Risk behavior of small and marginal farmers in Cauvery Delta Zone, Tamil Nadu

ABSTRACT

Farmers' risk preferences play an important role in agricultural production decisions, risk takers means the farmers who are willing to take risky decisions in farming, risk aversion means an attitude of reluctance to take risky decisions in farming. Climatic change effects all regions across the globe and causes substantial agitations that can be expected to be natural systems that have foreseeable influences on the economic systems of upland regions through both direct and indirect means. Risk preferences reflect the farmers' personal experiences and beliefs, these preferences explain how the decision-maker assesses and react to risks. This study characterizes risk behaviour among marginal and small farmers in Cauvery Delta Zone and determines how these risk preferences affects the farmers. The study was conducted in Cauvery Delta zone of Thanjavur, Thiruvarur and Nagapattinam districts with a Sample size of 366 farmers which consists of 183 marginal and 183 small farmers was selected randomly based on proportionate random sampling method. The risk behavior was measured by the measure of risk attitude and two lottery methods viz., Eckel-Grossman and Holt-Laury based lottery method. Measure of risk attitude results shows that, 27.60 per cent of farmers were moderate risk taker followed by 24.30 per cent were risk averser and 15.00 per cent of farmers were risk taker. The Eckel and Grossman lottery method result shows CRRA (Constant Relative Risk Aversion) value was 0.38 to 0.67, which shows that marginal farmers were risk aversers and small farmers were moderate risk takers. The CRRA adapted from Holt and Laury (2002) range for the maximum was 1.37 and minimum -1.71 for their choices. The majority of marginal farmers were risk aversers, the socio-economic characteristics of the farmers decides the risk preference. The risk-averse farmer this may imply risk-taking behavior that is reduced by risk aversion (resulting in on-farm risk management strategies) and a reduced demand of insurance.

Keywords: Attitude, Aversion, Cauvery Delta Zone, Farmers and Risk preference

1. INTRODUCTION

Agriculture sector always faces numerous types of risks and farmers ought to work under risks stirred by various factors, as includes market hitches, environmental nature, social and economic circumstances. Farming is an enterprise like other business activities and is the most important risk factor as natural hazards. Poor and agricultural communities of the developing world are affected most by the climate change, because they have poor adaptive capacity and inadequate access to alternate means of production. Risk and uncertainty play a crucial role in farmers' decision regarding production which is associated with their choice and level of inputs and outputs. As farming is a major source of revenue for rural households, it is indispensable for growers of rural households to ascertain and overcome risks toward production. Climate change is exacerbating climate variability, evident in more frequent and severe weather-related disasters, such as droughts, cyclones and floods. Farmers' risk preferences play an important role in agricultural production decisions. Recognizing the available options and selecting the appropriate method to elicit

