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Management and Socio-economic Aspects of Livestock Farming in Flood-prone Areas of Cuddalore District

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ABSTRACT

A detailed survey was conducted from September, 2020 to February, 2021 to document the socio-economic status and livestockrearing practices in the flood-prone areas of Cuddalore district. This study assessed the socio-economic profile, livestock holdings, housing practices, stocking density, and feeding management of livestock farmers in flood-prone areas of Cuddalore district, Tamil Nadu. Floods, among the major natural disasters affecting agriculture and livestock-based livelihoods in coastal regions of India. A total of 600 households (20 villages×30 farmers) were surveyed across three Geographical Areas (GGA I: 0–10 m, GGA II: 11–20 m, GGA III: >20 m above mean sea level). Results revealed a predominance of male farmers (63.83%) with an overall literacy rate of 64.48%, lower than the district average. Most farmers were daily wage labourers (65.17%) and had landholdings below one acre, with 33% landless. Thatched-roof housing was the most common (49.17%), and a significant proportion of farmers (40.16%) lacked any animal shelter. Livestock holdings were generally small, with non-descriptive cattle and goats predominating, and significant variations were observed in crossbred cow, goat, and sheep numbers across GGAs. The mean number of animals shed^{-1} ranged from 9.67 to 12.27, with higher stocking densities in GGA II. Regular concentrate feeding averaged 1.20 kg day^{-1}, increasing to 3.81 kg day^{-1} after floods to support recovery. The study highlighted that low literacy, small landholdings, and limited infrastructure constrained adaptive capacity among livestock farmers. These findings underscored the need for targeted extension services, flood-resilient animal housing, and improved feeding strategies to enhance livestock resilience in flood-prone areas.

KEYWORDS: Flood disaster, livestock, housing, feeding, socio-economic profile, Cuddalore

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1. INTRODUCTION

Flood disasters are recurrent annual events that cause extensive damage to agricultural production, human life, and property, severely disrupting livelihoods and livestock farming in floodplain regions. (Messner et al., 2007; Dewan, 2015; Khan et al., 2024). They cause feed scarcity, disease outbreaks, and socio-economic losses among farming households (Bayazid et al., 2025; Fahim and Sikder, 2022). Climate change further intensifies monsoonal flooding and adaptive challenges (Agrawala et al., 2003; Ghatak et al., 2012; Dey et al., 2021). In India, more than 8% of the total 40 m ha of agricultural land is prone to floods, with an average of about 8 m ha affected annually (Gupta et al., 2003). Globally, floods are among the major natural disasters, account for 17% of total losses caused by natural calamities, with the livestock sector contributing to 34% of these losses, second only to crop damage (49%) (Anonymous, 2012). During flood disasters, livestock and poultry are often more severely affected than humans, primarily because they are inadequately sheltered and poorly managed due to limited awareness of disaster preparedness and mitigation measures (Heath et al., 1999). The impacts on animals include the spread of zoonoses, increased disease outbreaks during and after floods, high mortality rates, loss of production, predation, and psychological effects on livestock owners such as grief, guilt, and distress following the loss or death of animals (Sen and Chander, 2003). Recent studies highlight that inadequate shelter, fodder shortage, and water contamination aggravate livestock vulnerability during floods (Chowdhury et al., 2020; Ferdushi et al., 2019; Hoq et al., 2021). Saini et al. (2024). These factors underscore the urgent need to study livestock rearing practices, assess potential losses in the livestock sector, and identify suitable mitigation strategies to minimize risks during floods. Cuddalore district in Tamil Nadu is classified as a disaster-prone area due to its low-lying topography, making it highly vulnerable to floods, cyclones, and tsunamis. In 2015, the district experienced severe floods and a cyclone that resulted in 54 human deaths, the loss of thousands of animals, destruction of 50,000 homes, and damage to over 24,000 ha of crops across 53 villages. As a coastal district where three major rivers drain into the Bay of Bengal, Cuddalore is particularly susceptible to recurrent flood events. Silambarasan et al. (2022a) reported that the Bhuvangiri, Kurinjipadi, Cuddalore, Keerapalayam, Panruti, Parangipettai, Kattumannarkoil, Kumaratchi, and Vriddhachalam blocks of Cuddalore district are highly vulnerable to livestock and poultry mortality during flood events. Adoption of scientific disaster mitigation strategies by farmers in these flood-prone areas is low, primarily due to limited extension services, capacity-building initiatives, and awareness programs. The authors also noted that multipurpose evacuation shelters in the district are insufficient, and some are located in low-lying areas, rendering them unsuitable during floods (Silambarasan et al., 2022b). Integrated strategies such as cooperative shelters, biosecure housing, and resilient feed systems are essential for mitigating livestock losses and ensuring sustainable rural livelihoods (Bissett et al., 2018; Wozniak et al., 2018; Rahman et al., 2015; Rozaki et al., 2021; Cerda and Webb, 2023; Meher et al., 2024; Hoegh-Guldberg et al., 2024). From a study on flood-prone areas of Dhubri District, Assam, Choudhury et al. (2025) emphasized block-level integrated contingency planning to mitigate agricultural losses; while, Gnanaraj et al. (2023) developed a flood hazard map of Cuddalore district, detailing river routes, lakes, drainage patterns, artificial canals, and connecting roads to facilitate flood forecasting and the formulation of mitigation strategies. In this context, the present study evaluated farmers' socio-economic status and livestock-rearing practices in flood-prone areas of Cuddalore district to assess potential losses and recommend suitable precautionary and mitigation measures.

