An assessment of risk attitude of dairy farmers in Uttaranchal (India)

by

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ABSTRACT

The study was carried out in the Tarai area of Uttaranchal state to (i) identify the sources of risks perceived to be relevant by the farmers, (ii) examine farmers' risk attitude, (iii) identify the factors that affect risk attitudes and (iv) evaluate the relative importance of different risk management strategies. Adverse effect on family health was perceived as a major source of risk by the dairy farmers, indicating the crucial role that surplus family labour plays in dairy farming in India. Lack of institutional support in dairying was also perceived to be a major source risk. Farmers' risk attitude was measured using an attitudinal scale approach. The attitudinal scale consisted of a series of different risk management strategies and the farmers' attitude was measured by his rating of each of those strategies. The analysis establishes a refined 22-item scale that can be applied by researchers to measure the risk attitude of dairy farmers in Indian context. The refined scale has high degree of reliability as farmers' responses to the items of the scale revealed a communal variation of 85%, which is higher than the minimally acceptable range of 65% to 70%. The study further revealed slight degree of risk aversion among farmers as revealed by the adoption such risk management tools like vaccinating the animals, calling a veterinarian, prevention of illness, maintaining hygienic conditions, and feeding adequate concentrates. Hence, there is a strong tendency on the part of the farmers to mitigate the production risks at farm level by adapting appropriate measures. But, a certain degree of risk taking behaviour was also seen in regard to certain risk management tools, especially livestock insurance. Regression analysis to ascertain relationship between socio-economic factors with risk attitudes, revealed largely insignificant influence of the variables considered in the study. Herd size and hours spent in off-farm work showed

negative and significant impact upon the risk attitude score. Number of dependents showed significant and positive relationship with the total score. The variables included in the study explained 54.5 per cent of variation in risk attitude score. As regards to relative importance of different risk management tools, carrying adequate cash reserve was cited by the farmers as relevant, which is against the general perception that Indian farmers, mostly being subsistent can not afford to hold cash reserve to meet future crisis.

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INTRODUCTION

Animal husbandry in India plays an important role in the rural economy. India is bestowed with huge and diverse livestock resources. As per recent estimates of FAO (2004), India has 222 million cattle, 95 million buffaloes, 24 million goats, 59 million sheep and 843 million poultry birds. More than two-third of the farmers in India belong to the marginal and small categories and are severely constrained in raising income through crop cultivation. The ubiquitous aspect of any village in India is the presence of 1-2 milch animals or a few small stocks like goat or poultry in every household, which mainly serves as a source of supplementary income. The ownership of livestock in India is more evenly distributed with landless agricultural labourers, small and marginal farmers. Therefore, progress in this sector would result in a more balanced development of the rural economy by way of increased opportunities for employment and income generation.

There is a common perception that farmers in India are averse to modifications in their production, financial and marketing practices due to their risk aversion behaviour. Therefore, there is a need for field level studies to assess the validity of such perception in the country to be able to make effective interventions through development policies, programmes and farm advisory services.

Livestock are almost an integral and inseparable component of farming system in the newly created state of Uttaranchal in India. The rural poor have sustained themselves in difficult conditions, and in their endeavour, livestock continue to be their active partner. Dairy animals (Cattle and buffalo) constitute the major share of livestock population in the state (45%

and 10%, respectively) and milk contributes the major share in total output from the sector (77%).

In view of the above, it would be useful to examine the risk attitudes and risk management strategies of dairy farmers. The aim of the paper is to (i) identify the sources of risks perceived to be relevant by the farmers, (ii) examine farmers' risk attitude, (iii) identify the factors that affect risk attitudes and (iv) evaluate the relative importance of different risk management strategies.

DATA AND METHODOLOGY

The study was carried out in Udham Singh Nagar district, which lies in the Tarai area of the Uttaranchal state. The major share of the state's dairy cattle and buffalo population is concentrated in this area. Rudrapur block from a total of eight blocks of the district was selected purposively as it is an agriculturally frontline area of the district. Four villages from the block were selected randomly, namely Chattarpur, Anandpur, Kanakpur and Dharampur. Complete enumeration of all the farmers having at least one milch animal was done. Farmers were categorized as landless, marginal (less than 2 ha of land), small (2 to less than 4 ha of land) and large farmers (4 and more than 4 ha of land). A sample comprising of 25 per cent of the total number of farmers holding milch animals from each village was then randomly selected, having representation from all the categories of households on proportionate basis. Thus, a total of 59 farmers comprising 10 landless, 21 marginal, 7 small and 21 large farmers were selected for the study. The average number of milch animals per household is given in Table 1.

Information and data on socio-economic characteristics of the farmers, attitudes towards risks in dairy farming and perception of respondents towards various sources of risk and risk management strategies were collected in personal interview on a pre-structured schedule.

For assessing the respondents' perception regarding various sources of risk, relevant sources of risks were identified. The respondents were asked to elucidate their perception about each source of risk on a 5-point scale (irrelevant-1, somewhat irrelevant-2, neutral-3, somewhat relevant-4 and relevant-5). Significance of difference of estimated average score from neutral score was tested using 't' test.

