



Sources of risks in livestock production and their management strategies in northern India

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Received: 12 October 2017; Accepted: 14 December 2017

ABSTRACT

This study was undertaken to analyze the opinion on risks sources and their management strategies in livestock enterprises. Data collected through a field survey conducted in Haryana and Rajasthan in 2015–16 from 913 livestock farmers on structured schedule forms the basis of this paper. Rajasthan depicts dry and harsh tract and Haryana with assured irrigated, and both contribute significant share in milk production. The socio-economic and demographic factors did not vary significantly except milk yield, experience in dairy, annual income for different categories of farmers. Our observation indicated that livestock owner faced risks from different sources, viz. breeding, animal health, marketing, institutional and policy related. Further risk management strategies including better breed, animal health checkup, seeking advice of veterinary expert, friend consultations, forward selling contracts, maintenance of farm inventory, accessibility to different financial, extension and government institutions etc. were adopted to cope up with risks in livestock enterprise. The determinants of source of risks were significantly influenced by a number of socio-economic and demographic characteristics. The herd size had negative relation with extent of various risks. Rajasthan farmers face higher degree of risk than Haryana. Higher education status also indicated that the lower risks and other factors like knowledge level and milk yield indicated positive influence of source of risks means higher knowledge level and yield, reduce the risks. The policy makers and researchers should see the solutions and options to minimize the source of risks in livestock production and management.

Key words: India, Livestock farming, Perception, Risk management strategies, Source of risks

Livestock production in smallholder production systems is vulnerable to a number of biotic and abiotic stresses, such as frequent occurrence of diseases and inadequate supplies of feed and nutrients that restrict realization of the production potential of animals. In addition, climate is emerging as a big threat to the sustainability of livestock production system. Climate change will affect livestock production through competition for natural resources, quantity and quality of feeds, livestock diseases, heat stress and biodiversity loss while the demand for livestock products is expected to increase by 100% by mid of the 21st century (Garnett 2009). These affect not only livelihood only of the livestock producers but also of all the stakeholders on livestock value chain, especially consumers. Reduction in supply raises product prices forcing consumers either to pay more or consume less. The consumption of disease-infected animals may adversely affect human health. Likewise, other stakeholders on the value chains especially those engaged in product marketing also face a squeeze in their incomes.

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In India, livestock besides being an important source of food, make significant contribution (>25%) to agricultural gross domestic product. Nonetheless, the importance of livestock goes beyond its food and income contribution. The distribution of livestock is more egalitarian than arable land, and at similar rate of growth, the livestock income has a larger effect on poverty reduction that does the growth in crop income (BIRTHAL and NEGI 2012). Livestock production in India is largely in the domain of women, and thus helps empower rural women (Jaya and BIRTHAL 2015). BIRTHAL and NEGI (2012) observed livestock income less susceptible to weather shocks compared to crop income, and thus sustains agricultural growth and smoothed household consumption.

Livestock in India, however, are low-yielding and livestock producers face several risks or constraints related to animal health, nutrition and breeding in improving livestock productivity. The empirical evidence on the production losses in livestock is scarce and anecdotal. In their seminal work, BIRTHAL and JHA (2008) estimated that more than 26% of the milk production in India was lost due to these constraints, and half of these was due to insufficient availability of feed and fodder, and the rest were shared by diseases (21%), breeding problems (18%) and inappropriate management (11%). Their study also provides

estimates of losses disaggregated by the type of constraint or risk challenging improvements in livestock productivity. Other studies have estimated losses in species-specific production loss due to one or the other disease and at regional level. For example, Singh *et al.* (2013) provide estimates of losses due to FMD in livestock; Mahajan *et al.* (2013) due to *peste des petits* in small ruminants in the state of Jammu and Kashmir, and Ganesh Kumar *et al.* (2008) due to avian influenza in Manipur. The morbidity and mortality rates in bovines was accounted for 31% and 9% respectively in Himachal Pradesh (Chaudhary *et al.* 2013).