2. MATERIALS AND METHODS

A detailed survey was conducted from September, 2021 to February, 2022 to document the socio-economic status and livestockrearing practices in the flood-prone areas of Cuddalore district. Two villages each from ten flood prone blocks namely, Cuddalore, Keerapalayam, Kattumannarkoil, Panruti, Kumaratchi, Vriddhachalam, Parangipettai, Kurinjipadi, Kammapuram and Bhuvangiri, were chosen for the survey. The selected villages were grouped into three geographical areas based on altitude (mean sea level, MSL): Geographical Area I included seven villages located up to 10.0 m MSL, Geographical Area II comprised six villages between 10.1 and 20.0 m MSL, and Geographical Area III consisted of seven villages situated above 20.0 m MSL. Figure 1 depicted the study area marked on the map of Cuddalore district. A three-stage sampling design was adopted in selection of farmers, comprising selection at the block level, followed by village level, and finally the individual livestock farmer level. A total of 600 farmers from these 20 villages (30 farmers village^{-1}) were individually interviewed and the responses were recorded. Since establishing trust with respondents was essential for collecting reliable data, rapport was built prior to conducting the interviews. Using a structured interview schedule, farmers were systematically interviewed. Probing and clarification were employed to ensure that respondents clearly understood the questions and provided accurate responses.

The information collected included details on socio-economic status, ownership of livestock and poultry, housing patterns, stocking density, feeding practices, and

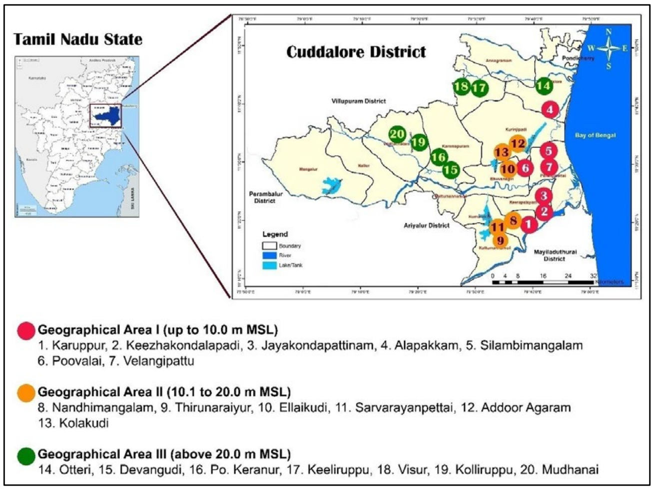

Figure 1: Map of flood-prone areas of Cuddalore district indicating the study locations

precautionary measures followed during flood disasters. The common types livestock shelters used in the study area were shown in Figure 2.

All data were analyzed using SPSS version 25 (IBM Corp., Armonk, NY, USA). The chi-square (X^2) test was used to evaluate associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION

3.1. Socio-economic profile of livestock farmers

The socio-economic profile of farmers in flood-prone areas of Cuddalore district was presented in Table 1. The proportion of male farmers was higher (63.83%) compared to female farmers (36.17%) across the three Geographical Areas (GGA). Specifically, the male-to-female ratios were 65.24:34.76, 62.22:37.78, and 63.81:36.19 percent in GGA I, II, and III, respectively. This deviated considerably from the district-level sex ratio recorded during the 2011–2021 census (Anonymous, 2021), which was nearly equal (50.3:49.7).

These findings indicated that livestock farming in the study area was predominantly undertaken by men, while women were primarily engaged in household responsibilities. A contrasting trend was observed by Khan et al. (2013), who reported a higher participation of females (52.13%) was slightly higher than males (47.87%) in livestock rearing in Mahamaya Nagar district, Uttar Pradesh.