Farmers' risk attitude was measured using an attitudinal scale approach. An aggregate score based on farmers' responses to a total of 31 statements (items), each representing a risk management tool in dairy farming was estimated. The responses to each of the statements correspond to the socio-psychological attribute of the individual farmer and his rating of the item conveys his attitude towards risk, based on his proclivity to adopt the particular risk management tool that the item reflects. This methodology of developing a risk attitudinal scale was used by Bard and Berry (2000), Lagerkvist (2005) and Meuwissen *et al* (1999). The underlying assumption in this method of measuring the risk attitude is that if attitude towards risk is a determinant of risk management strategy adopted by the farmers, the farmer's response to specific risk management tool would be an indicator of their risk attitude. The respondent's rating of the items was summed up to yield an aggregate score for the respondent, which was a quantitative measure of his attitude.

The widely used Likert's scale was used due to its suitability in measuring an individual's attitude as established by Chattopadhyaya (1963), Samanta (1977) and Bhattacharya (1993). The responses were measured on a 5-point scale. Strong disagreement

(score of 1) implied the willingness of farmer to adopt the risk management tool in question (risk aversion). On the other hand, strong agreement (score of 5) indicated a risk taking attitude. In between the two extremes, disagreement (score of 2), undecided/neutral (Score of 3) and agreement (score of 4) were included as alternative responses. Thus, a lower total for the respondent is then hypothesized to correspond to higher degree of risk aversion. While administering the schedule, both positive and negative statements were included to avoid response bias. The schedule also included a self-assessment question, wherein the respondents were asked to rate themselves on a scale of 0 to 10, when the score of 0 corresponds to highly risk averse and the score of 10 corresponds to highly risk taking attitude.

Before drawing inferences on the basis of the total score obtained by an individual on the attitudinal scale, it is pertinent to test how well the statements reflect on the risk attitude of the farmers. The empirical analysis consists of reliability testing and validity testing. The reliability of the attitudinal scale depends on the extent to which individual statements reflect the risk attitude of the respondents. **Validity testing** can be construct validity testing and convergent validity testing. Construct validity testing analyze the extent to which the total risk attitudinal score is related to different categories of respondents, in this study to different categories of farmers based on their landholdings. Convergent validity testing measures how different measures of the same risk attitudes, here total score based on the attitudinal scale and self-assessment score, relate to each other.

For **Reliability testing**, Cronbach's coefficient alpha as used by Bard and Berry (2000) and Lagerkvist (2005) was used to evaluate the reliability of the attitudinal scale. It is measured as:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_y^2}\right)$$

where, k is the number of statements, σ_i^2 is the variance of ith statement and σ_y^2 is the total variance of the k-item scale. The higher is the Cronbach's coefficient alpha, the better is its reliability.

The reliability of a scale being developed can be increased by deleting statements from the original scale, which have weak relationship to remaining statements' responses (Devillis, 1991). This relationship is found through Corrected Item Score Correlation (CISC), which is measured as:

$$r_{i(y-i)} = \frac{r_{yi}\sigma_y - \sigma_i}{\sqrt{\sigma_i^2 + \sigma_y^2 + 2\sigma_1\sigma_y r_{yi}}}$$

where, r_{yi} is the correlation of statement i with total score y, σ_y is the standard deviation of the total score, σ_i is the standard deviation of statement i, and $r_{i(y-i)}$ is the correlation of statement i with sum of scores of all statements, excluding statement i (Bard and Berry, 2000 and Lagerkvist, 2005). The scales are then optimized and the value of Cronbach's coefficient alpha is increased by deleting statements with negative or low- item score correlation.

For **Construct validity testing**, ANOVA was used to test for the hypothesized differences in the risk attitudes among different categories of farmers. Construct validation is implied if the results of the ANOVA differentiate between the risk attitudes of the farmers belonging to different categories.

Convergent validity testing was done by evaluating the correlation between the total score obtained on the basis of the attitudinal scale and the self-assessment score (which is a single-item scale) of the individuals (both being measures of the same construct). If the two measures are positively and significantly correlated, the results imply that the scale has convergent validity (Devillis, 1991).

Linear regression model was fitted to look into the relationship between risk attitude and various factors that might influence it. The socio-economic characteristics which were included as explanatory variables in the regression analysis were landholding, herd size, hours spent in off-farm work, share of milk in gross farm income, number of dependents, education of family members, age and education of head of the household and farm experience.

The relative importance of various risk management strategies was analyzed by asking the respondents to rate the risk management tools as per their importance on a 5-point scale (irrelevant-1, somewhat irrelevant-2, neutral-3, somewhat relevant-4 and relevant-5). Divergence of the estimated average score from the neutral score was tested by using the 't' test.

