Research Article

Indian Journal of Extension Education
Vol. 60, No. 2 (April–June), 2024, (61-65)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Risk Perception and Perceived Effects on Environment vis-à-vis Dairy Animal Waste Management in NCR, India

Misha M Madhavan[1]*, Gopal Sankhala[2], Sanjit Maiti[3], S. Smitha[4] and Aswathy Chandrakumar[5]

[1]Scientist, Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi-110012, India
[2]Head and Principal Scientist, [3]Senior Scientist, Dairy Extension Division, ICAR-National Dairy Research Institute, Karnal-132001, Haryana, India
[4]Assistant Professor, Department of Agricultural Extension Education, College of Agriculture, Vellayani, Trivandrum-695522, Kerala, India
[5]Scientist (Agricultural Extension), Transfer of Technology, ICAR-DCR, Puttur-574202, Dakshina Kannada, Karnataka, India
*Corresponding author email id: mishamadhavanmsy4@gmail.com

ARTICLE INFO

Keywords: Risk perception, Dairy farmers, Animal waste management, Effect on environment, Urban dairies, Peri-urban dairies

https://doi.org/10.48165/IJEE.2024.60212

Conflict of Interest: None

Research ethics statement(s): Informed consent of the participants

ABSTRACT

The study was carried out to evaluate the risk perception and perceived effect on the environment among dairy farmers in the National Capital Region (NCR) of India. The study conducted in seven districts across four sub-regions of NCR during 2018-19 included the development of a psychometric scale with four dimensions and standardization to measure risk perception. The scale was then administered to 252 dairy farmers from urban and peri-urban dairies in the study area. The results showed that the majority of the farmers perceived a medium level of risk (39.68%), followed by low (32.54%) and high (27.78%) levels of risk perception. Comparative analysis was conducted using Mann-Whitney U Statistic and Duncan Multiple Range Test, which found that the risk perception scores of the respondents in urban areas were significantly higher than those in peri-urban areas. The dairy farmers in the Delhi region of NCR perceived more risk with a mean value of 46.83±0.70, followed by Haryana (43.46±0.58), Uttar Pradesh (31.47±0.49), and Rajasthan (29.44±0.59). The use of dairy animal waste as manure in crop fields was ranked first among the positive effects, while the emission of greenhouse gases was recognized as the major negative effect perceived by farmers.

INTRODUCTION

Urban and peri-urban livestock keeping is a significant source of food and income for families with limited resources (Kusiluka, 2012). People keep dairy animals in urban and peri-urban areas because of the proximity to good markets and large number of consumers, financial constraints, and unemployment (Ayaga et al., 2005; Prain et al., 2010 & Mlozi, 2005). Most dairy farmers in urban areas live in low and medium-density areas and use their residences as dairy units (Mlozi, 2005). However, livestock units within limited space in urban areas produce large quantities of waste that can cause serious public health and environmental problems if not well managed (Morse, 1995; Hammond, 1997). For instance, in urban dairies of NCR, India, a large quantity of animal excreta is flushed with water, resulting in huge effluent discharged to nearby drainages without any treatment (Kiran, 2016). Organic matter accumulation in water causes pollution, which can be a factor in eutrophication of water bodies (Kuberle, 2005). Additionally, the decomposition process of animal waste produces noxious gases and odors that can negatively affect air quality (FAO, 2007b). Many microorganisms, such as bacteria, fungi, viruses, and intestinal parasites, are found in animal excreta, which can be a source of infection to people involved in waste handling (Defra, 2006; Murdoch, 2007). Even when animals show no signs of infection, the discharge of untreated wastewater from livestock units into ground and surface water creates health

Received 15-03-2024; Accepted 29-03-2024

problems for animals and humans who use this water (Sangodoyin, 1996; Defra, 2006). It is essential to understand the farmers' perceptions of the risks in agriculture before planning and developing any extension strategy (Priyadarshni et al., 2017). Therefore, it is essential to determine the farmers' perceptions of the risks associated with dairy animal waste management in urban and peri-urban areas for introducing appropriate coping strategies.