The literacy rate among respondents in the study area was 64.48%, which was much lower than the district average of 86.38% (Anonymous, 2021). Educational status varied across the GGAs: the proportion of illiterate farmers was highest in GGA I (48.10%), followed by GGA III

Figure 2: Types of livestock shelters commonly used by the farmers in flood prone areas of Cuddalore district

(32.86%) and GGA II (23.89%), with an overall average of 35.52%. Respondents with middle school education accounted for 24.76, 43.33, and 27.14% in GGA I, II, and III, respectively (overall 31.17%). High school education levels were 18.10, 27.22, and 29.05% in the respective areas (overall 24.67%). Higher secondary education was recorded in 3.81, 5.56, and 4.29% of respondents, while only 2.5% had undergraduate qualifications and a negligible 0.33% were postgraduates.Similar patterns of low educational attainment have been reported in other parts of India. Tajpara et al. (2020) observed 5.66% illiterates and 21% middle school educated farmers in Rajkot district of Gujarat, with only 3% graduates. Khan et al. (2013) also reported high illiteracy (36.93%) and low higher education (10.08%) among livestock farmers in Mahamaya Nagar district, Uttar Pradesh. Likewise, Sachin et al. (2022) found that flood-

Table 1: Socioeconomic profile of the livestock farmers in different geographical areas of flood prone Cuddalore district

Sl. No.	Details	Measures	Geographical area			Overall	X^2
			GGA I	GGA II	GGA III		
1.	Gender	Male	65.24 (137)	62.22 (112)	63.81 (134)	63.83 (383)	NS
		Female	34.76 (73)	37.78 (68)	36.19 (76)	36.17 (217)	
2.	Education	Illiterate	48.10 (101)	23.89 (43)	32.86 (69)	35.52 (13)	**
		8th standard	24.76 (52)	43.33 (78)	27.14 (57)	31.17 (187)	
		10th standard	18.10 (38)	27.20 (249)	29.05 (61)	24.67 (148)	
		12th standard	3.81 (8)	5.56 (10)	4.29 (9)	4.52 (7)	
		UG	3.33 (7)	0.00 (0)	3.80 (18)	2.50 (15)	
		PG	0.00 (0)	0.00 (0)	0.95 (2)	0.33 (2)	
3.	Occupation	Agriculture	20.48 (43)	0.56 (1)	3.80 (18)	8.67 (52)	**
		Livestock farming	20.00 (42)	8.89 (16)	14.76 (31)	14.83 (89)	
		Agri. labourers	11.90 (25)	06.11 (11)	8.57 (18)	9.00 (54)	
		Daily wages	43.33 (91)	84.44 (152)	70.48 (148)	65.17 (391)	
		Others	4.29 (9)	0.00 (0)	2.38 (5)	2.33 (14)	
5.	Annual income	Below Poverty line<Rs.48,000)	90.00 (189)	99.44 (179)	98.57 (207)	95.83 (575)	**
		Above Poverty line>Rs.48,000)	10.00 (21)	0.56 (1)	1.43 (3)	4.17 (25)	
6.	Land holdings	Landless	47.14 (99)	22.78 (41)	27.62 (58)	33.00 (198)	**
		Below one acre	31.43 (66)	44.44 (80)	33.81 (71)	36.17 (217)	
		1–2 acres	14.29 (30)	22.22 (40)	27.14 (57)	21.17 (127)	
		2–3 acres	4.29 (9)	9.44 (17)	5.71 (12)	6.33 (38)	
		Above 3 acres	2.86 (6)	1.11 (2)	5.71 (12)	3.33 (20)	

**Significant (p<0.01); Values in parentheses indicate the number of households affected dairy farmers in Ernakulam and Thrissur districts of Kerala were mostly educated up to middle (25.3%) or secondary school (24.7%), with only 2.7% graduates and no postgraduates. In contrast, Sharma et al. (2012) reported comparatively higher educational attainment, with 76% of dairy farmers in Kheda district, Gujarat, having secondary education or above.

With respect to occupation, the majority of farmers in the study area were daily wage labourers (65.17%), while smaller proportions were engaged in livestock farming (14.84%), agriculture (8.68%), and agricultural labour (9.00%). Thus, livestock farmers in flood-prone Cuddalore were primarily dependent on wage-based livelihoods. This contrastedwith reports from other regions. Patnaik (2021) observed that crop+livestock rearing was the primary livelihood for 56.88% of households in flood-prone Odisha. Sachin et al. (2022) reported dairying as the primary occupation of 79.3% of respondents in Kerala's flood-affected districts, while Gautam et al. (2007) also observed dairying as the main occupation in Varanasi district, Uttar Pradesh. By contrast, Rathod et al. (2009) reported that agriculture was the major livelihood (83.75%) of livestock farmers in Karnataka, with dairying as a supplementary activity. Sharma et al. (2012) also found that agriculture and animal husbandry together were the primary activities for 78% of dairy farmers in Kheda district, Gujarat.