RESULTS AND DISCUSSION

(i) Sources of risk:

Distribution of respondents according to their perception of relevance of different sources of risks and the average score for all the farmers for each source of risk is presented in Table 2. The standard deviations for each of the sources of risk were more than 1, indicating that disparity exists to some extent among the respondents' perception of risks. However, percentage of farmers considering a particular risk to be irrelevant or relevant and the average score denoted that the farmers perceived all the sources of risks to be relevant. The sources of risk perceived to be either somewhat relevant or relevant by large proportion of farmers (combined) were health situation of family (80% of respondents), animal diseases (79% of respondents), distant location of Artificial Insemination (AI) centres (69% of respondents) and lack of extension support (66% of the respondents). This was also corroborated by the average scores estimated for these sources of risks (4.34, 4.23, 3.73, and 4, respectively). The sources of

risks considered to be relevant or somewhat relevant by low combined proportion of farmers were changes in consumer preferences for milk and milk products (44% of respondents), poor conception rate due to AI (44% of respondents) and adoption of crossbred animals, (50%, of respondents). The average scores estimated for each source of risk exceeded the neutral score of 3 significantly at 1% level of significance or 5% level of significance. Interestingly, the highest score appeared in case of health situation of farm family as source of risk. This result suggests the importance of family labour in rearing milch animals as the head of the household generally remains busy in agricultural or other off-farm activities. The high scores assigned by respondents to the risks of animal diseases (4.29) and anoestrus (3.78) are understandable, given the prevalence of widespread parasitic diseases (especially, Fasciolosis and external parasitic infestations) and mineral deficiency in the study area. Lack of extension support, distant location of AI centres/veterinary hospitals, unavailability of credit and green fodder also received high scores (4.0, 3.73, 3.70 and 3.39, respectively) from the farmers indicating towards the lack of adequate institutional support for dairy farmers. The risks of poor conception rate due to AI and distant location of AI centres are obviously correlated as the farmers are not able to get their dairy animals inseminated at the proper time resulting in poor conception. Price of milk was also considered to be relevant source of risk by the farmers with an estimated score of 3.54. This is consistent with earlier findings (Bardhan *et al,* 2005), which cited some problems in the pricing mechanism of the dairy cooperatives, viz. fixing non-remunerative prices by the cooperatives in comparison to the cost of milk production, seasonal variability in price of milk and the practice of fixing the price based on the criteria of fat and SNF content in the milk only.

(ii) Farmers' risk attitude

A set of 31 statements put before the farmers to ascertain their risk attitudes and the mean score of each statement for each category of farmers, and also for all categories combined are given in Table 3. The statements are negatively worded and as mentioned earlier, the scoring of options were done in such a way that the option of strongly disagreeing got a score of 1, while that of strongly agreeing was assigned a score of 5. Thus, the lower the score for an individual statement, more likely the farmer is going to adopt or utilize the risk management tool that the statement reflects, due to his risk-averse attitude. Few statements, viz. statement numbers 2, 9, 10, 17, 21 and 22 are positively worded, but here also strong disagreement would correspond to a risk-averse attitude of the farmer. For example, disagreement with statement 21 ('my animals are often sick) would imply that the farmer has taken adequate measures to prevent occurrence of frequent illness in his animals, which obviously reflects a case of risk aversion. The mean scores across all categories of farmers were statistically above neutral (the score of value 3) for statements 1, 9 and 10. The average score ranged between 3.322 and 3.9 for these statements. Thus, farmers showed disinclination towards the implementation of practices like insuring animals (statement 1). Statements 9 and 10 were positively worded. Thus, agreement with the statements implied that the farmers were inclined to invest in specialized machinery and cross bred animals. These high scores suggest that farmers were not risk averse in respect of these three aspects.

Statements with attitudinal scores statistically lower than the neutral score of 3 were statements 3, 4, 6, 13, 14, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 29, 30 and 31.Thus, the risk management tools of having cash in hand, entering into future contracts in marketing livestock and livestock products, spreading milk production throughout the year, vaccinating animals,

calling a veterinarian, participating in trainings, stall feeding (non-preference of keeping animals in free-range system), producing highest quality products, having family members taking greater interest in dairying, consulting a veterinarian before taking a major decision in farming, prevention of diseases, having high productive animals, giving adequate bedding to animals, having larger manure storing capacity, having thorough supervision of animal production, growing fodder in between major crop cycles, use of High Yield Variety (HYV) fodder seeds, going for AI with improved quality semen and giving adequate concentrates to animals were utilized or agreed upon by the farmers as valid risk management methods in their farming systems. The farmers were mostly undecided about the importance of such risk management tools as urea treatment of low quality fodder (probably due to lack of awareness about the practice), having adequate life insurance, entering into contracts with input suppliers and having sufficient back-up labour to carry on production.

Reliability testing: As mentioned earlier, the purpose of reliability testing is to optimize the number of statements, by including such statements in the final refined scale which really contribute to explaining and measuring the risk attitude of the respondents. Table 4 presents the Corrected Item-Score Correlation (CISC) of each statement and the overall Cronbach's coefficient alpha. The overall coefficient alpha of 0.783 suggests that the 31 items (statements) included in the scale accounted for 78% of total variation of risk attitude. Therefore, the scale was optimized by deleting statements with negative or very low CISC. The deletion of statements continued as long as such deletions increased the value of coefficient alpha. When further deletions actually reduced the total alpha value, it signified that the scale has been optimized and its reliability cannot be increased any further. Table 5 gives a list of statements from the original 31 statements that provide the highest attainable value of alpha. At the first