The demand for animal food products is fast growing fast and so is consumers' awareness about food safety (Kumar *et al.* 2017 and Kumar and Joshi 2016). It is, therefore, important to identify the source of risks to livestock production and alleviate these through appropriate management and institutional interventions. The investigation on risk perceptions on livestock faces numerous challenges, which primarily arise from the fact that livestock researcher commonly form risk perceptions intuitively. Further, there is a common perception that farmers in developing countries are risk-averse and are reluctant to adopt new methods to manage risks because of their less capacity to manage these. In this paper, based on a survey of livestock producers on their perceptions about the risks, and the responses to manage these, we tried to understand the nature of livestock risk that farmer face and the strategies to manage risks.

MATERIALS AND METHODS

Primary data collected in 2015–16 from livestock producers in two north-western states, viz. Haryana and Rajasthan, as a part of a larger study that aimed at understanding the efficiency and inclusiveness of livestock service delivery systems there forms the basis of this paper. These states differ in their agro-climatic conditions and socio-economic development. The normal rainfall in both the states is almost similar (617 mm in Haryana and 594 mm in Rajasthan), but Haryana has 85% of its area under irrigation, compared to 41% in Rajasthan. Rajasthan faces a drought or drought-like situation once in every three years, while a higher level of irrigation in Haryana provides farmers protection against such extreme events. Rice and wheat are the dominant crops in Haryana, while the cropping pattern in Rajasthan is dominated by coarse cereals such as pearl-millet. Feed and fodder availability is much better in Haryana, but Rajasthan is acutely scarce in feed and fodder (Chand *et al.* 2016, Chand and Kumar 2016). Notwithstanding these differences, animal husbandry is an important source of livelihood in both the states. It contributes 24.2% to the gross domestic product for Haryana and 18.5% for Rajasthan. Markets for livestock products are also fairly well-developed in both the states. Per capita milk availability is 767 g in Haryana, and 555g in Rajasthan. However, Wool production is maximum in Rajasthan (basic statistics various issues; 19th Livestock Census 2012).

Dairying is the most reliable source of earning to the farmers in Rajasthan but with disappearing grazing land, restricted forest and stall feeding, the bovine are facing a severe shortage of fodder. With this background, this study was planned.

A multistage random sampling technique was adopted to select the districts, tehsils and villages. Two districts from each state (Yamuna Nagar and Kaithal from Haryana, and Udaipur and Bikaner from Rajasthan) were selected randomly. Subsequently, three tehsils from each district were selected to capture the wide range of farmers and then 1–2 villages from each selected tehsil were chosen randomly. Further, from each village, 50 farmers who had at least one milch animal at the time of survey were selected. Thus, sample comprised 1000 households, 500 from each state. However, 87 households were dropped because of their incompleteness or poor quality information. In this survey, besides the information of livestock services, some questions related to risks and risks management strategies were also included. Based on the total number of bovines, the sample households were post-classified into three categories, viz. small (≤ 3 animals), medium (4 to 5 animals) and large (≥ 6 animals). The data-set included information on personal and household characteristics of the livestock owners such as age and education of the household-head, landholding size, herd size and its composition, sources of risk in livestock production and their management strategies etc.

The sources of risks were grouped into four, viz. breeding related risks, health & disease risks, market risks and institutions and policy risks. The open ended questions were asked to the respondents to rate the different source of risks. Similarly, risks management strategies adopted and need to be adopted were rated on five point scale. The items measured using Likert type scale which is the most widely used approach to scaling responses in survey research and is often used interchangeably with rating scale. The scale is named after its inventor, psychologist Rensis Likert, and these were treated as continuous variable (Lien *et al.* 2007, Meuwssen *et al.* 2001, Patrick and Musser 1997). The five point scale on sources of risks used was not important = 1, somewhat not important = 2, neutral = 3, somewhat important = 4 and very important = 5. Likewise, farmers' opinion on risks management strategies and their importance were analysed on a five point scale as not useful = 1, somewhat not useful = 2, neutral = 3, somewhat useful = 4 and very useful = 5 (Similar methodology was adopted by Khan *et al.* 2014).

