Willingness to pay for Weather Based Crop Insurance in Punjab

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Abstract:

Crop insurance is one of the important risk management strategies adopted by farmers. However, one of the biggest challenge Government faces while promoting insurance is in setting optimum premium for crop insurance which can achieve higher participation of farmers in Insurance programme. With premium rate set at 1.5% of sum insured for wheat crop, are the farmers are willing to pay the premium at this rate to insure their wheat crop? It would be interesting to investigate this question in state like Punjab which has not implemented crop insurance. We conducted a Contingent Valuation Study to elicit Willingness to Pay (WTP) for crop insurance of wheat farmers in Punjab state. The sample consisted of 617 wheat farmers spread across 60 villages of 12 districts in Punjab. We found that it is farmers who has suffered crop loss in the past found to have higher WTP. Asset worthy farmers, banking literacy, extension contact was also found to have positive impact on WTP. The study indicated that WTP for crop insurance is around Rs 297 / acre, which is less than the existing rate of premium which is approximately Rs. 400 /acre (premium rate of 1.5%).

Acknowledegment:

JEL Codes: D91, Q12

#1399

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Abstract

Crop insurance is one of the important risk management strategies adopted by farmers. It helps farmer in bad agricultural season by compensating for the loss and Government in reducing the burden on disaster payments. In recent times, crop insurance is receiving much needed policy impetus in India, with the launch of Pradhan Mantri Fasal Bhima Yojana (PMFBY) (which also encompasses weather based crop insurance) which aims at insuring at least 50 per cent of cropped area in next five years. The scheme aims at achieving higher enrolment of farmers in crop insurance through subsidised premium and promise of timely settlement of claims. One of the biggest challenge Government faces is in setting optimum premium for crop insurance which can achieve higher participation of farmers in Insurance programme. With premium rate set at 1.5% of sum insured for wheat crop, are the farmers are willing to pay the premium at this rate to insure their wheat crop? It would be interesting to investigate this question in state like Punjab which has not implemented crop insurance citing there is very little risk in farming due to irrigated nature of agriculture in the state. We conducted a Contingent Valuation Study to elicit Willingness to Pay (WTP) for crop insurance of wheat farmers in Punjab state. The sample consisted of 617 wheat farmers spread across 60 villages of 12 districts in Punjab. We estimated WTP for both picture based and weather indexed crop insurance and found no significant difference between the two. We found that it is farmers who has suffered crop loss in the past found to have higher WTP. Asset worthy farmers, banking literacy, extension contact was also found to have positive impact on WTP. The study indicated that WTP for crop insurance is around Rs 297 / acre, which is less than the existing rate of premium which is approximately Rs. 400 /acre (premium rate of 1.5%). So, there is a market for crop insurance in Punjab state, if the premium amount is reduced by way of premium subsidy.

Key words: Crop Insurance, Willingness to Pay (WTP), Contingent Valuation Method (CVM).

JEL codes:

Introduction

Weather induced risks are the major source of income fluctuations of farmers. Climate change has increased frequency of weather aberrations threatening livelihood of

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farmers(Čolović & Petrović 2014). The magnitude of income loss translates beyond the production loss due to downward shift of entire agricultural economy (decrease in wages, asset price etc.)(Hazell *et al*. 2010). Small and marginal farmers are more vulnerable to such income shocks due to their dependence on natural resource endowments. Risks in agriculture may slow down economic development, if not managed properly(Hazell *et al*. 2010).

Households have different methods to cope with risks; self- insurance, growing resistant varieties, community help, loans (formal and informal), liquidating assets etc(Singh 2013). But, these methods are often ineffective and costly when faced with covariate risks affecting all the farmers in a region(Hazell 1992)(Swain 2014.). In the face of risk, farmers prefer to smoothen income; give up the risky enterprises(Gollier 2003)(Liu *et al*. 2013). Small and marginal farmers are more risk averse and can't cope risk without external help(Abebe & Bogale 2014). They may also use inputs at less than optimum level to maintain stock of liquid assets in case crop fails(Boyd *et al*. 2011)(Giné *et al*. 2012). De-risking small and marginal farmers is important to promote investment and adoption of newer technologies in farming(Akter *et al*. 2016).