instance 7 statements were deleted, viz. 2, 7, 9, 10, 17, 22 and 23. The alpha value of the new 24-item scale increased to 84 per cent. Further deletion of statements 4 and 19 provided a 22-item scale having an alpha value of 0.85. Statements 12 and 29 having low CISC were also deleted one by one to yield a 21-item and 20-item scale, respectively. But, the corresponding alpha values of these two scales (0.849 and 0.847, respectively) declined from that of the 22-item scale. Thus, the 22-item scale offered the best explanation of the variance with an aggregate coefficient alpha of 0.85. This value is much higher than the minimally acceptable alpha value of 0.65 as proposed by Devillis (1991). The value of the coefficient alpha of the optimized scale indicates that a communal variation of 85 per cent is caused by risk attitudes, which is higher than what were reported by Bard and Berry, 2000, (69%) and Lagerkvist, 2005, (83%). Table 6 reveals the correlation among the statements of the 22-item refined scale. Out of a possible 231 correlation coefficients, 112 coefficients (48.5%) were found to be statistically significant at either 1%, 5% or 10% level of significance.

Construct validity testing: Construct validity testing is done to ascertain whether the scale developed to measure a construct (here risk attitude) differentiates between different groups of the respondents. ANOVA was applied to test the hypothesis of differences in risk attitudes of different categories of farmers based on landholding. The results of the analysis revealed that there are no significant differences in risk attitudes (measured on the basis of attitudinal scale) among different groups of farmers classified on the basis of landholdings.

Convergent validity testing: Convergent validity is established if there is significant correlation between the different measures of the same construct (risk attitude). In this study, two measures for assessing risk attitudes were examined. First, the score obtained based on the farmers' responses to various risk management tools. Second, the self-assessment score,

wherein the respondent himself was asked to rate himself according to his own perception of his attitude towards risk. The estimated correlation of 0.12 between respondent's self-assessment score and the score obtained on the basis of the risk attitudinal scale was found to be statistically non-significant, implying that the way the farmers perceived their own attitudes to risks in farming is not consistent with their responses to risk management tools. This is in consonance with the findings of Bard and Berry (2000), who also reported low and non-significant correlation between the measure of risk attitude based on responses to risk management statements and self-assessment scores, which prompted them to conclude that a single-item self-assessment score may not be an accurate measure of risk attitudes.

(iii) Factors affecting risk attitudes

The regression results on factors affecting risk attitudes of dairy farmers are presented in Table 7. Three variables exhibited significant relationship with the risk attitudes of the farmers, viz. herd size, hours spent in off-farm work and number of dependents. Hours spent in off-farm work exhibited negative relationship with total risk score, implying that as time spent in off-farm work increases, aggregate score measuring risk attitude decreases, meaning thereby that risk aversion increases. Thus, off-farm work was perceived by the farmers as a tool for managing risk and hours spent in off-farm work can be considered as a measure of risk aversion attitude. Herd size also showed negative relationship with the total risk score, indicating that with increase in herd size farmers give more attention to their farming, implying risk aversion. Number of dependents exhibited statistically significant and positive relationship with the total risk score, implying that with the increase in the number of dependents, the risk score also increases, meaning thereby that the risk taking behaviour increases. Landholding size was not found to be a significant factor. This result supports the result of construct validity

testing in previous section. The value of R^2 indicates that the explanatory variables considered in the study together explained about 55 per cent variation in risk attitude of dairy farmers.

(iv) Risk management strategies:

Respondents' perception of risk management strategies according to their importance were also assessed using a scale from 1 (irrelevant) to 5 (relevant). The average score of each management strategy and the distribution of the respondents according to their perceptions are given in Table 8. The average score in case of six strategies, viz. producing at the least possible cost, buying personal insurance, applying strict hygienic rules, price contracts for inputs, off-farm employment and carrying adequate cash reserves were found to be significantly higher than the neutral score of 3, indicating their relevance to the farmers in managing risks. The finding of carrying adequate cash reserves as a management strategy refutes the general perception that, farmers in India, mostly being subsistent do not carry cash reserves to counter risk. The average score of the other three strategies, viz. buying livestock insurance, diversification and price contract for milk were not found to be statistically different from the neutral score of 3. This suggests that farmers were indifferent towards these risk management strategies but did not consider them irrelevant. Chi-square analysis was performed to ascertain whether perception of risk management strategies of the farmers were dependent upon their landholding. The results confirmed the earlier findings in this study that the perception of risk management strategies was independent of category of farmers based on the size of landholdings.

CONCLUSION

Adverse effect on family health was perceived as a major source of risk by the farmers, indicating the crucial role that family labour plays in dairy farming in India. This finding could

be useful for life insurance agencies in marketing their insurance products. Lack of institutional support in dairying was also perceived to be a major source of risk.

The risk attitudes of the dairy farmers were measured by the responses of the farmers to various risk management tools, which were included as scale items. The analysis establishes a refined 22-item scale that can be applied by researchers to measure the risk attitude of dairy farmers in Indian context. The refined scale has high degree of reliability as farmers' responses to the items of the scale revealed a communal variation of 85%, which is higher than the minimally acceptable range of 65% to 70%.