Risk perception is the evaluation of the adverse consequences of a particular hazard, which can be made by an individual, a group of people, or society. In this context, farmers' risk perception with respect to dairy animal waste management is the perceived likelihood of danger or negative consequences associated with the dairy animal waste management practices. As there is no such instrument for measuring the risk perception of dairy farmers with regards to animal waste management in the literature, this study includes the development and application of a psychometric scale for that purpose. The null hypothesis to be tested is that there is no difference in the risk perception level of dairy farmers in urban and peri-urban areas as well as between different sub-regions of NCR, India. The study also aims to analyze the perceived effects on environment by the dairy farmers due to the existing scenario of dairy animal waste management.

METHODOLOGY

This study was purposively carried out at NCR, India, considering the extent of urbanization and large number of urban and peri-urban dairies. Through proportionate random sampling method, seven districts were selected from the four sub-regions of NCR (Haryana, Delhi, Uttar Pradesh and Rajasthan). The selected districts were, Sonepat, Panipat and Palwal from Haryana, North and North West Delhi, Bhagpat from Uttar Pradesh and Alwar from Rajasthan.From each district, one city and 36 dairy farmers (18 from urban and 18from peri-urban area) from each city were selected randomly. So, a sample of 252 dairy farmers was selected as respondents and primary data was collected during 2018-19 from the respondents. A psychometric scale was newly developed and standardized for measuring the risk perception of dairy farmers following the Likert method of summated rating scale construction with little modifications (Likert, 1932 & Edwards, 1969). The final scale consisting 17 statements was administered to the dairy holders on a 5 point continuum. Scores were summed up to get the total score for risk perception of each respondent. The overall possible maximum and minimum score ranged between 68 to 0.Dairy farmers were categorized in to three different levels by cumulative square root frequency method to show the differential level of risk perception. The means of different sub regions of NCR were compared by Post-hoc Duncan's Multiple Range test (DMRT) (Duncan, 1955). To compare the means of two independent samples viz. urban and peri-urban areas, Mann Whitney U Statistic was used. The SPSS 20 software was used for performing these tests. To analyse the perceived effect on environment due to the dairy animal waste management, schedule was developed. Positive and negative effects of dairy animal waste management on the environment were listed out based on the literature review and expert's opinion. The respondents were then asked to rank the positive effects and negative effects based on their perception. The data was analyzed by using garret ranking method (Garret & Woodworth, 1969).

RESULTS

Risk perception of dairy holders regarding dairy animal waste management

A psychometric scale consisting of 17 statements was developed and standardized to assess the risk perception of dairy farmers. The newly developed scale was then used to measure the risk perception of 252 respondents, and their scores ranged from 24.00 to 63.00.

Based on the cumulative square root frequency method, the dairy farmers were classified into three categories of risk perception, as shown in Table 1. The study revealed that the majority of farmers (39.68%) perceived a medium level of risk, followed by those who perceived low risk (32.54%) and high risk (27.78%).

Table 1. Differential level of risk perception regarding dairy animal waste management among the respondents

Category	Percentage
Low (24-36.72)	32.54
Medium (36.73-46.74)	39.68
High (46.75-63)	27.78
Total	100

The respondents from different regions of the study were categorized into three risk perception groups for comparison, as shown in Table 2. It was observed that all respondents from Rajasthan perceived a low level of risk (100.00%), followed by Uttar Pradesh (97.22%), Haryana (8.33%), and Delhi (2.78%). The highest proportion of respondents with a high level of risk perception was found in Delhi (52.78%), followed by Haryana (29.63%). Notably, no farmers in the sub-regions of Uttar Pradesh and Rajasthan had a high level of risk perception.

