# Risk Preferences and Adoption of Climate Smart Agricultural Technologies - Evidence from India

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Mukesh Ray

# Motivation

- Technology adoption leads to higher economic growth and better standard of living for rural population.

- Still a vast majority of the farmers do not adopt or delay adoption. Why? Credit constraints, information, small farm size and uncertainty about the effectiveness of a new technology .

- This paper tries to explore the effect of risk preferences on adoption of three technologies in two regions of India. Punjab-Haryana and Bihar.

# Why Risk Preferences ?

- In most developing countries, agriculture is always a risky proposition given its dependence on environmental factors that are beyond farmer's control.
- Further, any new agricultural technology can have a wide distribution of outcomes increasing the associated uncertainty. So, any new agricultural technology is inherently perceived as an uncertain proposition.
- Consequently, farmers' perceived uncertainty regarding effectiveness of the technology allows individual risk preferences to play a major role in technology adoption .
- Omission of risk might bias other coefficients.

# Role of Risk in Tech Adoption

- Binswanger et al. (1980) elicited the risk preferences of a sample of Indian farmers. Their results showed mixed results and were inconclusive about the role of risk aversion on adoption.

- Byerles and Polanco (1986) analyzed farm survey data from Mexico to investigate the reasons for stepwise adoption of component of a technology package. Their results showed that adoption of new innovation was explained primarily by its profitability and riskiness.

- Liu (2013) analyzed the role of risk aversion, loss aversion and probability weighting measure for Adoption of BT cotton with Chinese farmers.

# Climate Smart Agriculture

- Sustainably **increase agricultural productivity and incomes** in order to meet national food security and development goals.

- Build resilience and the capacity of agricultural and food systems to **adapt to climate change** ( **risk reducing** )

- Seek opportunities to **mitigate emissions** of greenhouse gases and increase carbon sequestration

# Climate Smart Technologies

- **1. Laser Land Leveling** – Laser leveling is a user guided precision leveling technique used for achieving very fine leveling on the agricultural field.
- **2. Zero Tillage** - It is a way of growing crops or pasture from year to year without disturbing the soil through tillage**.**
- **3.Direct Seeded Rice** – The rice seeds are directly sown in the field where it is supposed to grow and not transplanted from another field.
- * All the three technologies are considered risk reducing by CGIAR, but individual perceptions of farmers might differ.

# Laser Land Leveler

- A machine equipped with a laser-operated drag bucket that ensures more flat, even surface in less time compared to the traditional ox-drawn scraper. Involves a battery operated laser beam that creates a plane of laser light above the field which is used as the levelling reference.

- **(+)** Evens surface, saves labor, saves water.
- **(+)** Even soil surface has a major impact on the germination, stand, and yield of crops due to homogeneous water distribution and soil moisture.
- **(-)** Could be expensive to buy. ( ~ $4000 to buy and $ 9 to rent per hour)

educes water use

# Zero Tillage – It is a way of growing crops or pasture from year to year without disturbing the soil through tillage. Instead of plowing their fields and then planting seeds, farmers who use zero tillage deposit seeds into holes drilled into the unplowed fields.

- **(+)** Excellent erosion control.
- **(+)** Soil moisture conservation.
- **(+)** Minimum fuel and labor costs.
- **(+)** Builds soil structure and health.

- **(-)** Increased dependence on herbicides.
- **(-)**Slow soil warming on poorly drained soils
- **(-)** Can impact productivity negatively.