risk preference among farmers is a crucial step for researchers investigating in decision-making processes under uncertainty. Risk takers means the farmers who are willing to take risky decisions in farming, risk aversion means an attitude of reluctance to take risky decisions in farming. Risk in agriculture is usually defined in the category of the distribution of outcomes (i.e. variance, standard deviation). In a more general approach, measures of dispersion are linked to an expected value, and risk can be reflected in the coefficient of variation. The risk preferences were elicited based on multi-item scales and lottery-choices tasks. Other risk aversion studies shows that, Croson and Gneezy (2009) found that "female farmers are more risk-averse than male farmers", Nielsen *et al.,* (2013) found that "old age farmers are more risk-averse than young age farmers". Harrison *et al.,* (2007) found that "farmers attaining formal education are more risk-averse than farmers with no education"; whereas Reynaud and Couture (2012) found "no such significant influence of education on risk attitudes of farmers". Miyata (2003) found that "farmers having large families are more risk-averse than with less family size", whereas Maart-Noelck and Musshoff (2014) found "no such effect of household size on risk attitudes". Cohen and Einav (2007) found that "rich farmers are more risk-averse than poor farmers"; whereas Tanaka *et al.,* (2010) found "no such significant effect of income on risk attitudes of sample households". Wiki *et al.,* (2004) found that "farmers with large size of land are more risk-averse than small and marginal farmers". Barham and Chitemi (2009) found that "farmers joining as a member of any group or organization are less risk-averse". Asravor and Sarpong (2022) from "the results of hypothetical lottery choice responses, show that 23.00 per cent of cereal farmers found to be extreme-risk-averse compared to legume farmers accounting of 18.00 per cent". Additionally, 26.00 per cent of legume farmers were moderate-risk-averse compared to cereal farmers accounting of 23.00 per cent, meager percentage of cereal farmers (8.00%) from Northern region of Ghana are more risk-neutral compared to legume farmers (6%). Nearly one-fourth of the Legume farmers (24.00%) were also found to be more intermediate risk averse than cereal farmers accounting of 20.00 per cent. Maniriho (2022) revealed that "farmers exposed to environmental risks and even more affected by impact born from shocks like destructive rains (60.2 per cent), mountain slides (22 per cent) and floods (4.8 per cent)". Edeh (2009) revealed that "the major environmental risk management methods used by the farmers include early land preparation and planting (92.59%), adoption of crop diversification (81.48%), use of improved rice varieties (74.07%); use of drainage practices (66.67%) and engaging in non-farm activities for income generation (54.63%)". The least environmental risk management practices adopted by farmers were the agroforestry practices (4.63%) followed by the use of irrigation practices (9.26%) and postponing rice transplanting (9.26%). Tamil Nadu is one of the most water-stressed states in India, the mean annual rainfall is 912mm of which 48.00 per cent comes from the erratic North-East monsoon (October-December) and 32.00 per cent from the South West Monsoon (June-September). Tamil Nadu has 17 major river basins, from this Cauvery Basin is the largest one. The availability of water resources in the delta is unreliable and flooding is common especially in the tail end reaches during the North-East monsoon. Meanwhile, climate change projections indicate an intensification of floods due to heavy rainfall, heavy downpour in a day, storm rainfall is predicted to increase by 19.00 per cent and rise in mean sea level. In coastal areas, flooding will increase because sea-levels are projected to rise from 0.29m to 0.87m by 2100. With this background the present study investigated Risk behavior of small and marginal farmers in Cauvery Delta Zone, Tamil Nadu.

2. METHODOLOGY

The main focus of this paper is to examine the risk behavior of small and marginal farmers in Cauvery Delta Zone, Tamil Nadu. About 73.00 per cent of the delta's population of 4.8 million is engaged in farming, fishing and is dependent on water resources for their livelihoods. However, the availability of water resources in the delta is unreliable and flooding

is common during the erratic northeast monsoon. Meanwhile, climate change projections indicate an intensification of floods as rainfall increases during the monsoon and sea levels rise. The study is based on households' survey conducted in six blocks from three districts viz., Ammapettai and Orathanadu blocks of Thanjavur district, Needamangalam and Mannargudi blocks of Thiruvarur district, Kilvelur and Thirumarugal blocks of Nagapattinam district. Two villages from each block were selected purposively based on more area under paddy cultivation. From the selected villages, a list of land holding size was obtained from the Assistant Director of Agriculture office of concerned blocks. Sample size of 366 farmers which consisted of 183 marginal and 183 small farmers was selected randomly based on proportionate random sampling method.