Disaster payment programme is widely adopted in many countries to support farmers to overcome crop failures. But direct payment schemes are least desired in economic sense, as they provide no risk protection(Coble & Barnett 2013). Crop insurance is one of the potentially important alternative to share risk and stabilise farm incomes(Abebe & Bogale 2014) (Liesivaara & Myyra 2014)(Abebe & Bogale 2014). Crop insurance helps farmer by sharing of risks on payment of premium amounts. On event of crop loss due to perils listed in insurance contract, compensation will be paid to farmer. It will also help Government by reducing the need for disaster payments. Farmers may not prefer to take credit in absence of insurance due to fear of losing the collateral used to secure on loans(Carter *et al*. 2007). Crop insurance also smoothen the credit flow to agriculture sector as risk of lending also decreases.

Recognising importance of tailoring insurance schemes for farming, India has launched its first multiple peril crop insurance 'Comprehensive crop Insurance Scheme (CCIS) in 1985(Giné *et al*. 2012)(Swain 2014.)(Government of India 2014). Subsequently it was modified and launched as 'National Agriculture Insurance Scheme' (NAIS). NAIS was again modified as MNAIS, which was in operation till 2016, when the new 'Prime Ministers Fasal Bhima Yojana' was launched.

All these insurance schemes are 'yield indexed' and operate on 'area basis'. Compensation (if any) will depend on shortfall in yield compared to normal for the region(Olivier & Niraj 2010). In each region (Hobli*), Crop Cutting Experiments (CCE) will be conducted by Agriculture Department to determine the actual yield for the year(Nair 2010)(Veeramani et al. 2005). If there is shortfall in yield, all farmers in the region gets compensation at the same rate. Farm level insurance difficult considering large number of small and marginal holdings in India and paucity of historical farm level yield data. Area based insurance also help in minimising the 'moral hazard' in insurance(Singh 2013).

India has also launched weather indexed crop insurance programme on pilot basis on 2003 kharif. Later, in 2007, Weather Based Crop Insurance Scheme (WBCIS) was launched(Mahul *and Verma*. 2010)(Kiran & Umesh 2015). In this scheme, insurance is linked to prespecified pattern of weather index used as proxy for crop loss. Using sophisticated simulation models, yield loss is determined whenever the weather parameter crosses the prespecified limit during the crop duration. weather indexed crop insurance is more transparent as it is based on publicly observable, exogenous variable(Giné *et al*. 2012). Also, there is no need of crop cutting experiments/ inspections which saves money and time and enable early claim settlement(Abebe & Bogale 2014) (Akter *et al*. 2016).

Weather indexed crop insurance is also not fool proof. It can only provide partial risk protection as farmers are also face many non-weather related risks in farming(Abebe & Bogale 2014). It can work when if the farmer's yield is correlated with weather parameters measured at weather stations(Chichilnisky 2002). Poor correlation between yield and weather parameters or errors in simulation may results in higher 'basic risk' which discourages farmer to insure his crop in the next season(Eric et al. n.d.). Moreover, scheme can be implemented only in areas where automatic weather stations are available. Having said that, weather indexed crop insurance still holds lot of promise and one of the important instrument to de-risk agriculture in the face of climate change(Ali 2013).

One of the challenge government face is in setting the suitable premium for crop insurance program to ensure higher participation of farmers(Liesivaara & Myyra 2014). Subsidy on premium is necessary to ensure farmer's participation in insurance programs, particularly in low and middle income countries (Babcock 2015.) . Subsidy on premium helps not only in getting more farmers enrolled in, in the long run it will help to improve efficiency of insurance program by better risk sharing(Swain 2014.). The 'Prime minister Fasal Bhima

yojana' (PMFBY), launched in 2016, also offers weather based crop insurance in areas at highly subsidised premium rate of 2 per cent of sum insured for kharif crops and 1.5 per cent of sum insured for rabi crops. Is the present subsidy rate being attractive enough for the farmer? We try to answer this by estimating the farmer's willingness to pay for weather based crop insurance programme in Punjab, which has no history of crop insurance. Estimate of willingness to pay for crop insurance will indicate whether the current level of subsidised premium level is enough to achieve higher rate of enrolment. This will also indicate whether there is market for crop insurance in Punjab.

Data and Methods

Data was collected from primary survey of wheat growers in 12 districts of Punjab. Punjab was purposively selected for the study, as historically, crop insurance program has not been implemented in the state of Punjab citing that there is little risk in farming in the region due to assured irrigation facilities. Objective was to elicit farmers WTP for insurance at a time when climate change and increased frequency of weather aberrations are making agriculture in the region riskier than wat it used to be. Study uses a stratified sampling frame, randomly selecting 12 districts from Punjab and in the next stage 2 to 3 blocks from each district. From each block, two villages were chosen for the study and 12 farmers were randomly surveyed from selected villages resulting in sample size of 720.