Poverty was widespread in the study area, with 95.83% of respondents living below the poverty line. Landholding patterns further reflected economic vulnerability: 33.00% of farmers were landless, 36.17% owned less than one acre and 21.17% had 1–2 acres, while only a small minority possessed more than two acres. In contrast, higher landholdings have been reported in other regions. For example, Tajpara et al. (2020) found no landless farmers among dairy farmers in Rajkot, Gujarat; instead, 14% were marginal farmers (<1 ha), 38.34% were small farmers (1.1–2 ha), and 32% were semi-medium farmers (2.1–4 ha). Sharma et al. (2012) reported that 80% of livestock farmers in Mahamaya Nagar district, Uttar Pradesh, held between 1 and 4 ha of land, while in Kheda district, Gujarat, 58% of respondents had small to medium landholdings. Mane et al. (2016) also documented a more balanced distribution of landholdings among dairy farmers in Jalgaon district, Maharashtra, with 6.5% landless, 23% marginal, 27% small, 29% medium, and 14.5% large landholders. Compared to these regions, the predominance of landlessness and smallholdings in Cuddalore highlighted the limited economic base of farmers, who relied more heavily on livestock than on agriculture for subsistence.

Statistical analysis further revealed that gender had no significant influence on livestock rearing across the GGAs. However, illiterate respondents were significantly more involved in livestock rearing compared to literates ($p<0.01$). Daily wage labour emerged as the predominant primary occupation ($p<0.01$), while livestock rearing was the most significant secondary occupation across GGAs ($p<0.01$). Landholding below one acre was also significantly more common ($p<0.01$) in the study area.

3.2. Dimensions of animal shelters

Nearly half of the respondents (49.17%; n=295) reported having thatched-roof animal houses, while 10.67% (n=64) maintained sheet-roof structures. A considerable proportion (40.16%; n=241) did not provide any form of animal housing, and none of the respondents had constructed pucca sheds. A similar trend was observed by Tajpara et al. (2020) in Rajkot district of the Saurashtra region of Gujarat, where 15.33% of dairy farmers had no cattle sheds, 72.00% maintained traditional sheds, and only 12.67% had scientific cattle sheds. These findings contrasted with observations from Odisha, where Behera et al. (2021) reported that 45–51% of farmers in flood-prone districts constructed *pucca* houses for livestock, and nearly 70% elevated their sheds above ground level as an adaptation to recurrent floods. They also noted that constructing flood-resilient animal housing was considered the most important strategy in minor flood-prone Dhenkanal district, while in major flood-prone Balasore district, it was ranked as the second most important strategy. In the present study, however, such practices were not observed, possibly due to lower literacy rates, lack of awareness, and minimal exposure to adaptation guidelines. The absence of organized commercial farms and the relatively small herd sizes (less than four animals farmer^{-1} on average) mightalso explain the limited adoption of permanent or elevated livestock housing. Globally, the Livestock Emergency Guidelines and Standards (LEGS) emphasized that preparedness in disaster-prone areas should include the construction of species-and region-specific flood-/storm-resistant shelters tailored to local contexts (Prem, 2023). The mean (±SE) dimensions of animal sheds in the three GGAs of Cuddalore district were presented in Table 2.

The mean length of sheds in GGA I, II, and III was 14.69, 15.10, and 14.73 ft, respectively, with an overall mean of 14.82 ft (range: 3–84). The corresponding mean widths were 10.82, 10.98, and 10.78 ft, with an overall mean of 10.85 ft (range: 5–80). The mean side wall heights were 6.79, 7.59, and 7.36 ft, respectively, with an overall mean of 7.21 ft (range: 1–12). The ridge heights were 10.14, 10.85, and 10.48 ft, respectively, with an overall mean of 10.46 ft (range: 2–13).