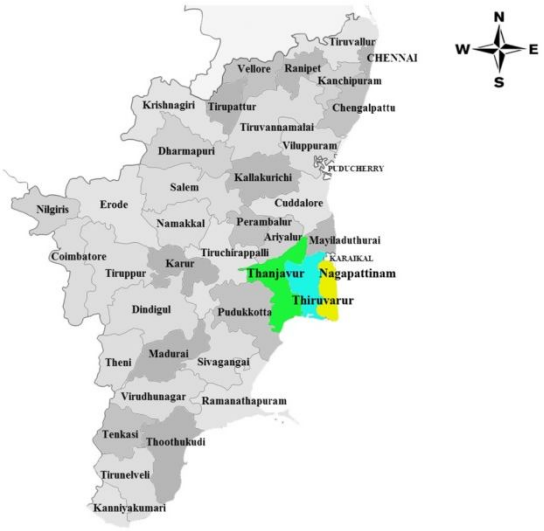

Figure 1: Map showing the study area

The primary data related to risk behavior were collected from farmer by survey method through personal interview with the help of a set of pre-tested schedules. The risk behavior is an important predictor to derive an innate of risk attitude. For this measurement of risk behavior the measure of risk attitude and two lottery methods viz., Eckel-Grossman and Holt-Laury based lottery method was employed to elicit their risk behavior. The Holt and Laury (2002) and Eckel and Grossman (2008) lottery method was used for analyzing risk behavior among farmers. The self-assessment questions we asked were judged on a 7 point Likert type item. For the self-elucidation of general risk attitude, the assessment scale was ranging from I avoid risk as much as possible as high risk averser to I enjoy taking risk as high risk taker. The two lottery experiments are based on the expected utility framework. CRRA scores are based on the assumed utility function with the following form:

$$U = X^{(1-r)}/(1-r)$$

In which U is the attributed utility to a value x and r is the relative risk aversion score. For both the Eckel and Grossman and the Holt and Laury adapted lottery experiments, we took a hypothetical approach, i.e. no real pay-out was given to the respondents.

The first lottery experiment is based on the lottery experiment by Eckel and Grossman (2008). Eckel and Grossman developed "a simple gamble-choice task to evaluate individual's CRRA. The respondents are offered a choice set of five gambles, each with two possible outcomes with an equal probability (representing a coin flip for instance) and one

sure offer. The sure offer has the lowest expected payoff and the expected payoffs of the gambles are linearly increasing as does the risk (measured as the standard deviation of the payoffs). The CRRA score is derived based on the choice of the respondents for their preferred gamble. We adapted the payoffs of the gamble choice set in such a way that no negative pay-out could occur".

"The second lottery experiment is based on the Holt and Laury MPL lottery experiment adapted" by Dave et al. (2007). The lottery experiment designed by Holt and Laury (2002), also known as the multiple price list (MPL), is generally accepted as the "gold standard" for risk elucidation in economic literature (Nielsen et al., 2013). This method uses a series of 10 choices between two gambles of which one is relatively safer compared to the other (lower variance). The low and high pay-outs of the gambles remain constant over the 10 choices but differ between the two gambles. The safer gamble has the least difference between the high and low payout (400 and 328 Rupees respectively in our hypothetical lottery experiment) and the riskier gamble has a much larger variance (770 and 95 Rupees in our hypothetical lottery experiment). The probability of winning the high or low pay-out remains the same over the two gambles but vary over the 10 choices. In the first choice set, the probability of winning the high pay-out is 10% for both gambles. Therefore, the safer option, with a 90% chance of winning the low pay-out of 328 Rs compared to 95 Rs in the riskier option, is the choice with the highest expected pay-out. The experiments based measures of assessing risk attitude are rooted in economic literature and assume risk attitude to be understood in the expected utility framework.

3. RESULTS AND DISCUSSION

The risk behavior approach has gained importance in the context of farmers' decision-making behaviour and their adoption of risk management strategies (Van Winsen 2014, Sulewski and Kłoczko-Gajewska 2014). The farmers risk behavior as assessed by measure of risk attitude and risk preference by lottery method.

Measures of risk attitude

Measure of risk attitude elicits the farmer's response to uncertainty which is mainly influenced by perception. The results of risk attitude was discussed below

Table 1: Distribution of farmers according to their risk behavior

S.No.	Category	Marginal farmers (n=183)		Small farmers (n=183)		Total farmers (n=183)	
		No.	Per cent	No.	Per cent	No.	Per cent
1.	High risk averser	1	0.50	0	0.00	1	0.30
2.	Moderate risk averser	28	15.30	0	0.00	28	7.70
3.	Risk averser	80	43.70	9	4.90	89	24.30
4.	Neutral	38	20.80	7	3.80	45	12.30
5.	Risk taker	14	7.70	41	22.40	55	15.00
6.	Moderate risk taker	19	10.40	82	44.80	101	27.60
7.	High risk taker	3	1.60	44	24.00	47	12.80
	Total	**183**	**100.00**	**183**	**100.00**	**366**	**100.00**