The study further revealed an overall mild degree of risk aversion among farmers. But, a certain degree of risk taking behaviour was also seen in regard to certain risk management tools, especially livestock insurance. With the financial structure in Indian agriculture, especially the livestock sector, being in transition, and more and more insurance companies entering the field of livestock insurance, the results of this study could be useful to them in ascertaining the extent to which the farmers are risk averse or risk taker to get a measure of demand for their products. The study established a high degree of risk aversion as revealed by the adoption of such risk management tools like vaccinating the animals, calling a veterinarian, prevention of illness, maintaining hygienic conditions, and feeding adequate concentrates. Hence, there is a strong tendency on the part of the farmers to mitigate the production risks at farm level by adapting appropriate measures.

Regression results showed that with increase in herd size and hours spent in off-farm work, risk aversion attitude increases. On the other hand, with increase in number of dependents risk taking behaviour increases. The variables included in the study explained about 55 per cent of variation in risk attitude score.

The results showed that amongst other risk management tools, carrying adequate cash reserve was cited by the farmers as relevant, which is against the general perception that Indian farmers, mostly being subsistent can not afford to hold cash reserve to counter risk. The finding regarding the willingness of the farmers to enter into price contract for inputs could be useful for agribusiness firms, specially feed companies in designing their marketing strategy.

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Table 1: Average number of milch animal holding per household

Category	Average land holding (ha)	Average herd size
Landless	-	1.70
Marginal	1.08	2.95
Small	3.31	3.14
Large	6.29	3.23
Pooled	3.02	2.86

Table 2: Distribution of respondents according to their perception of relevance of different sources of risk

Sources of risk	Irrelevant	Somewhat irrelevant	Neutral	Somewhat Relevant	Relevant	Average Score
1. Price of milk	9 (15.25)	5 (8.47)	13 (22.03)	10 (16.95)	22 (37.29)	3.542* (1.454)
2. Animal disease	3 (5.08)	2 (3.39)	7 (11.86)	10 (16.95)	37 (62.71)	4.288* (1.130)
3. Health situation of farm family	3 (5.08)	3 (5.08)	5 (8.47)	8 (13.56)	40 (67.80)	4.339* (1.154)
4.Changes in consumer preferences for milk and milk products	11 (18.64)	2 (3.39)	20 (33.90)	9 (15.25)	17 (28.81)	3.556* (1.387)
5. Changes in interest rates of banks	12 (20.34)	3 (5.08)	12 (20.34)	8 (13.56)	24 (40.68)	3.559* (1.534)
6. Milk yield variability	3 (5.08)	5 (8.47)	16 (27.12)	17 (28.81)	18 (30.51)	3.763* (1.135)
7. Ability to pay back loans	9 (15.25)	4 (6.78)	11 (18.64)	12 (20.34)	23 (38.98)	3.695* (1.429)
8. Technology (CB animals)	4 (6.78)	4 (6.78)	21 (35.59)	10 (16.95)	20 (33.90)	3.644* (1.214)
9. Unavailability of green fodder in all seasons	10 (16.95)	5 (8.47)	13 (22.03)	14 (23.73)	17 (28.81)	3.390** (1.427)
10. Poor conception rate due to AI	8 (13.56)	4 (6.78)	21 (35.59)	8 (13.56)	18 (30.51)	3.390** (1.352)
11. Silent heat	7 (11.86)	- (0)	16 (27.12)	18 (30.51)	18 (30.51)	3.368* (1.252)
12. Anoestrus	5 (8.47)	2 (3.39)	17 (28.81)	12 (20.34)	23 (38.98)	3.780* (1.247)
13. Unavailability of credit	2 (3.39)	6 (10.17)	20 (33.90)	11 (18.64)	20 (33.90)	3.695* (1.149)
14. Lack of Extension support	4 (6.78)	2 (3.39)	14 (23.73)	15 (25.42)	24 (40.68)	4* (1.099)
15. Distant location of AI centres/Vety. hospitals	8 (13.56)	3 (5.08)	10 (16.95)	13 (22.03)	25 (47.46)	3.729* (1.436)

Figures in parentheses indicate percentage of respondents
Figures in parentheses for the column of Average Score indicate Standard Deviations
Significant difference from the neutral score at *1% level of significance; ** 5% level of significance

