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Risk Attitude and Risk Management Strategies: An Analysis of Dairy Farmers in Tarai Area of Uttaranchal State

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I

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

Against this background, 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 the farmers' risk

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attitude, (iii) identify the factors that affect risk attitudes and (iv) evaluate the relative importance of different risk management strategies.

II

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 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. A complete enumeration of all the farmers having at least one milch animal was done and the farmers were categorised 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 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.

TABLE 1. AVERAGE NUMBER OF MILCH ANIMAL HOLDING PER HOUSEHOLD

Category	Average land holding (ha)	Average herd size
(1)	(2)	(3)
Landless	-	1.70
Marginal	1.08	2.95
Small	3.31	3.14
Large	6.29	3.23
Pooled	3.02	2.86

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

For assessing the respondents' perception regarding various sources of risk, the 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). The significance of difference of the estimated average score from neutral score was tested using 't' test.

How a question regarding a particular source of risk (say, milk yield variability) was posed before the respondent along with the choice options is illustrated below.

Statement/Response	Irrelevant	Somewhat irrelevant	Undecided	Somewhat relevant	Relevant
What is your perception about 'milk yield variability' as a source of risk in dairy farming?	1	2	3	4	5

Figures in boxes indicate the score assigned to a specific risk perception response.

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. Their response 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. The underlying assumption in this method of measuring the risk attitude is that if the 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. This methodology of developing a risk attitudinal scale was used by Bard and Berry (2000), Lagerkvist (2005) and Meuwissen *et al.* (1999).

The widely used Likert's scale was used as it was more suitable for measuring an individual's attitude as established by Chattopadhyay (1963), Samanta (1977) and Bhattacharya (1993). The responses were measured on a 5-point scale. A strong disagreement (score of 1) implied the willingness of the farmer to adopt the risk management tool in question (risk aversion). On the other hand, a 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 respondents is then hypothesised to correspond to higher degree of risk aversion. While administering the schedule, both positive and negative statements were included to avoid response bias.

The following examples would make clear how the farmer's response to a particular risk management tool reflects his attitude towards risk.

1. For e.g. consider statement 1 'I never insure my animals'. Strong disagreement to this statement (score of 1) would imply that the farmer has adopted this particular risk coping strategy. This reflects a 'risk aversion' attitude. On the other hand, strong agreement (score of 5) would reflect that the farmer is disinclined to adopt this risk mitigating tool. This naturally implies a 'risk taking attitude'.

2. Statements 13, 14, 24, 25, 29 and 31 (Table 3) all reflect those risk management tools that the farmers themselves can adopt at the farm level to mitigate the production risks. Strong disagreement with these statements

would imply that the farmers are willing to adopt the particular risk management tool in question, viz., vaccination, calling a veterinarian, providing adequate bedding to animals, having large capacity to store manure, using high-yielding variety (HYV) fodder seeds and providing adequate concentrate to pregnant animals. This reflects a 'risk aversion' attitude. Strong agreements on the other hand would imply that the farmers are not willing to adopt these risk mitigating tools and hence reflect 'risk taking' attitude.

It should be noted that for ascertaining how relevant different sources of risks are, the scores for each source of risk are aggregated across all respondents and the inference is drawn on the basis of the mean score. Similarly, for measuring the risk attitude of the farmers, the responses of every farmer is summed across all the items in the scale to form a total score. This procedure is purely descriptive. Nonetheless, it allows the scores for sources of risks and respondents' scores to be grouped in broad descriptive categories and scaled for comparison across sources of risk and respondents' scores.

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 correspondents 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 analyse the extent to which the total risk attitudinal score is related to different categories of respondents, in this study for different categories of farmers based on their landholdings. Convergent validity testing measures how different are 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 the i-th 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 optimised 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 hypothesised 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 analysed 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.

III

RESULTS AND DISCUSSION

(i) *Sources of Risk*

The 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, the 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 the family (80 per cent of respondents), animal diseases (79 per cent of respondents), distant location of Artificial Insemination (AI) centres (69 per cent of respondents) and lack of extension support (66 per cent 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

TABLE 2. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR PERCEPTION OF RELEVANCE OF DIFFERENT SOURCES OF RISK

Sources of risk (1)	Irrelevant (2)	Somewhat irrelevant (3)	Neutral (3)	Somewhat relevant (4)	Relevant (5)	Average ccore (6)
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 the 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.
** and * indicate significant difference from the neutral score at 5 and 1 per cent level of significance.

farmers were changes in the consumer preferences for milk and milk products (44 per cent of respondents), poor conception rate due to AI (44 per cent of respondents) and adoption of crossbred animals (50 per cent of respondents). The average scores estimated for each source of risk exceeded the neutral score of 3 significantly at 1 per cent or 5 per cent level of significance. Interestingly, the highest score appeared in case of the health situation of the 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 the 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. The 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 the earlier findings (Bardhan *et al.,* 2005), which cited some problems in the pricing mechanism of the dairy co-operatives, viz., fixing non-remunerative prices by the co-operatives in comparison to the cost of milk production, seasonal variability in the 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, lower the score for an individual statement, more likely the farmer is going to adopt or utilise 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 and 10. The average score ranged between 3.322 and 3.9 for these statements. Thus, farmers showed

TABLE 3. MEAN AND STANDARD DEVIATIONS OF RISK ATTITUDE STATEMENTS

Statements (1)	Category				
	Landless (2)	Marginal (3)	Small (4)	Large (5)	Overall (6)
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 new technology	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 specialised machinery for my production practices	2.1	3.286	4.286	4.048	3.075
	(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 contract 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)

(Contd.)