The econometric analysis was carried out to identify the determinants influencing of source of risks and its management as given below.

$$Y_w = \alpha + \beta_1 (\text{Experience}) + \beta_2 (\text{Education}) + \beta_3 (\text{Land holding size}) + \beta_4 (\text{No. of livestock}) + \beta_5 (\text{Milk yield}) + \beta_6 (D_1) + \beta_7 (D_2) + \beta_8 (D_3) + \beta_9 (D_4) + e_i \quad \dots (1)$$

where, Y_w , Weighted average of i^{th} respondent on source of risks (The weights were given based on the proportion

of risks in different sources); X_1 , experience in livestock farming in years; X_2 , education level in years (No. of schooling years); X_3 , land holding size (ha); X_4 , total no. of livestock; X_5 , milk yield in litres; D_1 , state dummy (if Rajasthan then 1, otherwise 0); D_2 , gender dummy (if female then 1, otherwise 0); D_3 , occupation status dummy (if livestock + agriculture then 1, otherwise 0); D_4 , knowledge about risks aversion schemes of the i_{th} respondent dummy (if Yes then 1, otherwise 0); e_i , random error term.

RESULTS AND DISCUSSION

Socio-economic characteristics of households: Table 1 presents key descriptive statistics with level of significance on characteristics of sample households by their herd class, i.e. small, medium and large. About 44.5% households were small livestock producers, followed by medium (30.4%) and large (25.01%) livestock producers. On an average, about 60% of household-head were literate. The incidence of illiteracy however was higher among small livestock producers and about half of them had not acquired any formal schooling, as compared to 35% of the medium and 25% of the large livestock producers. The importance of animal husbandry was also quite high among medium farmers. Large livestock producers, on the other hand, were more engaged in agriculture than in animal husbandry. The family size was significantly larger among the large producers. Average milk yield was about 5.8 liters per animal per day for sample as a whole. Nonetheless, it was positively associated with herd size. Animal housing conditions were also better among the large livestock

producers perhaps because of their better economic condition as shown by a higher level of assets and income. Further, about 70% of the farmers had availed credit from different formal sources. However, the availability of formal credit was positively associated with herd size. Partap *et al.* (2017) observed that half of the sample dairy farmers of Punjab finance their dairy activities borrowing from the formal as well as informal sources.

The financing by commercial banks was limited and biased in favour of resource rich dairy farms. Similarly, large livestock producers had a greater access to extension and trainings. The distance was one of the determinants of accessing of livestock services. Hence, our study indicated that farmers had to travel in the range of 5 to 10 km to avail the extension and other services. The service providers were remotely located in Rajasthan. However, for Haryana, distance covered to access the livestock services was less.

Sources of risks in livestock production: The respondents who responded on open ended questions were post classified based on their opinion on different source of risks. The information elicit the arrange score of sample households who participated in survey and their opinion was measured on five point scale along with standard deviations. Further, interpretation of Standard Deviation (SD) value indicates that if SD value is more than one for the respective risk, more disparity exists among the farmers opinion. These perceptions on source of risk related to breeding, health, marketing, institutions and policy risks are presented in Table 2. The weighted average was converted into percentage. The breeding services in livestock sector have

Table 1. Socio-economic features of the sample respondents

Indicator	Small (N=406)	Medium (N=278)	Large (N=203)	Overall (N=913)	F/ χ^2 value
<i>Education level (%)</i>					1.26*
Illiterate	49.6	35.2	24.6	39.7	
Below Primary	12.8	13.5	14.8	10.2	
Secondary	18.5	15.9	9.9	15.9	
Senior Secondary	17.8	25.4	27.7	22.1	
Above Sr. Secondary	1.3	10.1	23.2	9.0	
Subsidiary	41.1	52.6	67.2	50.2	
Experience (years)	37.8	38.4	36.6	37.7	1.559
Family size (no.)	4.4	4.5	4.7	4.5**	3.148
Total land (ha)	3.2	2.8	3.4	3.1***	2.433
Total livestock	2.53	4.43	8.59	632.23*	632.63
Average yield (litre/day)	5.58	5.76	6.43	5.80*	7.288
<i>Family headed by (%)</i>					1.035#
Male	95.4	93.2	96.1	94.9	
Female	4.6	6.8	3.9	5.1	
Value of farm assets (₹ 00000s)	1.59	3.89	7.98	3.71*	2.43
<i>Condition of cattle shed (%)</i>					1.268
Pucca shed	55.6	62.8	88.9	65.2**	
Kuchha shed	44.4	37.2	11.1	35.0	
<i>Distance from main market (% farmer)</i>					2.589#
<5 km	19.5	18.6	20.7	19.4	
5–10 km	15.4	22.5	25.3	19.9	
>10 km	65.1	58.9	54.3	60.7	