Assigning monetary value to non- marketed goods and measuring benefits of govt policies (including non -use values) has been an interest of economists(Hanemann *et al*. 1991). Hedonic pricing, travel-cost method, contingent valuation method (CVM) are the most commonly used to estimate the economic value of non-marketed goods and services(Carson *et al*. 2001)(Abebe & Bogale 2014). Contingent valuation is one of the mostly used method, where the objective is to estimate the willingness to pay (or accept) for change in provision of some goods or services, contingent upon hypothetical market situation(López-feldman 2013). National Oceanic Atmospheric Administration (NOAA)has provided set of guidelines and recommendations for implementing CVM studies(Abebe & Bogale 2014)(Birol et al. 2008)(Kimenju & De Groote 2008). Amongst different methods of carrying out contingent valuation, open ended questions, bidding game, single bound or double bound dichotomous choice question and choice experiment are commonly used. In our study, we have used 'double bound contingent valuation method' to elicit the farmer's willingness to pay for crop

insurance. As a test, we have also asked an open ended follow up question on how much amount the farmer is willing to pay to get his crop insured.

Key to success of CVM lies in developing hypothetical market situation for the product /service in question and elicit the willingness to pay contingent upon it(Tinch *et al*. 2015; Carson *et al*. 2001; Shashikiran & Umesh 2012.; Hanley et al. 2001). In the present study, we estimated willingness to pay for two types of insurance products, i.e., Weather Indexed Crop Insurance and Picture Based Crop Insurance. In each case, enumerators explain the details of the insurance program to farmers before presenting the bids. The information includes details on mode of implementation, risks covered, payment vehicle and loss estimation procedure. In Weather Indexed insurance program, parametric weather indices will be used as proxy for yield. Correlation between changes in weather parameters compared to normal with the crop yield (based on simulation) will be base for calculating compensation payable. In case of Picture Based insurance product, satellite imagery of crop will be used to estimate crop loss at individual level and consequentially the compensation.

Each responded is offered with a random bid amount with a question whether he is willing to pay that amount to get his crop insured. The farmer's response in the form of yes or no is captured by dichotomous variable. If the response of the farmer is yes, then the new bid amount (which is 200 more than the initial bid amount has been offered with second dichotomous choice question. If the answer to first question is no, then new bid amount will be 200 less than the initial bid. Depending on the answer we have information on two bids and yes or no response to the bids which distinctively increase the efficiency of WTP estimates(Hanemann *et al*. 1991; Hanemann & Kanninen 2008; Gao *et al*. 2010). This is information can be used econometrically to estimate Willingness to Pay (WTP).

Econometric estimation of WTP: Let t1 and t2 be the two bid amounts and the two variables capturing the response be Y_{1i} and Y_{2i} respectively. Farmers response can be grouped into following four categories.

1. (Yes, No): Farmer ready to pay initial bid amount but refutes for second bid amount. In this case $Y_{1i} = 1$ and $Y_{2i}=0$. Probability of getting this response is given by
   $Pr(Y, N) = Pr(t1 \leq WTP < t2)$ …….. (1)
   If WTP depends on set of explanatory variables, i.e., $WTP (Zi, ui) = Zi\beta + ui$, Where Zi is the vector of explanatory variables and β represents corresponding coefficients.

With assumption that error term is normally distributed with zero mean and standard deviation of σ, we can rewrite expression 1 as

$$\Pr(Y, N) = \phi\left(\frac{t_2 - Z_i^I\beta}{\sigma}\right) - \left(\frac{t_1 - Z_i^I\beta}{\sigma}\right) \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

2. (Yes, Yes): Here, both Y_{1i} and Y_{2i} =1 and probability can be written as

   Pr(Y, Y) = Pr(t1 <WTP> t2) …….. (3)

   Applying Bayes rule of probability and rearranging,

$$\Pr(Y, Y) = 1 - \phi\left(\frac{t_2 - Z_i^I\beta}{\sigma}\right) \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