Statistical analysis showed no significant differences in shed length and width among the GGAs. However, both sidewall height ($p<0.05$) and ridge height ($p<0.01$) differed

Table 2: Shelter dimensions in different geographical areas offlood prone Cuddalore district

Sl. No.	Descriptive (Feet)	Study location based on altitude			Significance	Overall Mean (Range)
		GGA I (up to 10 m)	GGA II (10.1–20 m)	GGA III (>20 m)		
1.	Shelter length	14.69±0.69	15.1±0.51	14.73±0.54	NS	14.82±0.35 (3–84)
2.	Shelter width	10.82±0.58	10.98±0.28	10.78±0.29	NS	10.85±0.25 (5–80)
3.	Sidewall height	6.79^{a}±0.14	7.59^{b}±0.14	7.36^{b}±0.15	**	7.21±0.08 (1–12)
4.	Height at ridge	10.14^{a}±0.16	10.85^{ab}±0.17	10.48^{ab}±0.17	*	10.46±0.10 (2–13)

NS: Not significant; *Significant (p<0.05); ** Significant (p<0.01); ^{ab}Mean with different superscripts in the same row differ significantly (p<0.05); Values in parentheses indicate the data range

significantly, with higher values in GGA II and GGA III compared to GGA I. This suggested that although the basic floor dimensions of sheds were similar across regions, structural variations in height might reflect differences in ventilation needs or local construction practices.

Earlier studies also highlighted the importance of housing design in flood-and cyclone-prone areas. Behera et al. (2020) reported that a majority (55.38%) of farmers in flood-prone districts of Odisha constructed sheds slightly above ground level to protect livestock during floods. Mandal et al. (2022) recommended disaster-resilient housing strategies such as a double-slope roof with an open ridge for loose housing systems and pyramidal roofing for close housing systems in cyclone-prone coastal regions.

Taken together, the findings from Cuddalore district indicate a predominance of thatched structures with limited use of permanent or disaster-resilient housing, leaving livestock vulnerable during floods. The observed variations in shed height across GGAs might represent localized adaptations, but overall, the absence of pucca housing highlighted the need for promoting improved and climate-resilient livestock shelter designs.

3.3. Livestock holding

The livestock holdings of farmers in flood-prone areas of Cuddalore district, stratified by mean sea level, were presented in Table 3. The average number of non-descriptive cattle household^{-1} was 1.73 in GGA I, 2.16 in GGA II, and 1.94 in GGA III, with an overall mean of 1.94. Crossbred cow holdings showed marked variation: farmers in GGA I maintained an average of 0.80 cows, while no crossbred cows were reported in GGA II, and farmers in GGA III kept an average of 0.32 cows. The overall mean across the district was 0.39 (range: 0–12). Buffaloes were relatively less common, with average holdings of 0.37 in GGA I, 0.00 in GGA II, and 0.01 in GGA III, giving an overall mean of 0.13 (range: 0–6).

Among small ruminants, goats were the most widely kept species, with mean holdings of 2.73, 2.37, and 4.46 in GGA I, II, and III, respectively, and an overall mean of 3.23 (range: 0–75). Sheep were less frequently maintained, with mean holdings of 1.55 in GGA I, 0.33 in GGA II, and none in GGA III, giving an overall mean of 0.64 (range: 0–100).

Table 3: Holding of livestock and poultry in different geographical areas of flood prone Cuddalore district

Sl. No.	Descriptive (Numbers)	Study location based on altitude			Significance	Overall Mean (Range)
		GGA I (up to 10 m)	GGA II (10.1–20 m)	GGA III (>20 m)		
1.	Non-descriptive cow	1.73±0.19	2.16±0.18	1.94±0.24	NS	1.94^{D}±0.12 (0–30)
2.	Cross bred cow	0.80^{c}±0.13	0.00^{a}±0.00	0.32^{b}±0.07	**	0.39^{ABC}±0.05 (0–12)
3.	Buffalo	0.37^{b}±0.07	0.00^{a}±0.00	0.01^{a}±0.01	**	0.13^{AB}±0.03 (0–6)
4.	Goat	2.73^{a}±0.30	2.37^{a}±0.37	4.46^{b}±0.54	**	3.23E±0.25 (0–75)
5.	Sheep	1.55^{b}±0.66	0.33^{a}±0.25	0.00^{a}±0.00	*	0.64^{ABC}±0.25 (0–100)
6.	Pig	0.00^{a}±0.00	0.02^{b}±0.03	0.00^{a}±0.00	*	0.01^{A}±0.01 (0–5)
7.	Desi chicken	2.52^{a}±0.41	2.34^{a}±0.46	4.49^{b}±0.58	**	3.16^{E}±0.29 (0–60)
8.	Turkey	1.20±0.31	1.67±1.67	0.00±0.00	NS	0.92^{C}±0.51 (0–300)

NS: Not significant; *: Significant (p<0.05); **: Significant (p<0.01); ^{ab}Mean with different superscripts in the same row differ significantly (p<0.05); ^{ABCDE}Mean with different superscripts in the column differ significantly (p<0.05); Values in parentheses indicate the data range

Pig rearing was negligible, recorded only in GGA II with a mean holding of 0.02 household^{-1}, yielding an overall mean of 0.01 (range: 0–5).