TABLE 3. *(Concld.)*

Statements (1)	Category				
	Landless (2)	Marginal (3)	Small (4)	Large (5)	Overall (6)
24. My animals never have plenty of bedding	2.4 (1.075)	2.286 (1.231)	3.714 (0.796)	2.429 (1.287)	2.525* (1.238)
25. I never have larger capacity to store manure than necessary	3 (1.247)	2.476 (1.167)	3 (1.155)	2.190 (1.289)	2.525* (1.237)
26. I do not have a thorough and well-documented supervision of my animal production	3.6 (0.843)	2.476 (1.030)	3.714 (0.756)	2.333 (1.390)	2.763*** (1.236)
27. I do not grow fodder crops in between paddy and rice	2.9 (1.197)	2.667 (1.155)	2.429 (1.618)	2.190 (1.167)	2.508* (1.223)
28. I never go for urea treatment of dry fodder	3.6 (1.265)	2.571 (1.076)	3.714 (0.951)	2.810 (1.470)	2.966 (1.299)
29. I never use HYV fodder seed	3.4 (0.966)	2.048 (0.921)	2.714 (1.604)	1.762 (1.221)	2.254* (1.254)
30. I never go for AI with high quality semen	3.7 (0.949)	2.667 (1.278)	2.143 (1.464)	2.381 (1.396)	2.678** (1.357)
31. I never feed adequate concentrate to pregnant and lactating animal	2 (0.667)	1.762 (0.889)	2.286 (1.127)	2.286 (1.586)	2.051* (1.181)

Figures in parentheses indicate standard deviations.
***, ** and * Significant at 10, 5 and 1 per cent level, respectively.

disinclination towards the implementation of practices like insuring animals (Statement 1). Statement 10 was positively worded. Thus, agreement with the statement implied that the farmers were inclined to invest in cross-bred animals. These high scores suggest that farmers were not risk averse in respect of these two 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 futures 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-yielding variety (HYV) fodder seeds, going for AI with improved quality semen and giving adequate concentrates to animals were utilised 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 optimise 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 per cent of total variation of risk attitude. Therefore, the scale was optimised 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 optimised 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

TABLE 4. CORRECTED ITEM SCORE CORRELATION

Items (1)	CISC (2)
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 contract 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

	24-item scale	22-item scale	21-item scale	20-item scale
Statements (1)	CISC (2)	CISC (3)	CISC (4)	CISC (5)
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 contract 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 (1)	3 (2)	5 (3)	6 (4)	8 (5)	11 (6)	12 (7)	13 (8)	14 (9)	15 (10)	16 (11)	18 (12)	20 (13)	21 (14)	24 (15)	25 (16)	26 (17)	27 (18)	28 (19)	29 (20)	30 (21)	31 (22)
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]	0.249[c]
29																				0.170	0.003
30																					0.053

a, b, c Significant at 1, 5 and 10 per cent level of significance, respectively.

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 optimised 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 per cent) and Lagerkvist, 2005 (83 per cent). 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 per cent) were found to be statistically significant at either 1, 5 or 10 per cent 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 land holdings.

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. The 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. Land holding size was not found to be a significant factor. This result supports the result of construct validity testing in the 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.

TABLE 7. LINEAR REGRESSION RESULTS ON FACTORS AFFECTING RISK ATTITUDES

Variables (1)	Regression coefficients (2)
(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

***, ** and * Significant at 1, 5 and 10 per cent level of significance.
Figures in parentheses are standard errors of regression coefficients.

(iv) *Risk Management Strategies*

The 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 the case of six strategies, viz., producing at the least possible cost, buying personal insurance, applying strict hygienic rules, price contracts for outputs, 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 subsistence farmers 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 inputs 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 the perception of risk management strategies of the farmers were dependent upon their land holding. The results confirmed the earlier findings in this study that the perception of risk management strategies was independent of the category of farmers based on the size of land holdings.

TABLE 8. DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR PERCEPTION ABOUT RELEVANCE OF DIFFERENT RISK MANAGEMENT STRATEGIES[@]

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

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

IV

CONCLUSION

The 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 the 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 per cent, which is higher than the minimally acceptable range of 65 per cent to 70 per cent.

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 takers 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 the 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 subsistence farmers cannot afford to hold cash reserve to counter risk.

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