The above table shows that, 43.70 per cent of marginal farmers were risk averser followed by 20.80 per cent of farmers were neutral they not averse or take the risk. They are late adopters in technological implementation. The 15.30 per cent of farmers were moderate risk averser. The results shows that majority of marginal farmers were risk averser, most of their occupational status was farming and wage earning and their annual income was low. Their educational status was illiterate to primary education, they have low level of change proneness and having less contact with external environment, which results the farmer reluctant to take risky decisions. This might be the reason for the marginal farmers to averse the risk in farming. More than two-third of small farmers (44.80%) were moderate risk taker followed by nearly one-fourth of farmers (24.00%) were high risk takers and 22.40 farmers were risk taker. This result implies that moderate risk taker was reported by nearly half of the small farmers, who are reluctant in taking decisions on some financial risks. They taking risk on crop production and diversification activities of their farms. And they have moderate to high level of annual income, this gives self-confidence among them, the income influences the farmers to build resilient measures and to prefer the risky decisions on farming to some extent. This might be the reason for having moderate risk taking behavior among the small farmers.

27.60 per cent of farmers were moderate risk taker followed by 24.30 per cent were risk averser, 15.00 per cent of farmers were risk taker and 12.30 per cent of farmers were neutral. The result shows that the half of the farmers take risk in farming followed by two-fifth of the farmers averse the risk in farming. This implies that majority of the marginal farmers were risk aversers and also small farmers take moderate risks, which particularly on production and they reluctant in taking decisions on financial risk. This might be the reason for having moderate risk taking ability among farmers.

Farmers' Risk Preferences

Risk preferences reflect the farmers' personal experiences and beliefs, these preferences explain how the decision-maker assesses and react to risks. The farmers risk preference was elicited by eckel grossman and holt laury lottery method, which has choices among the gambles and the farmers were asked to choose the choices accordingly their risk preferences was calculated and the CRRA (Constant Relative Risk Aversion) adapted from (Eckel and Grossman 2008, Holt and Laury 2002). The results were analyzed and discussed below,

Eckel -Grossman lottery method for risk preferences:

A simpler single-choice design of eckel -grossman lottery method where the farmers are asked to choose one gamble from five different gambles where the probabilities of low and high outcomes are always 0.5 in each gamble.

Table 2: Pay-out and Probability of eckel-grossman lottery method

S.No.	Your choice	Pay-out		Probabilities		Expected value (Rs.)	Difference (Rs.)	CRRA-range
		Low	High	Low	High			
1.	A	Rs. 100	Rs. 100	0.5	0.5	100	0	r>2
2.	B	Rs. 150	Rs. 75	0.5	0.5	112.50	75	0.67<r<2
3.	C	Rs. 200	Rs. 50	0.5	0.5	125	150	0.38<r<0.67

4.	D	Rs. 250	Rs. 25	0.5	0.5	137.50	225	0.20<r<0.38
5.	E	Rs. 300	Rs. 0	0.5	0.5	150	300	r<0.20

The CRRA scores are based on the assumed utility function, $U = X^{(1-r)}/(1-r)$, these CRRA score was adopted from the (Eckel and Grossman 2008) lottery method.

The farmers were asked to choose the choice from the eckel grossman lottery method and the results were discussed below,

Table 3: Distribution of farmers according to the Eckel -Grossman lottery method of risk preferences

S.No.	Your choice	Pay-out		Marginal farmers (n=183)		Small farmers (n=183)		Total farmers (n=366)	
		Low	Low	No.	Per cent	No.	Per cent	No.	Per cent
1.	A	Rs. 100	Rs. 100	34	18.60	0	0.00	34	9.30
2.	B	Rs. 150	Rs. 75	53	29.00	18	9.80	71	19.40
3.	C	Rs. 200	Rs. 50	61	33.30	27	14.80	88	24.00
4.	D	Rs. 250	Rs. 25	35	19.10	104	56.80	139	38.00
5.	E	Rs. 300	Rs. 0	0	0.00	34	18.60	34	9.30
	Total			**183**	**100.00**	**183**	**100.00**	**366**	**100.00**

