the crop insurance attribute levels. In general, most of the respondents preferred to pay increased premium for insurance attribute improvements up to a certain level, beyond which they demanded a subsidy or discount. The farmers preferred several of the improved attribute levels as compared to those of the current PMFBY. Pre-sowing risk and market risks happened to be most relevant for the farmers as they preferred prevented sowing and full crop coverage with market risks over the full crop coverage that is being currently offered in the PMFBY scheme. In case of yield estimation process attribute, the most preferred method was self-reporting as compared the currently practiced CCE method. With regard to claim settlement time and process transparency attributes, as can be expected, farmers preferred the settlement within 3 months and process transparency.

Keeping all else equal, the respondent farmers were willing to pay lesser by on average 230 INR per acre when risk coverage was reduced from full crop coverage to only prevented sowing. For market risks to be included to the full crop coverage, the farmers were willing to pay an additional 36 INR per acre. Farmers were willing to pay an additional 52 INR per acre to change the insurance unit from GP to plot or village levels. They were willing to pay lesser (requiring a subsidy) by 12 INR per acre for changing the yield estimation process from CCE to self-reporting. In case of claim settlement time attribute, farmers demanded a subsidy of 17 INR per acre for changing the claim settlement in more than 6 months to within 3 months of risk occurrence. This could be because they would anticipate that claiming settlement within 3 months would not be practical in a given context. Whereas, they were willing to pay 8 INR per acre from changing claim settlement to 3-6 months. The willingness to pay for bringing transparency in the process of implementation of the insurance scheme was 12 INR per acre.

These results indicate that designing improved insurance and ensuring ease of access with transparent and affordable crop insurance is advised. Besides, as farmers' preferences for several attributes were heterogeneous, insurance with flexible options especially with respect to risk coverages are highly advised. As beyond certain level of insurance attribute improvement, farmers demanded discount, government considering a subsidy provision could be a preferred option. Further, timely claim settlement and efficient yield loss estimation with minimum basis risk should be given top priorities for improving the insurance and increasing its take up rate.

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Appendix

Table A1: Details of premium loadings for attribute improvements

Attribute Levels	Change in Premium (%)	Change in Sum Insured (%)
Risk Coverage		
Prevented sowing	-60	-60
Full crop coverage (FCC)	00	00
FCC + Market risks	+15	+15
Insurance Unit		
Individual plot	+15	+15
Village	+10	+10
Gram panchayat (GP)	00	00
Block	-10	-10
Process Transparency		
Transparent_Yes	+10	+10
Transparent_No	00	00

Note: Base premium and Sum insured were considered as 800 and 10,000 INR per acre respectively, which were based on average amounts for rice crop in PMFBY in Odisha.

Table A2: Sample selection details

Districts	GCA_RICE ('000 hectares)	Risk Type	Total No. of Villages in district	No. of Villages Sampled proportionately (300)	Number of Farmers
BARGARH	326	Drought	1211	13	130
MAYURBHANJ	305	Drought	3966	43	143
GANJAM	252	Flood	3216	35	350
KALAHANDI	249	Drought	2255	24	240
BALASORE	226	Flood	2953	32	320
BALANGIR	204	Drought	1789	19	190
KEONJHAR	175	Both	2128	23	230
BHADRAK	168	Flood	1318	14	140
SAMBALPUR	162	Both	1317	14	140
NABARANGAPUR	147	Drought	897	10	100
SUBARNAPUR	137	Drought	963	10	100
PURI	135	Flood	1709	19	190
KENDRAPARA	134	Flood	1547	17	170
JAJPUR	126	Flood	1792	19	190
NUAPADA	105	Drought	668	8	80

Note: *GCA – Gross Cropped Area