# Direct Seeded Rice - Rice seed is sown and sprouted directly into the field, eliminating the laborious process of transplanting seedlings by hand

- **(+)** Direct planting is faster and less labor-intensive than transplanting.
- **(+)**It reduces land preparation time.
- **(+)** Reduces methane emission, which helps mitigate Climate Change.
- **(-)** Might increase weeds.
- **(-)**Yields reduced in some instances

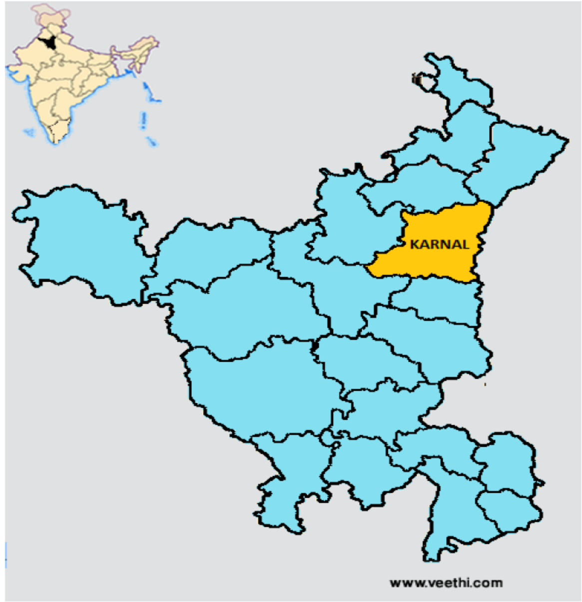
# Study on Climate Smart technologies. (CGIAR)

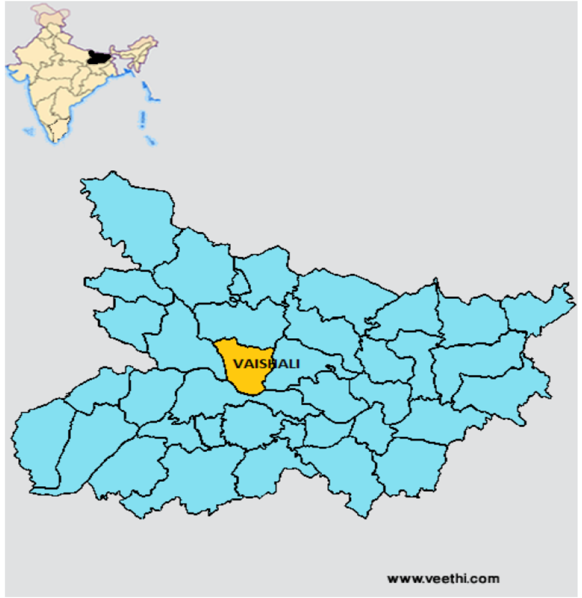
- For the broader adoption study, 80 villages each in three districts were randomly selected from a list of all wheat growing villages using the probability proportionate to size (PPS) method (where size was measured by net sown area of wheat and rice in the village as obtained from the last Census data).

- In each of these villages 10 households were selected randomly by the enumerators and a detailed questionnaire was administered to collect data on farmer and household characteristics, technology specific data for LLL, DSR and ZT, and adoption of other technologies by the household, and farmers' perception on constraints in wheat and rice farming.

- Data collection was done using a Computer Assisted Personal Interview (CAPI) method from a total of 2400 households across the three districts.
- **A subset of the sample was used for risk experiments.**

# Data


Ludhiana district, Punjab
Area: 3,767 km²
Population: 3.488 million (2011)

Karnal district, Haryana
Area: 1,967 km²
Population: 1.505 million (2011)

Vaishali district, Bihar
Area: 2,036 km²
Population: 3.495 million (2011)

- 240 household from 24 villages Ludhiana District in the state of Punjab
- 290 households from 29 villages in and Karnal District in the state of Haryana
- 410 households from 41 villages in Vaishali District in the state of Bihar

# Prospect Theory vs Expected Utility Theory

- In EUT, risk aversion is the sole parameter determining the curvature of utility function
- In prospect theory the shape of the utility function is jointly determined by three factors--risk aversion, loss aversion and a non-linear probability weighting measure.
- **Risk aversion** determines one's aversion to taking risk when the outcomes are positive.
- **Loss aversion** determines one's sensitivity to losses as compared to gains. *(If farmers consider investment in this technology can cause loss.)*
- **Non-linear probability weighting measure** determines ones tendency to overweight small probabilities and underweight large probabilities.*(Farmers around poverty line might overvalue the probability of falling back in poverty trap)*