Statistical analysis revealed significant differences across the GGAs. Goat and crossbred cow holdings were significantly higher (p<0.01) in GGA III compared to GGA I and II. Crossbred cow and sheep holdings were significantly higher (p<0.05) in GGA I than in the other two GGAs, while crossbred calf and pig holdings were significantly higher in GGA II. No significant differences were observed for non-descriptive cattle or turkey holdings across the study regions.

The predominance of goats as the preferred small ruminant in flood-prone areas highlighted their adaptability, short generation interval, and relatively low feed and housing requirements, making them a resilient choice under resource-constrained and disaster-prone environments. This finding was consistent with Singh et al. (2015), who reported that goats played a crucial role in supporting livelihoods in disaster-vulnerable regions due to their multipurpose utility and low maintenance costs. Similarly, Mane et al. (2016) observed that the majority (76.00%) of dairy farmers in Jalgaon district of Maharashtra maintained medium herd sizes (3–7 animals), while only 9.00% had small herds (≤2 animals), indicating that household herd composition varies widely across regions depending on resource availability and vulnerability factors.

The relatively lower numbers of buffaloes and pigs in the present study could be attributed to the high susceptibility of these species to waterlogging, poor adaptability to flooded environments, and higher feeding and management costs. Comparable findings were reported by Behera et al. (2020) in Odisha, where farmers in flood-prone areas preferred species like cattle and goats over buffaloes and pigs.

Overall, the results suggested that flood-prone households in Cuddalore district primarily relied on small ruminants and non-descriptive cattle for subsistence and livelihood security, while crossbred cows and buffaloes were less common due to their higher input requirements and greater vulnerability during floods.

3.4. Stocking density

The mean±SE of animal stocking density in different flood-prone areas of Cuddalore district was presented in Table 4. The overall mean number of animals shed^{-1} was 9.67, 9.98, and 12.27 in GGA I, II, and III, respectively, with an overall mean of 10.68 (range: 0–302).Species-wise analysis revealed that cows were maintained at mean numbers of 3.64, 3.03, and 3.65 shed^{-1} in GGA I, II, and III, respectively, with an overall mean of 3.45 (range: 0–30). Goats were the most prominent small ruminants, with mean holdings of 4.96, 7.45, and 5.33 across the three GGAs, giving an overall mean of 5.46 (range: 0–75). Sheep were less common, with averages of 3.52, 0.00, and 3.07 shed^{-1} (overall mean 3.33; range: 0–100). Pigs were recorded in low numbers, with averages of 1.09, 4.88, and 2.00 in GGA I, II, and III, respectively, yielding an overall mean of 1.64 (range: 0–40). Among poultry, desi chickens were maintained at 2.13, 2.16, and 2.42 shed^{-1} across the three GGAs, with an overall mean of 2.24 (range: 0–60). Turkey stocking was more variable, with means of 1.33, 6.79, and 4.54 in GGA I, II, and III, respectively, producing an overall mean of 3.88 (range: 0–300).

Statistical analysis revealed that the overall stocking density was significantly (p<0.01) higher in GGA II compared to GGA I, though no significant differences were observed between GGA II and III. Across species, no significant differences in stocking density were detected for cows, goats, sheep, pigs, chickens, or turkeys among the three GGAs. Likewise, the practice of tying animals within shelters did

Table 4: Stocking density of animals shelter^{-1} in different geographical areas of flood prone Cuddalore district

Sl. No.	Descriptive (Numbers)	Study location based on altitude			Significance	Overall mean (Range)
		GGA I (up to 10 m)	GGA II (10.1–20 m)	GGA III (>20 m)		
1.	Cow	3.64±0.29	3.03±0.20	3.65±0.38	NS	03.45^{A}±0.17 (0–30)
2.	Goat	4.96±0.58	7.45±1.8	5.33±0.84	NS	05.46^{AE}±0.51 (0–75)
3.	Sheep	3.52±1.40	0.00±0.00	3.07±0.43	NS	3.33^{BC}±0.83 (0–100)
4.	Pig	1.09^{a}±0.64	4.88^{b}±0.72	2.00^{a}±0.00	NS	01.64^{B}±0.42 (0–40)
5.	Desi chicken	2.13±0.41	2.16±0.51	2.42±0.46	NS	02.24^{A}±0.26 (0–60)
6.	Turkey	1.33±0.10	6.79±4.81	4.54±0.96	NS	03.88^{CD}±1.36 (0-300)
7.	Tying animal total	9.67±0.85	9.98±1.84	12.27±0.89	NS	10.68±0.7 (0–302)

NS: Not significant; *: Significant (p<0.05); **: Significant (p<0.01); ^{ab}Mean with different superscripts in the same row differ significantly (p<0.05); ^{ABCDE}Mean with different superscripts in the column differ significantly (p<0.05); Values in parentheses indicate the data range not vary significantly across the study areas.