Table 3: Mean and Standard deviations of risk attitude statements

Statements	Category				
	Landless	Marginal	Small	Large	Overall
1. I never insure my animals	3.3	3.429	3.714	3.095	3.322***
	(1.826)	(1.469)	(1.604)	(1.670)	(1.536)
2. I am the first producer in my village to adopt a newtechnology	2.2	2.857	3.857	3.190	2.983
	(1.033)	(1.621)	(1.069)	(1.436)	(1.456)
3. I never have enough cash on hand that can be easily converted to cash to pay all my debts	2.8	2.952	3.286	2.714	2.701***
	(1.317)	(1.322)	(0.756)	(1.231)	(1.019)
4. I never enter into future contract in marketing livestock/livestock products	2.9	2.810	2.286	2.810	2.763***
	(0.944)	(1.030)	(0.951)	(1.436)	(1.165)
5. I do not have adequate life insurance	3.2	2.571	2.714	2.857	2.797
	(1.229)	(1.165)	(1.380)	(1.352)	(1.256)
6. I never spread the milk production from the animals throughout the year	2.4	2.619	3.429	2.905	2.780***
	(1.265)	(1.322)	(0.976)	(1.300)	(1.274)
7. Off-farm income is not important for the financial survival of my family	2.5	2.810	3	3.095	2.681**
	(1.269)	(1.470)	(1.915)	(1.411)	(1.151)
8. In case of emergency, I do not have sufficient back-up management/labour to carry on production	2.9	2.714	3.143	3	2.898
	(1.287)	(1.309)	(1.464)	(1.414)	(1.335)
9. I use very specialized machinery for my production practices	2.1	3.286	4.286	4.048	3.475*
	(0.876)	(1.146)	(1.113)	(0.805)	(1.209)
10. I prefer investing in Crossbred animals	3.6	4.238	4.143	3.762	3.949*
	(1.265)	(1.091)	(1.069)	(1.338)	(1.209)
11. I never enter into contact with any input suppliers	2.6	2.810	3.429	2.810	2.847
	(1.350)	(1.209)	(0.976)	(1.167)	(1.186)
12. I am not a low-cost producer	3	2.905	2.571	2.714	2.814
	(1.247)	(1.261)	(0.535)	(1.189)	(1.152)
13. I never vaccinate my animals	2	2	2.143	1.952	2*
	(1.054)	(1.378)	(1.676)	(1.161)	(1.259)
14. I never call a veterinarian to my livestock production	1.8	1.667	2.143	2.048	1.881*
	(1.033)	(0.966)	(1.345)	(1.284)	(1.131)
15. I do not invest in farm operation to create opportunities for expansion	3.5	2.953	2.429	2.619	2.864
	(1.179)	(1.322)	(1.134)	(1.071)	(1.210)
16. I do not participate in trainings relevant to my dairy business on a regular basis	2.4	2.714	2.714	2.476	2.576*
	(1.075)	(1.102)	(1.380)	(1.078)	(1.102)
17. My animals are to some extent kept in free-range system	2.7	2.857	1.714	2.143	2.441*
	(1.418)	(1.062)	(0.756)	(1.195)	(1.193)
18. I do not produce highest possible quality even if it means higher cost	3.3	2.762	2.571	2.571	2.763*
	(0.982)	(1.261)	(1.272)	(1.326)	(1.236)
19. There is nobody else in the family who has a greater interest in dairy husbandry	1.7	2.476	2.857	3.238	2.661**
	(0.483)	(1.078)	(1.345)	(1.446)	(1.281)
20. I never consult a veterinarian or scientist before taking a major decision for the dairy enterprise	2.6	1.905	2.286	2.190	2.169*
	(1.350)	(1.044)	(1.113)	(1.123)	(1.132)
21. My animals are often sick	2.3	2.286	3	2.286	2.373*
	(1.252)	(1.146)	(1.528)	(1.231)	(1.230)
22. Productivity of any animals are very low	2.9	2.714	2.714	2.524	2.678**
	(1.524)	(1.102)	(0.951)	(1.365)	(1.238)
23. I never invest the greater share of income to outside dairy enterprise	3.5	3.095	3.143	3.048	3.153
	(1.269)	(1.338)	(1.069)	(1.244)	(1.243)
24. My animals never have plenty of bedding	2.4	2.286	3.714	2.429	2.525*
	(1.075)	(1.231)	(0.796)	(1.287)	(1.238)
25. I never have larger capacity to store manure than necessary	3	2.476	3	2.190	2.525*
	(1.247)	(1.167)	(1.155)	(1.289)	(1.237)
26. I do not have a thorough and well-documented supervision of my animal production	3.6	2.476	3.714	2.333	2.763***
	(0.843)	(1.030)	(0.756)	(1.390)	(1.236)
27. I do not grow fodder crops in between paddyand rice	2.9	2.667	2.429	2.190	2.508*
	(1.197)	(1.155)	(1.618)	(1.167)	(1.223)
28. I never go for urea treatment of dry fodder	3.6	2.571	3.714	2.810	2.966
	(1.265)	(1.076)	(0.951)	(1.470)	(1.299)
29. I never use HYV fodder seed	3.4	2.048	2.714	1.762	2.254*
	(0.966)	(0.921)	(1.604)	(1.221)	(1.254)
30. I never go for AI with high quality semen	3.7	2.667	2.143	2.381	2.678**
	(0.949)	(1.278)	(1.464)	(1.396)	(1.357)
31. I never feed adequate concentrate to pregnant and lactating animal	2	1.762	2.286	2.286	2.051*
	(0.667)	(0.889)	(1.127)	(1.586)	(1.181)

Figures in parentheses indicate standard deviations
Significant at * 1% level of significance; ** 5% level of significance and * 10% level of significance**