3. (No, Yes): In this case, Y_{1i}=0 and Y_{2i}=1

   Pr(N, Y) = Pr(t1 > WTP ≤ t2) …….. (5)

$$\Pr(N, Y) = \phi\left(Zi\frac{\beta}{\sigma} - \frac{t_2}{\sigma}\right) - \phi\left(Zi\frac{\beta}{\sigma} - \frac{t_1}{\sigma}\right) \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

4. (No, No): Case where both $_{Y1i}$ and $_{Y2i}$ =0

   Pr(N, N) = Pr(t1 < WTP < t2) …….. (7)

$$\Pr(N, N) = 1 - \phi\left(Zi\frac{\beta}{\sigma} - \frac{t_1}{\sigma}\right) \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

   Equation 2, 4,6 and 8 can be expressed in a likelihood functions as

$$\sum_{i=1}^{n}\left(d_i^{yn}\ln\left(\phi\left(\frac{t_2 - Z_i^I\beta}{\sigma}\right) - \left(\frac{t_1 - Z_i^I\beta}{\sigma}\right)\right) + d_i^{yy}\ln\left(1 - \phi\left(Z_i^I\frac{\beta}{\sigma} - \frac{t_1}{\sigma}\right)\right)\right.$$

$$\left. + d_i^{ny}\ln\left(\phi\left(\left(Z_i^I\frac{\beta}{\sigma} - \frac{t_2}{\sigma}\right) - \left(Z_i^I\frac{\beta}{\sigma} - \frac{t_1}{\sigma}\right)\right)\right) + d_i^{nn}\left(1 - \phi\left(Z_i^I\frac{\beta}{\sigma} - \frac{t_2}{\sigma}\right)\right)\right)$$

Where d_i^{yn}, d_i^{yy}, d_i^{ny} and d_i^{nn} are indicator variables which takes value zero or one depending on the respective response. From the estimates, we can compute WTP.

$\text{WTP on mean} = \beta_0 * \text{Constant} + \sum_{j=1}^{k}(\text{Mean value}_j * \beta_j)$, where j=1…k represents the control variables used in the analysis. (López-feldman 2013)

Description of the control variables used in the analysis

Variable	unit	Description
Male headed household	Dummy	Equal to 1 if male headed household, otherwise zero
Age	years	Age of head of the household
Literate	Dummy	Equal to 1 if Literate, otherwise zero
Backward class	Dummy	Equal to 1 if belongs to Scheduled class or Scheduled tribe, otherwise zero
Agriculture Primary Occupation	Dummy	Equal to 1 if Agriculture is the primary occupation, otherwise zero

Land	Acres	Total land cultivated by Farmer
Farming experience	Years	Years of experience in farming
Adopt Zero Tillage	Dummy	Equal to 1 if adopted Zero tillage, otherwise zero
Perception of Insurable Risks	Dummy	Equal to 1 if he perceives that insurable risks, zero otherwise
Experienced risk in last 3 year	Dummy	Equal to 1 if he has suffered crop loss due insurable risks in last three years, zero otherwise
Indebtedness	Dummy	Equal to 1 if the farmer has taken debt, otherwise zero
Extension contact	Dummy	Equal to 1 if the farmer has received technical knowledge from any of the extension agency, otherwise zero
Asset position	Index	Linear unweighted index of agricultural asset dummies (Tube well, pump, Tiller, tractor and seed drill)
Banking literacy	Dummy	Equal to 1 if he has a bank account, zero otherwise
Kisan Credit Card	Dummy	Equal to 1 if he has a Kisan Credit Card, zero otherwise
Deficit rainfall	Dummy	Dummy=1 if Actual rainfall is deficit by more than 20 per cent of normal for the district

Estimated willingness to pay is based on the mean value of explanatory variables or control variables. From this estimate, it is difficult to quantify the impact of different variables on WTP. But, it is possible to predict $\widehat{WTP}$ for each respondent by making use of coefficients of maximum likelihood estimation. Determinants of willingness to pay for insurance was analysed using $\widehat{WTP}$ as dependent variable with set of explanatory variable in simple linear regression framework.

Results

Data from primary survey designed in double bound contingent valuation format was analysed using 'dbound' stata package written by Alejandro Lopez-Feldman. The results are presented here. Table 1 depicts the socio-economic characteristics of the sample households. Average size of land holdings amongst the respondents was found to be 7.47 acres. Sample had fair representation of all categories of farmers viz., marginal, small, medium and large. Majority of the farmers were literate too.