The above table shows that one-third of the marginal farmers (33.30%) were choosing choice C with pay-out for heads was Rs.200 and pay-out for tails was Rs.50. Followed by 29.00 per cent of marginal farmers choosing choice B with pay-out for heads was Rs.150 and pay-out for tails was Rs.75. 19.10 per cent of marginal farmers choosing choice D with pay-out for heads was Rs.250 and pay-out for tails was Rs.25. This shows that majority of marginal farmers were choosing the choices A, B and C with their expected values as adopted from Eckel and Grossman (2008) was Rs.100 Rs.112.50 and Rs.125 respectively. This implies that the majority of marginal farmers were risk aversers and they preferring low risky choices. This shows that they are avoiding risks in farming and they are hesitant to adopt the improved technologies in their farms. More than half of the small farmers (56.80%) were choosing choice D with pay-out for heads was Rs.250 and pay-out for tails was Rs.25. Followed by 18.60 per cent of small farmers choosing choice E with pay-out for heads was Rs.300 and pay-out for tails was Rs.0. 14.80 per cent of small farmers choosing choice C with pay-out for heads was Rs.200 and pay-out for tails was Rs.50. This shows that majority of small farmers were choosing the choices C, D and E with their expected values as adopted from Eckel and Grossman (2008) was Rs.125, Rs.137.5 and Rs.150 respectively. The educational and occupational status of the farmer influences the risk behavior. Majority of small farmers have educational status of middle to graduate level, occupational status was farming and business activity. This influences their intended risk behavior, this might be the reason for having moderate risk taking ability with evidence from results of eckel and grossman lottery method.

38.00 per cent of farmers choosing choice D with pay-out for heads was Rs.250 and pay-out for tails was Rs.25. Followed by 24.00 per cent of farmers choosing choice C with pay-out for heads was Rs.200 and pay-out for tails was Rs.50. 19.40 per cent of farmers choosing choice B with pay-out for heads was Rs.150 and pay-out for tails was Rs.75. This shows that majority of farmers were choosing the choices B, C and D with their expected values as adopted from Eckel and Grossman (2008) was Rs.112.5, Rs.125 and Rs.137.5

respectively. This shows that the majority of farmers CRRA (Constant Relative Risk Aversion) adapted from Eckel and Grossman (2008) was 0.38 to 0.67, which shows that majority of farmers were moderate risk takers. The result implies that the farmer's educational and occupational status influences the intended risk behavior of farmers.

Holt-Laury lottery method of risk preferences

Holt-Laury lottery method has ten decisions with different variance options, with one of these choices randomly chosen for actual payoff.

Table 4: Pay-out and Probability of holt-laury lottery method

S.No.	Your choice	Probabilities		Expected value		E(A)-E(B)	CRRA -range
		Low	High	E(A)*	E(B)**		
1.	A	0.90	0.10	328	95	233	r<-1.71
2.	B	0.80	0.20	336	170	166	-1.71<r<-0.95
3.	C	0.70	0.30	344	245	99	-0.95<r<-0.49
4.	D	0.60	0.40	352	320	32	-0.49<r<-0.14
5.	E	0.50	0.50	360	395	-35	-0.14<r<0.15
6.	F	0.40	0.60	368	470	-102	0.15<r<0.41
7.	G	0.30	0.70	376	545	-169	0.41<r<0.68
8.	H	0.20	0.80	384	620	-236	0.68<r<0.97
9.	I	0.10	0.90	392	695	-303	0.97<r<1.37
10.	J	0.00	1.00	400	770	-370	1.37<r

*E(A): expected value for the safer gamble (Pay outs:Rs.320 – Rs.400)

**E(B): expected value for the riskier gamble (Pay outs:Rs.20 – Rs.770)

The CRRA scores are based on the assumed utility function, $U = X^{(1-r)}/(1-r)$, these CRRA score was adopted from the (Holt and Laury 2002) lottery method. The results of holt-laury lottery method were discussed below

Table 5: Distribution of farmers according to the Holt-Laury lottery method of risk preferences