# Experiment

- Risk preferences not easily assessed by standard household survey.
- A series of lottery based experiments to elicit risk behavior.
- For each of the 35 rows the respondent chooses between option A and Option B.
- Option B is more risky than Option A.
- In each series they can shift once.
- Shifting rows tells us about the risk parameters of the respondent.

| **Series 1** | **Option A** | | | **Option B** | | |
|---|---|---|---|---|---|---|
| **Q. no** | Rupees if you get 1,2,3 | Rupees if you get 4,5,6,7,8,9 10 | | Rupees if you get 1 | Rupees if you get 2,3,4,5,6,7,8,9 10 | Q No. |
| **1** | 40 | 10 | | 68 | 5 | 1 |

# Series 1

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| Series 1 | Option A | | | Option B | | Difference |
|---|---|---|---|---|---|---|
| **Question No.** | Rupees if you get 1,2 ,3 | Rupees if you get 4, 5 , 6, 7, 8, 9 , 10 | | Rupees if you get 1 | Rupees if you get 2, 3, 4,5, 6,7 ,8, 9, 10 | E(A)- E(B) |
| **1** | 40 | 10 | | 68 | 5 | 7.7 |
| **2** | 40 | 10 | | 75 | 5 | 7 |
| **3** | 40 | 10 | | 83 | 5 | 6.2 |
| **4** | 40 | 10 | | 93 | 5 | 5.2 |
| **5** | 40 | 10 | | 106 | 5 | 3.9 |
| **6** | 40 | 10 | | 125 | 5 | 2 |
| **7** | 40 | 10 | | 150 | 5 | -0.5 |
| **8** | 40 | 10 | | 185 | 5 | -4 |
| **9** | 40 | 10 | | 220 | 5 | -7.5 |
| **10** | 40 | 10 | | 300 | 5 | -15.5 |
| **11** | 40 | 10 | | 400 | 5 | -25.5 |
| **12** | 40 | 10 | | 600 | 5 | -45.5 |
| **13** | 40 | 10 | | 1000 | 5 | -85.5 |
| **14** | 40 | 10 | | 1700 | 5 | -155.5 |

# Series 2



| Series 2 | Rupees if you get 1,2,3,4,5,6,7,8,9 | Rupees if you get 10 | | Rupees if you get 1,2,3,4,5,6,7 | Rupees if you get 8,9, 10 |
|---|---|---|---|---|---|
| 15 | 40 | 30 | | 54 | 5 |
| 16 | 40 | 30 | | 56 | 5 |
| 17 | 40 | 30 | | 58 | 5 |
| 18 | 40 | 30 | | 60 | 5 |
| 19 | 40 | 30 | | 62 | 5 |
| 20 | 40 | 30 | | 65 | 5 |
| 21 | 40 | 30 | | 68 | 5 |
| 22 | 40 | 30 | | 72 | 5 |
| 23 | 40 | 30 | | 77 | 5 |
| 24 | 40 | 30 | | 83 | 5 |
| 25 | 40 | 30 | | 90 | 5 |
| 26 | 40 | 30 | | 100 | 5 |
| 27 | 40 | 30 | | 110 | 5 |
| 28 | 40 | 30 | | 130 | 5 |

# Series 3 ( For loss aversion)

| Series 3 | Rupees if you get 1,2,3,4,5 | Rupees if you get 6,7,8,9,10 | | Rupees if you get 1,2,3,4,5 | Rupees if you get 6,7,8,9,10 |
|---|---|---|---|---|---|
| **29** | 25 | -4 | | 30 | -21 |
| **30** | 4 | -4 | | 30 | -21 |
| **31** | 1 | -4 | | 30 | -21 |
| **32** | 1 | -4 | | 30 | -16 |
| **33** | 1 | -8 | | 30 | -16 |
| **34** | 1 | -8 | | 30 | -14 |
| **35** | 1 | -8 | | 30 | -11 |

# Model – Prelec Utility Function

- $U(x,p;y,q) = \begin{cases} v(y) + w(p)\big(v(x) - v(y)\big) & if \quad x > y > 0 \; or \; x < y < 0 \\ w(p)v(x) + w(q)v(y) & if \quad x < 0 < y \end{cases}$