Table 1. Summary statistics of the respondents

Sl. No	**Variable**	**Unit**	**Average value**
1	Farmer age	Years	45.45
2	Farmer experience	Years	26.16
3	Land owned	Acres	7.47
4	Backward class	Dummy=1 if belongs to SC or ST or OBC	0.17
5	Marginal farmer	Dummy=1 if Size of land holding is less than 2.5 acre, 0 otherwise	0.15

6	Small farmer	Dummy=1 if Size of land holding is >= 2.5 acre & <5 acre, 0 otherwise	0.24
7	Medium farmer	Dummy=1 if Size of land holding is >= .5 acre & <10 acre, 0 otherwise	0.30
8	Large farmer	Dummy=1 if Size of land holding is more than 10 acres, 0 otherwise	0.32
9	Illiterate	Dummy=1 if illiterate, 0 otherwise	0.17
10	KCC	Dummy=1 if has KCC, 0 otherwise	0.39
11	Bank account holder	Dummy=1 if has bank account, 0 otherwise	0.90
12	Asset index	Linear unweighted index of agricultural asset dummies (Tube well, pump, Tiller, tractor and seed drill)	3.20
13	Perception of insurable risks	Dummy=1 if has perception weather risks which can be insured, 0 otherwise	0.54
14	Experienced risk	Dummy=1 if he has experienced risk in farming in last three years, 0 otherwise	0.55
15	Indebtedness	Dummy=1 if indebted, 0 otherwise	0.62
16	Extension contact	Dummy=1 if household has any pone formal source of extension contact, 0 otherwise	0.64
17	Cost of pesticide used	Amount spent on pesticide in Rs. /ha	1245.20
18	Deficit rainfall	Dummy=1 if Actual rainfall is deficit by more than 20 per cent of normal for the district	0.21

In CVM studies, it is important to consider the distribution of initial bid amounts. In our study, we had 8 initial bids ranging between 400 and 2200, which were carefully chosen to match with the premium amount payable to get crop insurance at different rates. In the current insurance scheme, 1.5 % of sum insured must be paid as premium. Average wheat yield of Punjab is approximately 17quintals per acre and maximum insurable sum comes to around 26010 at current minimum support price (MSP). So, the premium payable will be around Rs. 400 /acre if farmer insures entire value of the crop. Keeping this in mind, the bid amounts starting from 400 was selected and were randomised using computer program. Bids above 1000 were minimised as they were too high. The distribution of bids is given below.

Table 2: Distribution of initial bid

Initial bid	Freq.
400	121
600	142
800	108
1000	154
>1000	191
Total	716

According to economic theory, as price of the good increases, its demand decreases. Similarly, it is expected that as the bid amount increases, probability of getting ‘no’ response will increase. This is called as ‘price test’ in CVM literature(Carson et al. 2000). To examine

this, we have tabulated initial bid offered and corresponding response in table 3. As per theoretical expectation, with increase in bid amount from 400 to >1000, proportion of 'no' response is also increasing. For the initial bid of 400, 59% of farmers responded with a no while for bid of 800, the percentage of no answer shot up to 81%.

Table 3: Distribution of initial bid and corresponding answers

Answer1 /Bid	400	600	800	1000	>1000	Total
No	69	108	87	143	179	586
	(57)	(76)	(81)	(93)	(94)	
Yes	52	34	21	11	12	130
	(43)	(24)	(19)	(7)	(6)	
Total	121	142	108	154	191	716

Figures in parenthesis indicates percentage to total

Willingness to pay was estimated using maximum likelihood estimation, results are presented in table 4. First part of the table presents coefficients of control variables used in the analysis. Variables relating to social position, education, extension contact, risk experience in farming, asset position, banking literacy are used as control in estimating WTP to increase the accuracy of estimation. Significance and positive coefficient for control variable indicates positive relationship between getting 'yes' response and variable. But, magnitude of influence cannot be inferred from this analysis. Land holdings and Asset Index were found to increase the probability of getting a 'yes' response to the bid presented. These two factors mainly indicate the ability to pay for insurance and as per theoretical expectation had positive coefficient. Deficit rainfall and pesticide usage were also found to have positive influence on farmers willingness to participate in insurance(Akter et al. 2016). These two variables indicate risk in farming and hence have positive coefficient. Older farmers were reluctant to participate in insurance as indicated by negative coefficient for 'age' variable. Negative relationship between age and demand for crop insurance is well documented(Abebe & Bogale 2014)(Liesivaara & Myyra 2014).