Table 4: Corrected item score correlation

Items	CISC
1. I never insure my animals	0.437
2. I am the first producer in my village to adopt a new technology	0.038
3. I never have enough cash on hand that can be easily converted to cash to pay all my debts	0.328
4. I never enter into future contract in marketing livestock/livestock products	0.119
5. I do not have adequate life insurance	0.441
6. I never spread the milk production from the animals throughout the year	0.288
7. Off-farm income is not important for the financial survival of my family	0.052
8. In case of emergency, I do not have sufficient back-up management/labour to carry on production	0.417
9. I use very specialized machinery for my production practices	-0.019
10. I prefer investing in Crossbred animals	0.006
11. I never enter into contact with any input suppliers	0.464
12. I am not a low-cost producer	0.202
13. I never vaccinate my animals	0.460
14. I never call a veterinarian to my livestock production	0.504
15. I do not invest in farm operation to create opportunities for expansion	0.387
16. I do not participate in trainings relevant to my dairy business on a regular basis	0.318
17. My animals are to some extent kept in free-range system	-0.239
18. I do not produce highest possible quality even if it means higher cost	0.322
19. There is nobody else in the family who has a greater interest in dairy husbandry	0.143
20. I never consult a veterinarian or scientist before taking a major decision for the dairy enterprise	0.590
21. My animals are often sick	0.262
22. Productivity of any animals are very low	0.066
23. I never invest the greater share of income to outside dairy enterprise	0.095
24. My animals never have plenty of bedding	0.295
25. I never have larger capacity to store manure than necessary	0.418
26. I do not have a thorough and well-documented supervision of my animal production	0.405
27. I do not grow fodder crops in between paddy and rice	0.254
28. I never go for urea treatment of dry fodder	0.375
29. I never use HYV fodder seed	0.223
30. I never go for AI with high quality semen	0.394
31. I never feed adequate concentrate to pregnant and lactating animal	0.310
Cronbach's Coefficient alpha	**0.783**

Table 5: Refined set of statements for risk attitude scale

Statements	24-item scale	22-item scale	21-item scale	20-item scale
	CISC	CISC	CISC	CISC
1. I never insure my animals	0.452	0.420	0.431	0.441
3. I never have enough cash on hand that can be easily converted to cash to pay all my debts	0.367	0.369	0.353	0.359
4. I never enter into future contract in marketing livestock/livestock products	0.147	-	-	-
5. I do not have adequate life insurance	0.473	0.464	0.459	0.450
6. I never spread the milk production from the animals throughout the year	0.297	0.275	0.274	0.282
8. In case of emergency, I do not have sufficient back-up management/labour to carry on production	0.442	0.439	0.442	0.444
11. I never enter into contact with any input suppliers	0.484	0.479	0.469	0.470
12. I am not a low-cost producer	0.237	0.251	-	-
13. I never vaccinate my animals	0.422	0.424	0.434	0.434
14. I never call a veterinarian to my livestock production	0.490	0.488	0.484	0.490
15. I do not invest in farm operation to create opportunities for expansion	0.443	0.457	0.445	0.430
16. I do not participate in trainings relevant to my dairy business on a regular basis	0.330	0.333	0.312	0.311
18. I do not produce highest possible quality even if it means higher cost	0.363	0.382	0.355	0.370
19. There is nobody else in the family who has a greater interest in dairy husbandry	0.083	-	-	-
20. I never consult a veterinarian or scientist before taking a major decision for the dairy enterprise	0.567	0.591	0.570	0.573
21. My animals are often sick	0.250	0.282	0.254	0.268
24. My animals never have plenty of bedding	0.278	0.281	0.292	0.306
25. I never have larger capacity to store manure than necessary	0.395	0.395	0.410	0.394
26. I do not have a thorough and well-documented supervision of my animal production	0.422	0.424	0.434	0.452
27. I do not grow fodder crops in between paddy and rice	0.248	0.272	0.275	0.243
28. I never go for urea treatment of dry fodder	0.359	0.371	0.366	0.372
29. I never use HYV fodder seed	0.253	0.285	0.251	-
30. I never go for AI with high quality semen	0.419	0.438	0.434	0.427
31. I never feed adequate concentrate to pregnant and lactating animal	0.244	0.243	0.257	0.265
Aggregate coefficient alpha	0.842	0.85	0.849	0.847

Table 6: Zero-Order Correlation matrix among different statements of the 22-item scale