Where

- $v(x) = \begin{cases} x^{\sigma} & for \quad x > 0 \\ -\lambda(-x^{\sigma}) & for \quad x < 0 \end{cases}$
- probability weighting function $w(p) = exp[-(-lnp)^{\alpha}]$, for $0 < \alpha \leq 1$
- $x$ & $y$ are outcomes and $p$ & $q$ are probabilities.
- $\sigma$ = risk aversion coefficient, $\lambda$ = loss aversion coefficient, $\alpha$ = non-linear probability weighting measure

* If $\lambda = 1$ and $\alpha = 1$, then the above model reduces to EUT.

# Estimation of Risk Parameters

| Series 1 | Option A | | | Option B | | |
|---|---|---|---|---|---|---|
| Q. no | Rupees if you get 1,2,3 | Rupees if you get 4,5,6,7,8,9 10 | | Rupees if you get 1 | Rupees if you get 2,3,4,5,6,7,8, 9 10 | Q. no |
| 6 | 40 | 10 | | 125 | 5 | 6 |
| 7 | 40 | 10 | | 150 | 5 | 7 |

| Series 2 | Option A | | | Option B | | |
|---|---|---|---|---|---|---|
| Q.no | Rupees if you get 1,2,3,4,5,6,7,8, 9 | Rupees if you get 10 | | Rupees if you get 1,2,3,4,5,6,7 | Rupees if you get 8,9,10 | Q.no |
| 20 | 40 | 30 | | 65 | 5 | 20 |
| 21 | 40 | 30 | | 68 | 5 | 21 |

$U_{6A} > U_{6B}$ & $U_{7A} < U_{7B}$

$U_{20A} > U_{20B}$ & $U_{21A} < U_{21B}$

# Estimation of Risk Parameters

| Series 1 | Option A | | | Option B | | |
|---|---|---|---|---|---|---|
| Q. no | Rupees if you get 1,2,3 | Rupees if you get 4,5,6,7,8,9 10 | | Rupees if you get 1 | Rupees if you get 2,3,4,5,6,7,8,9 10 | Q. no |
| 6 | 40 | 10 | | 125 | 5 | 6 |
| 7 | 40 | 10 | | 150 | 5 | 7 |

| Series 2 | Option A | | | Option B | | |
|---|---|---|---|---|---|---|
| Q.no | Rupees if you get 1,2,3,4,5,6,7 ,8,9 | Rupees if you get 10 | | Rupees if you get 1,2,3,4,5,6 ,7 | Rupees if you get 8,9,10 | Q.n o |
| 20 | 40 | 30 | | 65 | 5 | 20 |
| 21 | 40 | 30 | | 68 | 5 | 21 |

- $10^{\sigma} + \exp[-(-ln0.3)^{\alpha}]\,(40^{\sigma} - 10^{\sigma}) \;>\; 5^{\sigma} + \exp[-(-ln0.1)^{\alpha}](125^{\sigma} - 5^{\sigma})$
- $10^{\sigma} + \exp[-(-ln0.3)^{\alpha}]\,(40^{\sigma} - 10^{\sigma}) \;<\; 5^{\sigma} + \exp[-(-ln0.1)^{\alpha}]\,(150^{\sigma} - 5^{\sigma})$
- The **(σ, α )** combinations that satisfy the above inequalities are (0.4,0.4), (0.5,0.5), (0.6.0.6), **(0.7,0.7)**, (0.8,0.8), (0.9,0.9), (1,1).

- $30^{\sigma} + \exp[-(-ln0.9)^{\alpha}]\,(40^{\sigma} - 30^{\sigma}) \;>\; 5^{\sigma} + \exp[-(-ln0.3)^{\alpha}](65^{\sigma} - 5^{\sigma})$
- $30^{\sigma} + \exp[-(-ln0.3)^{\alpha}]\,(40^{\sigma} - 30^{\sigma}) \;<\; 5^{\sigma} + \exp[-(-ln0.3)^{\alpha}](68^{\sigma} - 5^{\sigma})$
- The **(σ, α )** combinations that satisfy the above inequalities are (0.8, 0.6), **(0.7, 0.7)**, (0.6, 0.8), (0.5, 0.9) or (0.4, 1).