Table 2. Differential level of Risk Perception across the sub-regions of NCR

Study Area	Low (24-36.72)#	Medium (36.73-46.74)#	High (46.75-63)#
Delhi (n=72)	2.78	44.44	52.78
Haryana (n=108)	8.33	62.04	29.63
Uttar Pradesh (n=36)	97.22	2.78	0
Rajasthan (n=36)	100	0	0
Overall (n=252)	32.54	39.68	27.78

score for level of classification. Values given in table is percentage of respondents.

Comparative analysis of risk perception among dairy farmers in urban and peri-urban dairies across different sub-regions

The risk perception of dairy farmers in urban and peri-urban areas was compared using Mann-Whitney U statistics, as shown in Table 3. The results revealed that in urban dairies, farmers' risk perception was significantly higher than those in peri-urban areas

Table 3. Comparative evaluation of risk perception in urban and peri urban areas across different sub-regions

States	N	Mean ± SD	Urban		Peri Urban		Mann Whitney	P value
			N	Mean ± SE	N	Mean ± SE	U statistic	
Delhi	72	46.83±0.70[a]	36	51.53±0.67	36	42.14±0.50	32**	<0.001
Haryana	108	43.46±0.58[b]	54	47.80±0.66	54	39.13±0.48	205**	<0.001
UP	36	31.47±0.49[c]	18	32.67±0.77	18	30.28±0.48	92.5*	0.027
Rajasthan	36	29.44±0.59[c]	18	31.39±0.68	18	27.5±0.72	57**	0.001
Total (NCR)	252	40.71±0.54	126	44.36±0.80	126	37.06±0.55	3995.5**	<0.001

**significant at 1%, in a two tail test. *significant at 5% in a 2 tail test. Multiple comparisons are based on the DMRT post hoc test. Values with different superscripts column wise differs significantly at 5% level of significance

in Delhi, Haryana, and Rajasthan, with a P-value of less than 0.001. In Uttar Pradesh, the risk perception was also significantly higher at a 5% level of significance, with a P-value of 0.027. Overall, in the National Capital Region (NCR), the risk perception of respondents in urban areas was significantly higher than that of those in peri-urban areas, with a P-value of less than 0.001. To compare the risk perception of dairy holders in different regions of NCR, Duncun's Multiple Range Test (DMRT) was applied, as shown in Table 3. The results indicated that there was a significant differentiation at a 5% level between the dairy holders of Delhi and Haryana in terms of their risk perception regarding dairy animal waste management. The dairy holders of Uttar Pradesh and Rajasthan had the same level of risk perception but differed from those in Delhi and Haryana. The dairy holders in Delhi perceived more risks regarding dairy animal waste management, with a mean value of 46.83±0.70, followed by Haryana (43.46±0.58), Uttar Pradesh (31.47±0.49), and Rajasthan (29.44±0.59).

The different dimensions of risk perception regarding dairy animal waste management i.e., Human health risk, Animal health risk, Environmental risk and Financial risk were also compared with the mean values across different sub-regions (Table 4). According to Table 4, the study found that dairy holders in Delhi perceived the highest human health risk, with a mean value of 16.92±0.32, followed by dairy holders in Haryana (14.55±0.27), Rajasthan (10.58±0.32), and Uttar Pradesh (9.89±0.34). Haryana dairy holders perceived more animal health risk (5.5±0.11) followed by Delhi (5.33±0.13), Uttar Pradesh (4.06±0.13), and Rajasthan (3.64±0.17). In terms of environmental risk, Haryana dairy holders perceived more risk (13.28±0.18) followed by farmers in Delhi (13.03±0.25), Uttar Pradesh (9.83±0.24), and Rajasthan (8.97±0.28). Delhi farmers stood first in financial risk perception (11.56±0.20) followed by Uttar Pradesh (7.69±0.23) and Rajasthan (6.28±0.31).