#Frequency used; *, **, ***represent the level of significance at 1% and 5%, 10%.

played a very crucial role in bringing country at top in terms of milk production in the world. Development of location specific breeds, the accessibility of breeding services has helped livestock owner to maintain high yielding animals. However, breeding related risks trigger the major shocks to the farmers during entire period. The source of risks in livestock production perceived by the small farmers as somewhat useful to very useful were repeat breeding (76%),

delay in breeding services accessibility (64%), lack of knowledge on heat detection (84%). While farmers had different sources of risks which were somewhat not useful and not useful at all for breeding services ranged from 16 to 36% in same category of farmers. The medium and large farmers perceived these sources of risks as somewhat useful and very useful and were in the range of 62 to 87%. However, the opinions of not useful and somewhat not

Table 2. Source of risks in livestock production

Source of risk	Small		Medium		Large		Overall	
	Score	SD	Score	SD	Score	SD	Score	SD
<i>Breeding related</i>								
Repeat breeding	4.65	1.15	3.89	0.83	4.15	0.85	4.31	0.99
Delay in breeding services accessibility	3.86	0.84	4.05	0.73	3.65	0.85	3.87	0.81
Knowledge about timely animal heat detection	4.39	1.11	3.65	0.89	4.78	0.85	4.25	0.99
Pre-delivery complications	2.65	0.72	4.81	1.25	3.17	0.86	3.42	0.91
<i>Animal health related</i>								
Delay in accessibility of health services	4.87	1.43	3.63	1.43	4.98	0.83	4.52	1.30
Incidences of livestock diseases	3.81	0.83	2.55	0.83	3.86	0.73	3.44	0.81
Accidental injury to animal	3.56	0.73	2.85	0.73	3.65	0.89	3.36	0.77
Financial hardship to maintain good animal health	4.54	0.89	3.78	0.89	4.71	1.25	4.35	0.97
Poor health services in rural areas	3.87	1.25	4.86	1.25	3.89	0.71	4.18	1.13
Non-availability of vet. doctors in the centres	3.45	0.71	3.56	0.71	3.55	0.83	3.51	0.74
Nutritional deficiencies	3.42	0.83	2.11	0.83	3.56	0.89	3.05	0.84
Poor infrastructure to face hardship in harsh weather	4.54	0.89	4.51	0.89	4.65	0.87	4.56	0.89
<i>Market related</i>								
Fluctuations in milk prices	3.75	0.91	3.84	0.91	3.85	0.83	3.80	0.89
Animal milk yield reduction	4.45	1.11	4.15	0.83	4.63	0.89	4.40	0.98
Difficulties in marketing of livestock products	3.89	0.85	3.87	0.73	3.98	0.83	3.90	0.81
Consumer preference biasness	3.91	0.85	4.01	0.89	3.95	0.73	3.95	0.84
Fear of increasing inputs price	3.85	0.85	3.87	1.25	3.86	0.89	3.86	0.98
Fear of reduction in fodder production	3.9	0.86	4.21	0.71	4.61	1.25	4.15	0.90
Increasing feed cost	4.88	1.23	4.65	0.83	4.98	0.71	4.83	0.99
Increasing expenses of supervision	3.89	1.13	3.92	0.89	3.92	1.13	3.91	1.06
Declining grasslands/pastures	3.92	0.87	3.89	0.87	3.98	0.87	3.92	0.87
Increasing trend in labour wages	3.12	1.11	4.26	0.83	4.32	1.11	4.21	1.02
Fear of change in technology	3.84	1.12	3.45	0.89	4.65	1.12	3.90	1.05
<i>Institutions and policy related</i>								
Limited accessibility of financial services	4.32	1.13	4.56	0.71	4.44	0.73	4.42	0.91
Limited accessibility of extension services	3.81	0.85	3.86	0.83	4.06	0.89	3.88	0.85
Chance of burglary and theft	3.83	0.79	3.92	0.89	4.98	1.25	4.11	0.92
Family health issues	4.15	1.21	4.36	0.83	4.26	0.71	4.24	0.98
Changes of Govt. policies	3.9	0.85	4.02	0.73	4.12	0.83	3.99	0.81
Environmental policy	3.89	0.84	3.95	0.89	4.56	0.89	4.06	0.87
Climatic risk (Extreme conditions hot and winter)	4.86	1.27	4.65	1.25	4.35	0.87	4.68	1.17
Accidental fire and floods	3.07	0.82	3.18	0.83	3.45	0.82	3.19	0.82