Farmer's WTP for insurance was estimated to be Rs. 297 /acre for Weather indexed Insurance. The estimate was statistically significant too. As a reality check, we have also asked farmer an open ended follow up question about how much the amount he is willing to pay for insurance, and the mean value of responses found to be 271 Rs/ acre. As noted earlier, on an average, premium for existing crop insurance products works out to be 390 Rs/ acre if the farmer wants to insure 100% of threshold value of the crop. If the farmer wish to insure only 75% of value of the crop, then premium amount would be around 290 Rs/ acre which is very close to farmers' willingness to pay for insurance. So, if no additional subsidy on premium is not given, farmer may insure only 75% of value of crop. Lower sum insured as percentage of value of crop has been reported in earlier insurance schemes as well and has been a cause of concern(Damodaran, 2016). But, the earlier stand of Government that there is no market for crop insurance in Punjab seems to be no longer valid.

Another approach could be to linking premium subsidy with adoption of climate smart technologies like zero tillage and laser land levelling. If the farmers who adopted these

technologies can get additional premium subsidy, then this would benefit adoption of crop insurance as well as climate smart technologies making agriculture more resilient.

Table 4: Estimated willingness to pay for crop insurance.

Variable	Coefficient	P value
Male headed household	225.48	0.46
Farmer age	-20.44	0.00
literate	69.56	0.47
Backward Class	124.81	0.20
Agriculture primary occupation	59.08	0.59
Land owned	10.21	0.03
Farmer experience	16.11	0.00
Adopter of zero tillage	19.20	0.83
Perception of insurable risks	22.33	0.74
Experienced risk	27.99	0.67
Indebtedness	82.93	0.24
Extension contact	111.32	0.16
asset index	79.99	0.01
Bank account holder	170.78	0.19
KCC	10.34	0.87
Cost of pesticide used	0.14	0.05
Unseasonal rains	-19.24	0.40
Deficit rainfall	207.29	0.02
Adopter of Improved variety	-0.03	1.00
Like farming	23.97	0.79
_cons	-390.02	0.34
Sigma		
_cons	576.40	0.00
WTP	297.02	0.00

	Coef.	Std. Err.	P Value	[95% Confidence interval]	
WTP	297.02	46.68	0.00	205.52	388.53

Table 5. Willingness to pay compared with insurance premium for wheat in Punjab

Average yield of wheat (Quintal)	Minimum Support Price (Rs/quintal)	Gross value of crop/ Maximum sum insured	WTP (Rs/acre)	Premium (Sum insured= 100% of gross value) (Rs/acre)	Premium (Sum insured= 75% of gross value) (Rs/acre)	Premium (Sum insured= 50% of gross value) (Rs/acre)
17	1530	26010	297	390.15	292.6125	195.075

Factors influencing WTP was analysed by using simple linear regression model and results are presented in table 6. As can be seen from the results, Asset index, Size of land

holdings have positive relationship with the willingness to pay. Literature on demand for crop insurance also suggest that the wealthy farmers have higher willingness to pay for insurance(Liesivaara & Myyra 2014)(Ali 2013)(Abebe & Bogale 2014)(Hazell *et al*. 2010). Variables such as indebtedness, literacy and bank account were also positive. Insurance being a financial instrument for risk management, financial literacy significantly affects demand for crop insurance. To ensure higher participation of farmer in crop insurance schemes, it is important to create financial literacy amongst farmers(Giné et al. 2012; Singh 2013; Ali 2013). Farmers who have recently suffered crop loss are willing to pay more to insurance product indicated by positive coefficient for 'experienced risk', 'pesticide cost' and 'deficit rainfall'. Similar results were reported by (Gollier 2003). Figure 1 depicts relationship between difference in willingness to pay for insurance and risk experience. Willingness to pay of small holders who have suffered crop loss recently had more willingness to pay than those who didn't. the effect is visible for small and marginal holdings as they are more averse to risks.

Interestingly, for farmer belonging to districts witnessed unseasonal rainfall (rainfall of January to April was 20% more than normal) in the previous year, willingness to pay for insurance was less. 2014-15 wheat crop in Punjab suffered heavily due to unseasonal rains. Punjab government announced compensation ranging from 2000 to 8000 Rs per acre depending on extent of damage. When the farmer can get compensation for free, why should he pay for crop insurance ex ante?(Skees 1993). This may be the case of disaster payments crowding out the potential crop insurance in the area. Adopter of improved varieties of wheat (like HD2967, HD 3086 and Wh1105) had less willingness to pay compared to others. It may be due less perceived risk in these varieties as the varieties are resistant to major disease of wheat – yellow rust. Age also had negative association with willingness to pay for insurance.