# Observations Dropped



In cases where the respondent never switched in either of the three series, it is likely that he/she did not understand the game and therefore such observations were dropped from the analysis.

(All Option A or all Option B for three games)

# PT holds true



| Variable | Description | Mean | Std. Dev. | Null |
|---|---|---|---|---|
| a | Probability weighting function parameter | 0.693***(0.008) | 0.253 | a=1 |
| σ | Curvature of the prospect value function | 0.574***(0.011) | 0.335 | σ=0 |
| λ | Measure of loss aversion | 4.194***(0.134) | 4.089 | λ=1 |
| N=918 | | | | |

- If a < 1, w(p) has an inverted S shape, which indicates an overweighting of low probabilities and an underweighting of high probabilities.
- Increasing σ on 0 to 1 range implies a lower degree of risk aversion, while increasing σ on range above 1 implies increasing risk-seeking behavior. A value of σ = 1 implies risk neutrality
- λ ≠1 implies there is a kink in the indifference curve around zero.

# Risk Coefficients Across the States

| | Punjab & Haryana | | Bihar | | |
|---|---|---|---|---|---|
| **Variable** | **Obs** | **Mean** | **Obs** | **Mean** | **Ha: diff != 0** |
| Sigma | 512 | 0.56 | 408 | 0.59 | P>\|t\|=0.1953 |
| Alpha | 512 | 0.70 | 408 | 0.69 | P>\|t\|=0.7202 |
| Lambda | 512 | **3.37** | 406 | **5.23** | P>\|t\|= 0.0000 |

# Summary Statistics (HH level)



| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Sigma | 0.574 | 0.335 | 0.05 | 1.5 |
| Lambda | 4.194 | 4.089 | 0.065 | 12.64 |
| Alpha | 0.693 | 0.253 | 0.05 | 1.45 |
| HH Land owned in acres | 5.93 | 8.82 | 0.01 | 85 |
| HH Size | 6.77 | 3.51 | 2 | 31 |
| Highest level of Education in HH | 11.70 | 3.39 | 0 | 17 |
| HHH Education level | 7.86 | 4.07 | 0 | 17 |
| HH poverty score | 52.53* | 16.80 | 6.00 | 83 |
| HHH Age | 44.23 | 12.97 | 19 | 90 |
| Avg time to nearest town(mins) | 31.11 | 28.78 | 1.00 | 145 |
| Amount earned in risk games | 71.30 | 136.06 | 0 | 1721 |
| N=918(HH) | | | | |

*For this poverty score the likelihood of being under poverty line is 0.407

# Information about Technology



| Overall | LLL | DSR | Zero Till |
|---|---|---|---|
| Never Heard | 906 | 1,285 | 1,164 |
| Heard | 1,332 | 952 | 1,074 |
| % Heard | **59.52** | **42.56** | **47.99** |
| Total HH | 2,238 | 2,237 | 2,238 |

| Risk HH | LLL | DSR | Zero Till |
|---|---|---|---|
| Never Heard | 479 | 548 | 495 |
| Heard | 439 | 370 | 423 |
| % Heard | **47.82** | **40.31** | **46.08** |
| Total | 918 | 918 | 918 |

# Adopters, Never Adopters and Dis-adopters

| **Overall** | **LLL** | **DSR** | **Zero Till** |
|---|---|---|---|
| Heard | 1,332 | 952 | 1,074 |
| Adopters | 862 | 52 | 79 |
| Never adopted | 470 | 900 | 995 |
| Dis-adopters | 36 | 22 | 43 |
| % Adopters among those know | **64.71** | **5.46** | **7.36** |

| **Risk HH** | **LLL** | **DSR** | **Zero Till** |
|---|---|---|---|
| Heard | 439 | 370 | 423 |
| Adopters | 298 | 24 | 21 |
| Never adopted | 141 | 346 | 402 |
| Dis-adopters | 7 | 7 | 12 |
| % Adopters among those know | **67.88** | **6.49** | **4.96** |