useful were in the range of 13 to 38% for same categories of farmers. Though source of risks exhibited different trend across the herd size categories but it gave the signal that breeding related risks trigger more anxieties to the livestock owners. Romey (2009) reported similar findings in the case of adoption of improved management practices in Australia.

Animal health related risks experienced by livestock owners were recorded and analysed. It was observed that farmers felt that risks as somewhat useful to very useful delay in availability of health services by farmers (79%), incidences of disease (81%), accidental injury, financial hardship, poor health services for family (67%), non-availability of veterinary doctors, nutritional deficiency (64%), respectively. While farmers who perceived above stated health related risks, as not useful or somewhat not useful ranged from 19% to 28%. However, some respondents were of neutral opinion (8%). Across the different categories of farmers, the similar trend was observed. The market volatilities generate the risks as perceived by livestock owners across the different categories were analysed. Under the small category of famers' impact of risk producing factors were, change in milk price (84%), reduction in milk yield (82%) followed by increased feed cost, change in technology, non-availability of fodders and difficulties in marketing of livestock products. They were somewhat useful to very useful as expressed in the range of 58% to 96% farmers, whereas medium farmers were of opinion on market related risks that milk yield, consumer preferences biasness, increased input cost, increased expenses in animal maintenance, difficulties in marketing of livestock products, decline in pasture land, shortage of labour and fear of technology change and their opinion varied from 56% to 97% for somewhat useful to very useful sources of risks. Hence, these source of risks from majority of respondents' opinion for different categories of farmers need to be taken care, so that these negative effects can be minimised and livestock may develop in sustainable manner. However, about 3% to 44% medium farmers, 5% to 22% larger farmers had the opinion that above source of risk were not useful or somewhat not useful only. The source of risks from institutional and policy front were also analysed. Majority of small (73%), medium (67%) and large (48%) farmers were of opinion that limited accessibility to financial services, family health issues, climate risks, change in government policies etc. were somewhat to very useful as the source of risks and need to be addressed through policy instruments.

The limited accessibility of extension services, accidental fire etc. were perceived as major source of risks by small farmers (28%) while medium and large farmers (68%) indicated major source of risks. Therefore, study suggests that market related risks should be tackled through proper policy and institutional support so that small and marginal farmers continued to be livestock owners and may be able to contribute to nation building in terms of increased livestock production. The source of risks and expected

effects on farmers livelihood, need to be at top priority of livestock development agencies and policy makers in the study areas. Bardhan and Tiwari (2007) reported that adverse effect on family health and lack of institutional support in dairy farming in India were major source of risks while Meuwissen *et al.* (2001), observed that source of risk, viz. meat price, epidemic animal disease and milk price as the most relevant ones.