Table 6: Factors affecting WTP of individuals

WTP	Coefficient	P value
Farmer age	-19.58	0.00
Backward class	136.09	0.00
literate	63.99	0.00
Land owned	10.77	0.00
age2	-0.01	0.22
land2	-0.02	0.07
Farmer experience	15.79	0.00
Zero tillage adopter	24.67	0.00
Indebtedness	106.51	0.00
Asset Index	82.08	0.00
Bank account holder	199.31	0.00
KCC	4.65	0.31
Cost of pesticide	0.15	0.00
Unseasonal rains	-19.37	0.00
Deficit rainfall	198.14	0.00
Experienced Risk	26.82	0.00
Adopter of improved variety	-18.30	0.01

Like farming as profession	44.25	0.00

District dummies are used and standard errors clustered at region

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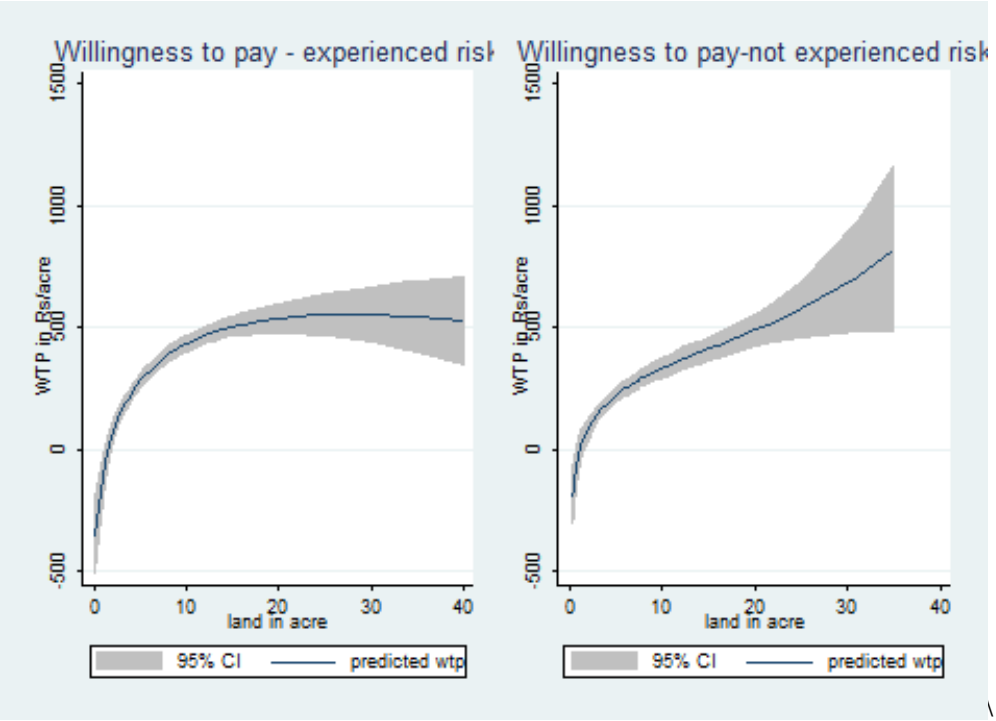

Figure1: Difference in WTP for farmers who have and haven't experienced risk in farming

Conclusion

Crop insurance will continue to play a vital role in stabilising farm income and de-risking agriculture. Subsidy on insurance premium is necessary to ensure higher enrolment of farmers and to increase the efficiency of insurance. Deciding the premium amount (/subsidy required) is a challenge for Government. Willingness to Pay (WTP) of farmers act as indicator of maximum premium farmer are ready to pay to insure their crop. In this study, we have estimated WTP for weather based crop insurance in Punjab. The results indicate that WTP for insurance is 297 Rs/ acre and at this amount, farmers can insure only 75% of threshold value of the crop. An additional subsidy of 100 Rs/acre, will ensure higher participation of farmers in crop insurance. We also found that financial literacy of farmers, wealth position and experience of crop loss to have positive relationship with WTP.

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