# Reasons for not adopting



| **Farmers heard but never used. Why?** | **LLL** | **DSR** | **Zero Till** |
|---|---|---|---|
| Unwilling to try new technology | **12** | **112** | **53** |
| lack training/information | 39 | 33 | 77 |
| Expensive to hire/build | 98 | 5 | 26 |
| Service/materials not available in the | 35 | 15 | 44 |
| Gives Less Yield | 6 | **398** | **472** |
| Not satisfied with output | 0 | **201** | **232** |
| Does not look good | 1 | 5 | 3 |
| High weed | 0 | 60 | 3 |
| Not suitable on small Land | 12 | 13 | 17 |
| Land is naturally level/ no need | **224** | 14 | 13 |
| Lack of information | 3 | 43 | 53 |
| Others | 11 | 0 | 1 |
| Cannot say | 29 | 1 | 1 |
| Total | 470 | 900 | 995 |

# Econometric Framework

- $Y_{hK} = \begin{cases} 1 \; if \quad EU(Y \; = 1) - \; EU(Y = 0) \; > \; 0 \\ 0 \qquad otherwise \end{cases}$

## *Probit*

- $Y_{hL} = \beta_0 + \; \beta_{11} \, X'_h + \beta_{21} \, R'_h \; + \mu_{hL}$

X' = Vector of demographic, socio-economic and plot level variables influencing technologies adoption.

R' = Risk aversion coefficient, loss aversion coefficient , probability weighting measure.

Standard errors are clustered at HH Level.

Analysis at the plot level, only where respondent is also the plot manager.

# Results (Laser Land Leveler)



| VARIABLES | Probit( at means) | LPM(District f.e) |
|---|---|---|
| | | |
| Alpha | -1.070*** | -0.900* |
| | (0.386) | (0.464) |
| Sigma | 0.392 | 0.374 |
| | (0.364) | (0.519) |
| Lambda | 0.116*** | 0.062* |
| | (0.0385) | (0.033) |
| Age | -0.003 | -0.002 |
| | -0.008 | (0.010) |
| Age*alpha | 0.0216** | 0.018 |
| | (0.00893) | (0.011) |
| Age*Sigma | -0.00903 | -0.010 |
| | (0.00804) | (0.012) |
| Age*lambda | -0.00249*** | -0.001* |
| | (0.000847) | (0.001) |
| HH poverty score | 0.00253 | 0.001 |
| | (0.00352) | (0.004) |
| Did you or anyone in the household access credit for ag. production | -0.107* | -0.100 |
| | (0.0557) | (0.064) |
| Time it takes on average to travel to nearest commercial town | 0.000438 | 0.000 |
| | (0.00154) | (0.002) |
| Formal Education of Main Respondent | 0.0121 | 0.008 |
| | (0.00908) | (0.011) |
| N | 284 | 298 |
| R-squared/ Pseudo R-squared | 0.328 | 0.376 |

| VARIABLES | Probit( at means | LPM(District f.e) |
|---|---|---|
| | | |
| Wheat Yeild per acre | -0.0114 | -0.021** |
| | (0.0127) | (0.009) |
| Rice Yeild per acre | 0.00414 | 0.004 |
| | (0.00531) | (0.004) |
| Soil Quality(good) | 0.304* | 0.905*** |
| | (0.185) | (0.194) |
| Soil Type(Sandy) | -0.338** | -0.583*** |
| | (0.144) | (0.161) |
| Soil Type(Sandy Loam) | -0.125 | -0.273** |
| | (0.120) | (0.111) |
| Soil Type(Clay Loam) | -0.122 | -0.183** |
| | (0.0976) | (0.090) |
| Soil Salinity(High) | 0.315** | 0.347*** |
| | (0.126) | (0.120) |
| Soil Salinity(Medium) | 0.268*** | 0.315*** |
| | (0.0944) | (0.100) |
| Soil Salinity(low) | 0.197** | 0.172* |
| | (0.0990) | (0.094) |
| Irrigation Type(Flood with pump) | | -0.139 |
| | | (0.125) |
| Irrigation Source(River/canal water) | - | -0.271 |
| | | (0.263) |
| N | 284 | 298 |
| Rsquared/ Pseudo R-squared | 0.328 | 0.376 |