The average scores were more than 3.0 for most of the sources of risk except for five factors in all the categories of farmers. This indicated that almost all the attributes on which opinion of respondents asked were useful to very useful. However, scores >4.0 which indicated that sources of risks were very useful, viz. repeat breeding, lack of knowledge in heat detection in breeding related risks. Whereas health related source of risks were delay in accessibility of health services, financial hardship and poor infrastructure. Market related risks for which risks were higher were variations in the yield, increased feed cost under small herd size. While, similar trend observed for medium and large categories. Though farmers expressed as very useful sources of risks but they were not in the same order across the different categories of farmers. Therefore, risks sources as expressed by various category of respondent were many and the possible reasons were elicited from the information provided by farmers, i.e. lack of awareness about the government scheme, precautions to be taken during pregnancies, feed formulations, time for AI, affordability, claims settlement, risk over aversion schemes and several others. Hence, government should intensify the efforts and inform the livestock owners about different source of risks associated with livestock enterprises with precautions, management and supervision strategies so that probable losses may be minimized.

Management strategies for risks aversion: The risk management strategies as measured on five-point scale for breeding, health, marketing and institutions and policy aspects are summarized in Table 3. With the perusal of this table, it was found that under breeding components of livestock, farmers have adopted good breed's semen for AI so that they can get better calf. They told that if they get high yielding breed calf, in future they will get good yield or better price for animal sale and many risks will be minimized. Therefore, they always look for good breed for AI (73%). Some farmers informed that they go up to district headquarters and approach the Sr. Veterinary officers to send good quality semen at village dispensaries. Further, it was informed by farmers (47%) that they are ready to pay high amount for good breed semen. However, it was noticed in some parts of Haryana and Rajasthan that they paid higher price for AI to the private practitioners with the assurance of good breed semen available with them. The better breed semen utilization scores were nearly 4.83 which indicate that this strategy was somewhat to very useful. Health related risk management strategy included prevention of diseases by vaccinations time to time. Another strategy was protection of animals during extreme and hard climate.

Under extreme climate, farmers of Rajasthan devised animal protection mechanism as Rajasthan depicts the harsh and dry climate which is difficult for livestock management. Farmers reported that during extreme heat, they use gunny bags dipped into water and hanged in the direction of hot wind on cattle shed walls so that animals feel comfort during summer. Some farmers (28%) reported that they spread sand on cattle shed floor every day and sprinkled some water before animal enter in the shed. Similarly, during heavy cold, a spread sheet of gunny bags or cotton cloths will be prepared and spread on the body of animal during morning and evening. However, in Haryana, farmers used fans in the cattle shed and constructed *pucca* shed (73%) for protection of animal. About 39% farmers reported they go for frequent check of animals so that animal can be

maintained with good health. However, about 48% farmers reported to have hygiene milk production. The score for diseases prevention and protection from extreme climate was nearly five indicating these strategies were very useful. However, in no case, score was less than 2.0 which means, no one felt health management strategies are not useful. Market related risks management strategies adopted by the respondent were somewhat useful to very useful, since they received score >4.0. The farmers reported that search of off-farm employment (53%), stock of sufficient inventory (57%), leasing out the farm machinery to earn extra money and increased use of machinery (34%), keeping fixed cost low (23%), advance input price contract (39%), reduction cost of production (63%) and marketing of livestock products at better price were some of the strategies and