Effects on environment as perceived by the farmers

The rankings provided by the survey participants were analyzed using the Garret ranking method, as shown in Table 5. The majority of dairy farmers perceived the most significant positive effect of using animal waste as 'Dung and urine add nutrient content to soil when used as fertilizers'. The next significant positive effect was the reduction in the use of LPG, dung cake, and firewood through the use of biogas. The third rank was given to the reduction of the biomagnification effect caused by chemical fertilizers and pesticides through the use of dung and urine as an alternative. The positive effects of reducing soil erosion and increasing soil organic matter content were ranked 4th and 5th, respectively. In terms of negative effects, the farmers identified the emission of methane and nitrous oxide gases from animal and dung as the worst effect, causing global warming and climate change. The runoff of manure to surface water causing water pollution and the pollution of air with dust and dirt particles from dung were ranked second and third, respectively.

Table 4. Comparative evaluation of different dimensions of risk Perception across different sub-regions (Mean±SE)

Study Area		Human health risk	Animal health risk	Environmental risk	Financial risk
Delhi	Urban (n=36)	18.75±0.38	5.92±0.15	14.39±0.29	12.47±0.26
	Peri Urban (n=36)	15.08±0.28	4.75±0.15	11.67±0.24	10.64±0.20
	Total (n=72)	16.92±0.32	5.33±0.13	13.03±0.25	11.56±0.20
Haryana	Urban (n=54)	16.26±0.30	5.91±0.17	14.43±0.22	11.20±0.21
	Peri Urban (n=54)	12.83±0.31	5.09±0.13	12.13±0.19	9.07±0.17
	Total (n=108)	14.55±0.27	5.5±0.11	13.28±0.18	10.14±0.17
Uttar Pradesh	Urban (n=18)	10.89±0.48	4.39±0.18	9.28±0.42	8.11±0.36
	Peri Urban (n=18)	8.89±0.37	3.72±0.14	10.39±0.18	7.28±0.25
	Total (n=36)	9.89±0.34	4.06±0.13	9.83±0.24	7.69±0.23
Rajasthan	Urban (n=18)	11.33±0.37	4±0.24	9.28±0.42	6.83±0.41
	Peri Urban (n=18)	9.83±0.47	3.28±0.23	8.67±0.38	5.72±0.43
	Total (n=36)	10.58±0.32	3.64±0.17	8.97±0.28	6.28±0.31
Overall		13.99±0.23	4.98±0.08	12.10±0.16	9.64±0.16

Table 5. Effects on environment as perceived by the farmers

S. No.	Effect on Environment	Average Score	Rank
A.	Positive Effects		
1.	Dung and Urine of Bovines add nutrient content of soil when used as fertilizers	67.65	1
2.	Use of Biogas decrease the use of LPG, dung cake and firewood	63.28	2
3.	As an alternative, dung and urine reduces the biomagnification effect due chemical fertilizers and pesticides	54.97	3
4.	Reduce the soil erosion when apply in farm fields	43.79	4
5.	Increase the soil organic matter content	38.39	5
6.	Bioremediation of environment pollutants	31.79	6
B.	Negative Effects		
1.	The methane and nitrous oxide gases emitted from animal and dung causes global warming and climate change	65.48	1
2.	Runoff of manure to surface water causes water pollution	61.96	2
3.	Dust and dirt particles from dung pollute the air	50.16	3
4.	Bad odour persists in the environment if not managed properly	40.69	4
5.	Burning of dung cake results in high concentration of particulate matter in the environment	31.67	5