| VARIABLES | Probit( at means | LPM(District f.e) |
|---|---|---|
| Has any member of your household migrated in the past 5 years? | -0.0194 | -0.020 |
| | (0.0733) | (0.081) |
| HH Size | 0.0330* | 0.025 |
| | (0.0180) | (0.020) |
| Total land owned by HH(in acres) | 0.000461 | 0.001 |
| | (0.00296) | (0.005) |
| Total Household durable assets | -5.19e-08 | 0.000 |
| | (7.38e-08) | (0.000) |
| What was your birth order. | 0.00878 | 0.001 |
| | (0.00925) | (0.008) |
| How many people does the HH interacts in the village on a regular basis | 0.158*** | 0.207*** |
| | (0.0385) | (0.035) |
| By how much ft groundwater level has declined in past 10 years | -0.00382** | -0.004** |
| | (0.00179) | (0.002) |
| Constant | -0.200 | -0.200 |
| | (1.650) | (1.650) |
| Observations | 284 | 298 |
| Rsquared/ Pseudo R-squared | 0.328 | 0.376 |
| Robust standard errors in parentheses | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | |

# Results (Either of the three technologies)



| VARIABLES | Probit( at means | LPM(District f.e) |
|---|---|---|
| | | |
| Alpha | -0.519** | -0.376 |
| | (0.233) | (0.283) |
| Sigma | 0.157 | -0.190 |
| | (0.236) | (0.226) |
| Lambda | 0.055*** | 0.054*** |
| | (0.020) | (0.018) |
| Age | 0.001 | -0.000 |
| | (0.00520) | (0.006) |
| Age*alpha | -0.00120*** | 0.006 |
| | (0.000464) | (0.006) |
| Age*Sigma | -0.00450 | 0.003 |
| | (0.00527) | (0.004) |
| Age*lambda | 0.00911* | -0.001*** |
| | (0.00544) | (0.000) |
| HH poverty score | 0.00323 | -0.001 |
| | (0.00209) | (0.002) |
| Did you or anyone in the household access credit for ag.production | -0.0992** | -0.049 |
| | (0.0405) | (0.053) |
| Time it takes on average to travel to nearest commercial town | 0.00128 | 0.001 |
| | (0.00113) | (0.001) |
| Formal Education of Main Respondent | 0.00883 | 0.010 |
| | (0.00625) | (0.007) |
| N | 428 | 436 |
| R-squared/ Pseudo R-squared | 0.580 | 0.597 |

| VARIABLES | Probit( at means | LPM(District f.e) |
|---|---|---|
| | | |
| Wheat Yeild per acre | -0.00880** | 0.001 |
| | (0.00367) | (0.001) |
| Rice Yeild per acre | 0.0132*** | -0.001 |
| | (0.00430) | (0.002) |
| Soil Quality(good) | 0.136* | 0.863*** |
| | (0.0819) | (0.095) |
| Soil Type(Sandy) | -0.171** | -0.318*** |
| | (0.0866) | (0.100) |
| Soil Type(Sandy Loam) | -0.0107 | -0.064 |
| | (0.0629) | (0.048) |
| Soil Type(Clay Loam) | -0.0852 | 0.006 |
| | (0.0535) | (0.048) |
| Soil Salinity(High) | 0.287*** | 0.098 |
| | (0.0796) | (0.099) |
| Soil Salinity(Medium) | 0.247*** | 0.114* |
| | (0.0552) | (0.068) |
| Soil Salinity(low) | 0.240*** | 0.044 |
| | (0.0586) | (0.055) |
| Irrigation Type(Flood with pump) | -0.368*** | |
| | (0.100) | |
| Irrigation Source(River/canal water) | 0.477** | |
| | (0.216) | |
| N | 428 | 436 |
| Rsquared/ Pseudo R-squared | 0.580 | 0.597 |