Table 3. Risks management strategies adopted by respondents

Source of risk	Small		Medium		Large		Overall	
	Score	SD	Score	SD	Score	SD	Score	SD
<i>Breeding related strategies (12%)</i>								
Always go to healthy male animal for natural service	3.87	0.09	4.12	0.85	4.45	1.11	4.08	0.88
Always go for better breed semen for AI	4.83	1.45	4.55	1.12	4.61	0.89	4.70	1.23
Consult to the doctor for pregnancy check up	2.67	0.76	3.80	0.87	3.78	0.68	3.26	0.78
<i>Animal health related strategies (16%)</i>								
Prevent disease	4.84	1.16	4.56	1.23	4.88	1.32	4.76	1.22
Applying hygiene method for milk production	2.82	0.87	3.42	0.78	4.83	1.16	3.93	0.91
Protect from the extreme climate (Using fans, heater, wet gunny bags, cold/hot air protection)	4.81	1.16	4.86	0.98	3.92	0.86	4.63	1.04
Regular check-up for animals	3.80	0.85	3.32	0.43	4.90	1.83	3.90	0.94
<i>Market related strategies (32%)</i>								
Marketing of milk and milk products	3.88	0.83	3.45	0.65	3.80	0.86	3.73	0.78
Search of off-farm employment	4.86	1.16	4.67	1.28	4.80	1.42	4.79	1.25
Advance milk price contact (buyer)	3.83	0.84	3.56	0.089	3.89	0.85	3.76	0.61
Advance input price contact (seller)	3.80	0.84	3.21	0.75	3.94	0.84	3.65	0.81
Efforts for low cost of production	3.84	0.84	2.46	0.81	3.91	0.87	3.44	0.84
Stock of adequate inventory	4.81	1.16	4.56	1.54	3.94	0.87	4.54	1.21
Farm machinery leasing out	4.90	1.16	4.87	0.96	3.80	0.58	4.65	0.97
Keeping fixed cost low	4.84	0.84	4.44	0.68	3.92	0.85	4.51	0.79
<i>Institutions and policy related (40%)</i>								
Livestock insurance	3.83	0.85	4.01	0.79	4.85	1.35	4.11	0.94
Renewal and regular premium	3.84	0.84	3.89	0.83	4.91	1.10	4.09	0.89
Life insurance claims	3.83	0.83	3.68	0.75	3.85	0.89	3.79	0.82
Crop insurance claims	3.80	0.85	3.56	0.88	3.90	0.83	3.75	0.85
Owning of agricultural land	3.85	0.84	3.45	0.89	3.87	0.84	3.73	0.86
Accessibility of production technology	2.11	0.86	3.12	0.69	3.84	0.81	3.65	0.80
Management of labour	4.86	1.16	4.56	1.03	3.88	0.86	4.55	1.05
Maintaining cash for uncertain situation	3.88	0.85	4.05	0.85	3.82	0.83	3.92	0.85
Use of ICT	3.84	0.85	3.98	0.94	4.85	1.21	4.11	0.96
Discuss with fellow farmers on new technology	3.83	0.83	3.68	0.75	3.85	0.89	3.79	0.82

found to be very useful. However, across the different categories of farmers, the pattern of risk management strategies was not uniform. But they had adopted these strategies for risk minimization.

The government policies and institutions plays crucial role in development of dairy sector. The accessibilities to the institution facilities to take advantage for improvement of livestock, livelihood, help many ways. Therefore, time to time government had introduced variety of risk minimization measures to safeguard the farmers, i.e. livestock insurances, credit facilities, subsidies, financial support etc. It was observed that livestock insurance, crop insurance, use of ICTs, accessibility to latest production technology had score of more than 4.0 which indicated that their strategies to mitigate the various risk were good and very useful. However, strategies like insurance renewal, possession of land, discussion with farmers & friends were somewhat useful strategies as they received score >3.0.

The institutions and policy related strategies adopted by different categories of farmers were not uniformly in similar pattern. However, small, medium and large category farmers adopted one or another strategy to minimize the risks they faced in livestock enterprises. The study revealed that all three categories of farmers faced risks and were serious about the different sources of risks, indicating the importance of livestock policy which is unambiguous and predictable. The study provided the useful insight for policy advocates, researchers and programme implementing agencies suggesting that they should considered the risk management strategies suggestion and accordingly policy formulation should be carried out which will motivate the farmers and will give confidence, going for sustainable livestock production.

Determinants of source of risks in livestock enterprise: The data on the determinants of the source of risks in livestock enterprise was worked out by using regression model. A number of socio-economic variables were hypothesized to determine the factors influencing the source of risks. The significance of the diagnostic statistics (linear regression R^2) shows a good fit for the model. The results of the regression model are presented in Table 4. The weighted average of scores of each category of source of risks was taken as dependent variable.

The explanatory variable considered were age, education, gender, household experience in livestock rearing, herd size, average yield of milch animal, four dummies were used.