DISCUSSION

The newly developed measurement tool, risk perception scale provides an understanding on the variation in risk perception by the dairy farmers across NCR, India. The result shows that large number of respondents perceive medium risk and low risk due to the existing animal waste management scenario in urban and peri-urban dairies at NCR. But there exist high risk situations in the urban dairies in NCR (Kiran, 2016 & Madhavan, 2018). The reason for low-risk perception might be the low awareness level of the dairy farmers regarding potential harmful effects of improper waste management. Ren et al., (2016) found a significant relationship between knowledge and risk perception in a study conducted at Shanghai regarding the risk perception towards a highly protested waste to energy facility. Tripathi et al., (2016) reported the low awareness level of dairy farmers in Uttar Pradesh regarding the harmful effects of animal waste. Differently, in a study conducted in Sub-Saharan Africa, business operators were surveyed on their solid waste disposal practices. The respondents had good knowledge of the hazards associated with unsanitary solid waste disposal, but their risk perception was found to be sub-optimal (Awosan et al., 2017). In this regard, Kamara (2006) reported that many people did not perceive the linkage between method of handling the waste and the quality of environment. The results show high level of risk perception by dairy farmers in urban areas compared to peri-urban. This difference may be due to the varying reasons like, in peri-urban areas mostly agriculture is the main occupation and dairying is subsidiary (Dwivedi et al., 2014) and the land availability for storage and management practices of waste is high in peri-urban areas. The human health risk perception and financial risk perception were highest among the respondents from Delhi compared to other sub-regions. It can be attributed to their personal and socio-economic characteristics as reported in a study conducted at Italy regarding public concerns towards solid waste management. They observed that perceived health risk of developing cancer due to the burning of solid waste was significantly higher in females, younger, educational level lower than university (Sessa et al., 2009). Regarding the perceived effect on environment, there was not wide variation between the average score values of garret ranking, which strengthened the view that farmers perceived the positive and negative effects of animal waste equally. The use of dung as manure in crop fields were known to all the farmers as it is a traditional practice. Many of the farmers had some idea regarding the scope of biogas production from dung which can decrease the LPG consumption in households for cooking purpose. This was perceived as a great advantage as biogas plants produce fuel out of waste. Even though the farmers were not particular regarding the gases which emitted from dung, they were having the opinion that nowadays the climate has been changing significantly than the previous years. When they were informed regarding the contribution of dairy animals in this climate change occurrence, they considered it as the most important negative effect. A large number of farmers were observed the surface water pollution in their nearby water bodies and hence perceived this negative effect as more important than the cause for air pollution. As most of the farmers get used to the odour present in the dairy units, they did not find it as a major issue. The farmers were not much aware regarding the dung cakes burning issues so poorly identified this as a major negative effect.

CONCLUSION

In urban dairies, risk perception by dairy farmers is high compared to peri-urban dairies due to several constraints in waste management. It showcases the need for implementing risk reduction interventions in urban dairies for managing the animal waste more effectively. The public health risk, animal health risk environmental risk and financial risk were perceived differently by dairy holders of different sub-regions in NCR hence area-based strategies and interventions are required to overcome the risks. The farmers should be educated about the different risks associated with the improper animal waste management by organizing awareness campaigns and training programmes. This study can pave way for designing need-based training modules on effective animal waste management options available considering the limitation of space in cities. The study provides a new instrument for measuring the risk perception level of dairy farmers regarding animal waste management.

REFERENCES

Awosan, K. J., Oche, M. O., Yunusa, E. U., Raji, M. O., Isah, B. A., Aminu, K. U., & Kuna, A. M. (2017). Knowledge, risk perception and practices regarding the hazards of unsanitary solid waste disposal among small-scale business operators in Sokoto, Nigeria. *International Journal of Tropical Disease and Health*, *26*(2), 1-10

Ayaga, G., Kibata, G., Lee-Smith, D., Njenga, M., & Rege, R. (2005). *Policy prospects for urban and peri-urban agriculture in Kenya.* Urban Harvest–International Potato Center, Lima, Peru.https://www.researchgate.net/profile/Mary-Njenga-2/publication/263426766_Urban_and_Peri_Urban_Agriculture_Policy_Prospects_for_in_Kenya/links/599a7e170f7e9b3edb19057c/Urban-and-Peri-Urban-Agriculture-Policy-Prospects-for-in-Kenya.pdf

Defra (2006). *Farming livestock and zoonotic diseases*. Department for Environment, Food & Rural Affairs, Gov.UK. Retrieved November 4, 2017, fromhttp://www.defra/gov.uk/farm

Duncan, D. B. (1955). Multi range and multi F tests. *Biometrics*, *11*, 1-42.