Comparable findings have been reported from Bangladesh, where Abulude and Fadiyimu, (2024) observed that larger herds with poor infrastructures often experienced higher mortality during floods due to inadequate shelter. Similarly, Singh et al. (2015) emphasized that poor housing and high stocking densities increased susceptibility to disease outbreaks during natural calamities.

Taken together, the results highlighted that although stocking densities in the present study were moderate, the lack of climate-resilient housing and limited preparedness strategies could exacerbate the vulnerability of livestock farmers during recurrent floods.

3.5. Concentrate feeding

The levels of concentrate feeding for cattle across different flood-prone Geographical Areas (GGA) of Cuddalore district were presented in Table 5. Under normal conditions, the average daily concentrate feeding was 1.07, 1.17, and 1.35 kg in GGA I, II, and III, respectively, with an overall mean of 1.20 kg. During floods, concentrate feeding showed a marginal increase to 1.30, 1.31, and 1.32 kg in GGA I, II, and III, respectively (overall mean 1.31 kg). After floods, the quantity of concentrate offered rose sharply, averaging 4.07, 4.14, and 2.94 kg in GGA I, II, and III, respectively, with an overall mean of 3.81 kg.

Statistical analysis revealed that concentrate feeding under normal conditions was significantly (p<0.01) higher in GGA III compared to GGA I and II. However, no significant differences were observed across GGAs during or after floods. Overall, concentrate feeding was lowest during floods (1.31 kg) and highest after floods (3.81 kg), reflecting adaptive responses to feed scarcity and the need to support animals in post-flood recovery.

Table 5: Concentrate feeding (kg) for cattle in different geographical areas of flood prone Cuddalore district

Sl. No.	Concentrate feed given day^{-1} (kg)	Study location based on altitude			Significance	Overall Mean (Range)
		GGA I (up to 10 m)	GGA II (10.1–20 m)	GGA III (>20 m)		
1.	Routinely	1.07a±0.05	1.17a±0.03	1.35b±0.05	**	1.20±0.25 (1–61)
2.	During flood	1.3±0.03	1.31±0.04	1.32±0.04	NS	1.20±0.03 (0–3)
3.	After flood	4.07±0.22	4.14±0.71	2.94±0.26	NS	3.81±0.02 (0–3)

NS: Not significant; *: Significant (p<0.05); **: Significant (p<0.01); [ab]Mean with different superscripts in the same row differ significantly (p<0.05); Values in parentheses indicate the data range

During floods, concentrates were often used to compensate for forage shortages. Comparable findings have been reported elsewhere. For instance, Behera et al. (2021) observed that farmers in flood-prone districts of Odisha relied heavily on concentrate feeding as an adaptation strategy when grazing resources were lost. Similarly, Singh et al. (2015) emphasized the importance of concentrate supplementation in disaster-hit areas to maintain livestock productivity and safeguard household livelihoods.

In all study villages, farmers did not provide concentrates to small ruminants. While concentrate supplementation was not a routine practice under normal conditions, limited supplementation during and after floods was observed. This pattern wasconsistent with the recommendations of Kashyap et al. (2021), which emphasized concentrate feeding during emergencies, often facilitated by veterinary extension advice and the distribution of feed supplies by the Department of Animal Husbandry and voluntary organizations.

This study observed a changing trend in the quantity of feed provided to animals over the course of a flood disaster. However, abrupt dietary changes could predispose animals to digestive disturbances and reduced performance (Llewellyn et al., 2016). Therefore, gradual dietary transitions were recommended, with new feeds introduced in small amounts and progressively increased while reducing familiar feeds (Chiba, 2014). After floods, farmers commonly increase concentrate feeding to 3–6 kg day^{-1} to aid stress recovery and restore milk production, a practice also highlighted by Dillard et al. (2022).

The Livestock Emergency Guidelines and Standards (LEGS) emphasized feed security as a critical component of disaster preparedness, recommending procurement, storage, and timely distribution of feed to meet increased demands during and after flood events (Prem, 2023). Integrating such preparedness strategies into local livestock management systems in flood-prone districts like Cuddalore could substantially reduce flood-related production losses and improve resilience.

4. CONCLUSION

Male farmers predominantly engaged in livestock rearing, while widespread illiteracy limited the adoption of improved management practices. Most farmers were landless or owned less than one acre, relying heavily on livestock for their livelihood. Thatched or sheet-roofed shelters were common, with many households lacking proper housing. Livestock holdings were small, and concentrate feeding increased after floods.