The coefficient of determination (R^2) was in the range of 30 to 35% indicating the extent of variation explained by the included dependent variables in the model. However, in the case of breeding related risks, milk yield, female headed families, education level, main occupation as agriculture had negative coefficient, indicating higher extent of these variable reduce the risks. The coefficients for experience in livestock, age and knowledge of insurance reduce the risks. Similarly, health related risks had positive coefficients for experience, age landholdings size, milk yield, gender and knowledge level about insurance. This

Table 4. Determinants of participation in insurance scheme

Explanatory variable	Coefficient			
	Breeding risks	Health risks	Marketing risks	Institutions and policy Risks
Experience (Yrs)	0.0037	0.0135	0.0143	0.0234
Education (Yrs)	-0.0106	0.0051	-0.0097	-0.0106
Landholding size (ha)	0.0038	0.0052	0.0031	0.0037
Total no. of livestock	-0.0157*	-0.0133	-0.0072**	-0.0156**
Milk yield/day in litres	0.0782*	0.0417	0.0962*	0.0782**
D1=State dummy (if Rajasthan then 1, otherwise 0)	-0.0311*	-0.0123*	-0.0398*	-0.0311*
D2= Gender dummy (if female then 1, otherwise 0)	-0.0021*	0.0029	0.0079	-0.0011
D3= Occupation dummy (if main then 1, otherwise 0)	-0.3176*	-0.2687	0.1809*	-0.3176*
D4=Knowledge on insurance scheme (yes then 1, otherwise 0)	0.1655	0.0720	0.1329	0.1655
Constant	0.1108	0.0424*	5.6578*	0.1108
R^2	0.324	0.335	0.345	0.301

D1 to D4 are the dummy variables introduced. *, **Level of significance at 1% and 5%, respectively.

indicates that Rajasthan farmers faced more risks as compared to Haryana farmers as coefficient was negative. The explanatory variables like market, institutional and policy related risks, total livestock had negative coefficients but were significant. However, age, experience, land holding size and milk yield and knowledge level had positive influence on source of risks, indicating the extent of these attributes increase with increase in various risks. Thus, study clearly indicated that age, experience, milk yield, and knowledge of risk aversion scheme are important determinants. This previous studies conducted on risk management strategies by researchers (Mohammed and Ortmann 2005, Feder *et al.* 1985, Akinda 2014, Romy *et al.* 2009) were on similar line. However, in our study, only 10% of the households were headed by females. Farmers' in the study area had high farming experience which might have contributed to their proficiency in utilizing technologies and alternative risk management strategies (Ugwumba *et al.* 2010).

Conclusions and policy implications

The livestock act as live ATM for marginal and small farmers. Since, their livelihood depends on type and number of livestock reared by them. The source of risks reported by livestock owners were related to marketing followed by institutional & policy, health and breeding. Farmers

experienced these risks and effects on their livelihood. We observed that lack of accessibility to health and breeding services, shortage of veterinary staff, fluctuation of livestock produce price, non-institutional support, climatic variability etc. were the major source of risks. Marketing and institutional risks were at top rank and need to be addressed in livestock policy framework. The strategies adopted like insurance, protection of animals from heat/cold, vaccination and inventory management for inputs and many more, have helped the farmers to cope up with adversities reported that effect on family health and lack of institutional support in dairy farming in India were perceived as major source of risks (Bardhan and Tiwari 2007). While, Meuwissen *et al.* (2001), observed source of risk, viz. meat price, epidemic animal disease and milk price fluctuation as the most relevant. The determinants of risks indicated that farmers who had high level of education, experience, milk yield face less risk. Further, Haryana farmers experienced less risk due to high income and better livestock services. This study provided the useful insight for policy advocators, researchers and programme implementing agencies for improving the livestock production system. The risk management strategies that were most preferred and useful need to be further strengthened by institutional and policy supports. The study suggests that market related risks should be tackled through proper policy and institutional support so that small and marginal farmers can access them for higher livestock production.

ACKNOWLEDGEMENT

Authors are very thankful to anonymous referees and Dr P S BIRTHAL for their valuable suggestions that helped us to improve this manuscript.

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