S.No.	Your choice	Probabilities		Marginal farmers (n=183)		Small farmers (n=183)		Total farmers (n=366)	
		Low	High	No.	Per cent	No.	Per cent	No.	Per cent
1.	A	0.90	0.10	4	2.30	0	0.00	4	1.10
2.	B	0.80	0.20	16	8.70	0	0.00	16	4.40
3.	C	0.70	0.30	41	22.40	0	0.00	41	11.20
4.	D	0.60	0.40	33	18.00	4	2.20	37	10.10
5.	E	0.50	0.50	34	18.60	7	3.80	41	11.20
6.	F	0.40	0.60	20	10.90	8	4.40	28	7.60
7.	G	0.30	0.70	9	4.90	24	13.10	33	9.00
8.	H	0.20	0.80	16	8.70	63	34.40	79	21.60
9.	I	0.10	0.90	10	5.50	58	31.70	68	18.60
10.	J	0.00	1.00	0	0.00	19	10.40	19	5.20
	Total			**183**	**100.00**	**183**	**100.00**	**366**	**100.00**

The result shows that, 22.40 per cent of marginal farmers choosing the choice C with low (0.70) and high probability (0.30), this implies that the farmers choosing with low probability of Rs.344 and high probability of Rs.245. Followed by 18.60 per cent of marginal farmers choosing E with low (0.5) and high (0.5) probability of payout value of Rs.360 for low and Rs.390 for high probabilities and 18.00 per cent of marginal farmers choosing D choice, the low (0.6) and high (0.4) probability with payout of Rs. 352 for low probability and Rs.320 for high probability. The results of marginal farmers implies CRRA (Constant Relative Risk Aversion) adapted from Holt and Laury (2002) range for the maximum marginal farmers was 0.15 for their choice. This shows that the majority of marginal farmers were risk aversers. More than one-third of small farmers (33.34%) choosing the choice H with low (0.20) and high probability (0.80) of payout for low probability was Rs.384 and high probability of Rs.620. Followed by 31.70 per cent of small farmers choosing I with low (0.10) and high (0.90) probability of payout value of Rs.392 for low and Rs.695 for high probabilities and 13.10 per cent of small farmers choosing G choice, the low (0.30) and high (0.70) probability with payout of Rs. 376 for low probability and Rs.545 for high probability. The results of small farmers CRRA (Constant Relative Risk Aversion) adapted from Holt and Laury (2002) range for the maximum marginal farmers was 1.37 for their choice. This shows that the majority of small farmers were moderate risk takers. This implies that their educational and occupational status, high income level and favorable attitude on risk resilience strategies are the major influence on the farmers risk preferences.

More than two-fifth of the farmers (21.60%) choosing the choice H with low (0.20) and high probability (0.80) of payout for low probability was Rs.384 and high probability of Rs.620. Followed by 18.60 per cent of farmers choosing I with low (0.10) and high (0.90) probability of payout value of Rs.392 for low and Rs.695 for high probabilities. 11.20 per cent of farmers choosing C & E choice, for the choice C the low (0.70) and high (0.30) probability with payout of Rs. 344 for low probability and Rs.245 for high probability. The results shows that the CRRA (Constant Relative Risk Aversion) adapted from Holt and Laury (2002) range for the maximum was 1.37 and minimum -1.71 for their choices. This shows that the majority of farmers were risk aversers and moderate risk takers. This implies that their size of land holding decides their risk preferences. The similar findings was reported from the findings of He *et al.,* (2020), who also reported that more than 60.00 per cent of farmers choosing high probabilities of 0.50 to 1.00 with parallel low probability level ranging from 0.50 to 0.00.

4. CONCLUSION

The Farmer's decision on risk preference is inferred by comparing the actual count of safe and risk lottery choices chosen by the farmers. Individual lottery-choice decisions tend to exhibit risk aversion as revealed by the count of safe lotteries chosen and CRRA range. The results of measures of risk attitude shows that one-fourth of farmers were risk takers and nearly one-fourth were risk aversers. The results of eckel grossman and holt laury lottery method also shows that majority of farmers were moderate risk takers. The study shows that risk-averse farmers are less likely to choose off-farm risk management strategies, explanations can be found in the novel and innovative nature of some off-farm risk management strategies included, as well as in the fact that for most farmers the farm business (or yield) is considered as in irreplaceable commodity that cannot be valued in marketable terms. The risk-averse farmers do not choose no risk management as an alternative, but focus on on-farm measures. Majority of the farmers were reluctant to take decisions on implementation of improved technologies and building resilient measures in their farm. The majority of the farmers were moderate risk takers, the policy makers should design the policies which will helps in capacity building among the farmers.

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