Dwivedi, K. P., Kumar, A., & Singh, P. (2014). Profile of peri-urban and rural dairy farmers: A Comparative Analysis. *Indian Journal of Extension Education*, *50*(3&4), 53-57.

Edwards, A. L. (1969). *Techniques of attitude scale construction.* Vakils, Feffer and Simons Private Limited. Mumbai.

FAO (2007b). *On-farm compositing methods: compositing process and techniques*. FAO Corporate Document Repository. Retrieved January 24, 2018 http://www.fao.org/docrep/007/y5104e/

Garrett, E., & Woodworth, R. S. (1969). *Statistics in psychology and education*. Bombay: Vakils, Feffer and Simons Private Limited. Mumbai.

Hammond, C. (1997). *Animal waste and the environment*. Retrieved November 13, 2017, from http://www.bae.uga.edu/ extension/ pubs/c827.cd.htm.

Kamara, A. J. (2006). *Household participation in domestic waste disposal and recycling in the Tshwane Metropolitan area: an environmental education perspective*. M. ed Thesis *(Unpub.)* University of South Africa, South Africa.

Kiran, R. (2016). *Roles and Issues of marginalised dairy holders in urban and peri-urban areas of national capital region*. M.Sc. Thesis *(Unpub.)*, National Dairy Research Institute (Deemed University) Karnal (Haryana), India

Kuberle, T. (2005). *The impact of factory farms on the environment*. Environmental Articles. http://www.allcreatures.org/articles/

Kusiluka, L. J. M., Gallet, P., & Mtawa, A. N. (2012). Animal waste management practices and perceptions on public and environmental health risks. *Huria: Journal of the Open University of Tanzania*, *12*(1), 57-75.

Likert, R. (1932) A technique for the measurement of attitudes. *Archives of Psychology*, *22*(140), 157-159.

Madhavan, M. M. (2018). *A Study on management of dairy animal waste and its effect on environment in urban and peri-urban areas of National Capital Region (NCR), India*. PhD Thesis *(Unpub.)*, National Dairy Research Institute (Deemed University). Karnal (Haryana), India.

Mlozi, M. R. S. (2005). *Urban animal agriculture: its palliativity and reasons for persistence in Tanzanian towns*. RICS Foundation pp. 26 *http://www.ricsfoundation.org*

Morse, D. (1995). Environmental considerations of livestock producers. *Journal of Animal Science*, *73*, 2733-2740.

Murdoch, B. A. (2007). *Agriculture Notes: Zoonoses - Animal diseases that may also affect humans*. State of Victoria Department of Primary Industries. ISSN 1329-8062, 5 pp.

Prain, G., Karanja, N. & Lee-Smith, D. (2010). *African Urban Harvest: Agriculture in the cities of Cameroon, Kenya and Uganda*. International Development Research Centre, pp 335.

Priyadarshni, P., Rakshit, S., & Padaria, R. N. (2017). Development and validation of scale to measure risk orientation of farmers. *Indian Journal of Extension Education*, *53*(1), 1-6.

Ren, X., Che, Y., Yang, K., & Tao, Y. (2016). Risk perception and public acceptance toward a highly protested Waste-to-Energy facility. *Waste management*, *48*, 528-539.

Sangodoyin, A. Y. (1996). Nutrient benefits and environmental aspects of land disposal of livestock waste. *Environmental Management and Health*, *7*(1), 33-38.

Sessa, A., Di Giuseppe, G., Marinelli, P., & Angelillo, I. F. (2010). Public concerns and behaviours towards solid waste management in Italy. *European Journal of Public Health*, *20*(6), 631-633.

Tripathi, H., Tripathi, B. N., Shyam, J., & Balaraju, B. L. (2016). Awareness regarding occupational health hazards and risks of zoonoses associated with livestock rearing among male and female workers in Uttar Pradesh. *Indian Journal of Extension Education*, *52*(1&2), 38-44.