| VARIABLES | Probit( at means) | LPM(District f.e) |
| --- | --- | --- |
| Has any member of your household migrated in the past 5 years? | 0.0344 | 0.036 |
| HH size | 0.0128 | 0.006 |
| | (0.00851) | (0.006) |
| Total land owned by HH(in acres) | 0.00125 | 0.001 |
| | (0.00221) | (0.005) |
| Total Household durable assets | 1.06e-07** | -0.000 |
| | (4.40e-08) | (0.000) |
| What was your birth order. | 0.0137** | 0.002 |
| | (0.00672) | (0.007) |
| How many people does the HH interacts in the village on a regular basis | 0.0902*** | 0.100*** |
| | (0.0228) | (0.024) |
| By how much ft groundwater level has declined in past 10 years | -0.00220* | -0.003** |
| | (0.00130) | (0.001) |
| Constant | -0.695* | -0.695* |
| | (0.366) | (0.366) |
| Observations | 428 | 436 |
| Rsquared/ Pseudo R-squared | 0.580 | 0.597 |
| Robust standard errors in parentheses | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | |

# Discussion

- Risk parameters- loss aversion and non-linear probability weighting measure seems to explain technology adoption. This goes in line with the claim that these are risk reducing technologies.

- Loss aversion has a positively significant coefficient suggesting that an increase in loss aversion increases the probability of adopting these technologies. This makes sense as these technologies are thought of as risk reducing.

- Both the loss aversion and non-linear probability weighting parameters seems to have different effect at different ages.

- one unit increase in loss aversion leads to a 11.6% increase in probability adoption of LLL and 5.5 % increase in probability of adoption of either of the three technologies. ( probit marginal effect).

# Discussion

- Non-linear probability weighting measure has a negatively significant coefficient, suggesting that as **a** goes down technology adoption goes up. This means as the farmers who overvalue the smaller probabilities tend to adopt these technologies more.

- Plot characteristics, HH characteristics also seem to explain a major part of the tech adoption as suggested by literature.

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Thank you

| Mock Game 1 | | | | |
|---|---|---|---|---|
| | Option A | | Option B | |
| **Question No.** | Number of Candies for chip 1-5 | Number of Candies for chip 6-10 | Number of Candies for chip 1-5 | Number of candies for chips 6-10 |
| **1** | 3 | 2 | 5 | 1 |
| **2** | 3 | 2 | 6 | 1 |
| **3** | 3 | 2 | 7 | 1 |
| **4** | 3 | 2 | 8 | 1 |
| **5** | 3 | 2 | 9 | 1 |
| | | | | |

| Mock Game 2 | | | | | |
|---|---|---|---|---|---|
| **Series 1** | Option A | | | Option B | |
| **Question No.** | Number of Candies for chip 1,2,3 | Number of Candies for chips 4-10 | | Number of Candies for Chip 1 | Number of candies for chip 2-10 |
| **1** | 4 | 2 | | 5 | 1 |
| **2** | 4 | 2 | | 6 | 1 |
| **3** | 4 | 2 | | 7 | 1 |
| **4** | 4 | 2 | | 8 | 1 |
| **5** | 4 | 2 | | 9 | 1 |
| **6** | 4 | 2 | | 10 | 1 |
| **Series 2** | Number of Candies for chip 1-5 | Number of Candies for chip 6-10 | | Number of Candies for chip 1-5 | Number of Candies for chip 6-10 |
| **7** | 6 | 2 | | 7 | 1 |
| **8** | 2 | -1 | | 10 | -1 |
| **9** | 1 | -1 | | 12 | -2 |
| **10** | 1 | -1 | | 14 | -3 |
| **11** | 1 | -2 | | 16 | -4 |
| **12** | 1 | -2 | | 18 | -5 |