Statements	3	5	6	8	11	12	13	14	15	16	18	20	21	24	25	26	27	28	29	30	31
1	**0.306[b]**	**0.231[c]**	0.178	**0.336[a]**	**0.264[b]**	0.015	**0.232[c]**	0.132	**0.293[b]**	0.164	0.186	**0.464[a]**	0.090	0.182	**0.454[a]**	**0.449[a]**	0.196	**0.247[c]**	0.002	**0.423[a]**	0.029
3		0.142	**0.405[a]**	**0.300[b]**	**0.297[b]**	**0.242[c]**	**0.232[c]**	0.165	**0.316[b]**	0.103	0.130	0.177	0.042	**0.259[b]**	0.065	**0.244[c]**	0.215	0.139	0.110	0.112	**0.220[c]**
5			**0.280[b]**	**0.296[b]**	**0.511[a]**	**0.259[b]**	**0.414[a]**	**0.319[b]**	**0.356[a]**	0.198	**0.324[b]**	**0.304[b]**	0.195	0.037	**0.325[b]**	**0.268[b]**	0.035	**0.217[c]**	**0.230[c]**	**0.335[b]**	0.030
6				-0.034	**0.342[a]**	0.042	0.150	0.197	**0.238[c]**	0.080	0.109	0.170	0.141	0.140	0.064	0.196	0.051	**0.225[c]**	0.057	0.148	-0.004
8					**0.338[a]**	0.156	**0.277[b]**	**0.380[a]**	**0.258[b]**	**0.240[c]**	**0.257[b]**	**0.320[b]**	**0.254[c]**	**0.242[c]**	0.190	**0.246[c]**	**0.254[c]**	**0.256[b]**	0.078	0.191	**0.233[c]**
11						**0.345[a]**	**0.243[c]**	**0.269[b]**	**0.286[b]**	0.174	0.163	**0.264[b]**	0.134	**0.291[b]**	0.173	0.198	0.197	**0.466[a]**	0.084	**0.269[b]**	0.129
12							-0.005	0.142	**0.229[c]**	**0.303[b]**	0.174	**0.289[b]**	**0.318[b]**	-0.087	-0.099	0.077	0.007	0.099	0.141	**0.248[c]**	-0.107
13								**0.642[a]**	0.158	**0.236[c]**	**0.321[b]**	**0.399[a]**	0.167	0.122	0.133	**0.255[c]**	**0.230[c]**	0.021	0.164	**0.242[c]**	**0.325[a]**
14									**0.265[b]**	**0.443[a]**	**0.312[b]**	**0.461[a]**	**0.243[c]**	0.193	0.156	0.214	0.107	0.068	0.155	0.188	**0.482[a]**
15										**0.461[a]**	**0.381[a]**	**0.256[b]**	0.035	0.002	**0.267[b]**	0.093	0.176	**0.304[b]**	**0.364[a]**	**0.424[a]**	0.029
16											0.140	**0.294[b]**	0.208	0.052	0.128	0.039	-0.183	**0.279[b]**	0.167	0.103	0.136
18												**0.350[a]**	**0.240[c]**	-0.007	**0.286[b]**	0.041	**0.300[b]**	0.027	0.206	**0.313[b]**	0.091
20													**0.412[a]**	**0.268[b]**	**0.292[b]**	**0.485[a]**	0.099	**0.262[b]**	0.188	**0.575[a]**	**0.264[b]**
21														**0.311[b]**	0.039	**0.252[c]**	**-0.23[c]**	0.213	-0.107	0.125	0.129
24															**0.245[c]**	**0.230[c]**	0.071	**0.269[b]**	-0.021	-0.001	0.359
25																**0.365[a]**	**0.470[a]**	0.194	**0.346[a]**	**0.308[b]**	-0.007
26																	0.184	0.199	**0.329[b]**	**0.303[b]**	0.079
27																		0.076	**0.465[a]**	0.215	0.030
28																			0.122	**0.277[b]**	0.249c
29																				0.170	0.003
30																					0.053

Significant at: [a]1% level; [b] 5% level of significance and [c] 10% level of significance

Table 7: Linear regression results on factors affecting risk attitudes

Variables	Regression coefficients
(Y) Total risk attitudinal score	
(a) Intercept	69.28 (8.79)
(X_1) Landholding (ha)	1.20 (1.684)
(X_2) Herd size (No. of milch animals)	-1.05** (0.548)
(X_3) Off-farm work (Hrs. spent)	-2.73* (0.406)
(X_4) Share of milk in gross farm income	-5.73 (5.793)
(X_5)Number of dependents (Adult equivalents)	0.96*** (0.669)
(X_6) Age of head of household (Years)	0.16 (0.14)
Coefficient of Multiple determination (R^2)	0.545

* Significant at * 1% level of significance; ** 5% level of significance and *** 10% level of significance
Figures in parentheses are standard errors of regression coefficients

Table 8: Distribution of respondents according to their perception about relevance of different risk management strategies[@]

Risk management strategies	Irrelevant	Somewhat irrelevant	Neutral	Somewhat relevant	Relevant	Average score
1. Producing at lowest possible cost	3 (5.08)	3 (5.08)	13 (22.03)	11 (18.64)	29 (49.15)	4.017* (1.181)
2. Buying livestock insurance	19 (32.20)	3 (5.08)	15 (25.42)	16 (27.12)	6 (10.17)	2.780 (1.415)
3. Buying personal insurance	8 (13.56)	- (0)	11 (18.64)	14 (23.73)	26 (44.07)	3.847* (1.362)
4. Applying strict hygiene rules	2 (3.39)	3 (5.08)	7 (11.86)	10 (16.95)	37 (62.71)	4.305* (1.087)
5. Price contract for outputs	10 (16.95)	4 (6.78)	25 (47.46)	6 (10.17)	14 (23.73)	3.153 (1.362)
6. Price contracts for inputs	13 (22.03)	- (0)	22 (37.29)	12 (20.34)	12 (20.34)	3.203** (1.349)
7. Diversification	14 (23.73)	2 (3.39)	25 (47.46)	5 (8.47)	13 (22.03)	3.068 (1.425)
8. Off-farm employment	15 (25.42)	1 (1.69)	14 (23.73)	18 (30.55)	11 (18.64)	3.353** (1.448)
9. Carrying adequate cash reserve	4 (6.78)	2 (3.39)	13 (22.03)	18 (30.51)	22 (37.29)	3.932* (1.143)

Figures in parentheses indicate percentage of total number of farmers
Figures in parentheses in column of Average Score indicate Standard Deviations
Significant difference from the neutral score at *1% level of significance; ** 10% level of significance
[@]choice of risk management strategy is independent of landholding ($\chi^2 = 10.907$, P> 0.1)