5. REFERENCES

Agrawala, S., Ota, T., Ahmed, A.U., Smith, J., van Aalst, M., 2003. Development and climate change in Bangladesh: Focus on coastal flooding and the Sundarbans. Organisation for Economic Co-operation and Development (OECD), Paris, France. https://research.fit.edu/media/site-specific/researchfitedu/coast-climate-adaptation-library/asia-amp-indian-ocean/bangladesh/OECOD.--2003.--DEVELOPMENT-AND-CLIMATE-CHANGE-in-Bangladesh.pdf.

Abulude, F.O., Fadiyimu, A.A., 2024. The impact of flooding on dairy cattle farms: Challenges, consequences, and mitigation strategies. ASEAN Journal of Agriculture and Food Engineering 3(2), 89–124. https://ejournal.bumipublikasinusantara.id/index.php/ajafe/article/view/505.

Anonymous, 2012. Post disaster damage, loss and needs assessment in agriculture, Food and Agriculture Organization of the United Nations. Available from: https://www.fao.org/4/an544e/an544e00.pdf. Accessed on: August 21, 2025.

Anonymous, 2021. Population census report 2011–2021. Office of the Registrar General & Census Commissioner, India. Government of India. Available from: https://censusindia.gov.in. Accessed on: August 21, 2025.

Bayazid, A.A., Harun, A.B., Billah, M.M., Afrin, M., Ali, M.Z., Meher, M.M., 2025. Impact of flood on livestock farming and a possible solution to reduce the suffering of livestock in the Haor region of Bangladesh. Journal of Research in Veterinary Sciences 5(2), 144–155. https://doi.org/10.5455/JRVS.20250220104116

Behera, J., Jha, S.K., Maiti, S., Garai, S., 2021. A study on housing management strategies adopted by livestock rearers in flood-prone districts of Odisha. Journal of Community Mobilization and Sustainable Development 16(1), 223–228. DOI: 10.13140/RG.2.2.12143.10400.

Behera, J., Jha, S.K., Maiti, S., Garai, S., Latha, M.C., 2020. Perception of livestock-rearers about environmental impact of the flood in Odisha, India. Indian Journal of Extension Education 56(3), 21–26. https://doi.org/10.5958/2454-552X.2020.00021.3.

Bissett, W., Huston, C., Navarre, C.B., 2018. Preparation and response for flooding events in beef cattle. Veterinary Clinics of North America: Food Animal Practice 34(2), 309–324. https://doi.org/10.1016/j.cvfa.2018.03.005.

Cerda, J.R., Webb, T.L., 2023. Wildlife conservation and preserving biodiversity: Impactful opportunities for veterinarians? Journal of the American Veterinary Medical Association 261(7), 1–9. https://doi.org/10.2460/javma.23.02.0094.

Chiba, L., 2014. Beef cattle nutrition and feeding. In: Animal Nutrition Handbook. University of Auburn. https://agriculture.auburn.edu/wp-content/uploads/2021/12/Anmal-Nutrition-Handbook-2014-3rd-Rev-Chiba.pdf.

Choudhury, M., Moshahary, J., Basumatary, B. Z., Deka, P., Sarma, B., Ahmed, P., 2025. Spatial and temporal assessment of flood-affected areas in Dhubri district of Assam using RS and GIS. International Journal of Bio-resource and Stress Management 16(4), 1–9. https://doi.org/10.23910/1.2025.6060.

Chowdhury, M.S.R., Ahsan, M.I., Khan, M.J., Rahman, M.M., Hossain, M.M., Harun-Al-Rashid, A., 2020. Data on prevalence, distribution and risk factors for Foot and Mouth Disease in grazing cattle in Haor areas of Bangladesh. Data in Brief 28, 104843. https://doi.org/10.1016/j.dib.2019.104843.

Dewan, T.H., 2015. Societal impacts and vulnerability to floods in Bangladesh and Nepal. Weather and Climate Extremes 7, 36–42. https://doi.org/10.1016/j.wace.2014.11.001.

Dey, N.C., Parvez, M., Islam, M.R., 2021. A study on the impact of the 2017 early monsoon flash flood: Potential measures to safeguard livelihoods from extreme climate events in the Haor area of Bangladesh. International Journal of Disaster Risk Reduction 59, 102247. https://doi.org/10.1016/j.ijdrr.2021.102247.

Dillard, L., Mullenix, K., Rodning, S., 2022. Animal, forage & feed management after a flood. Alabama Cooperative Extension System. https://www.aces.edu/blog/topics/beef/animal-forage-feed-management-after-a-flood/.

Fahim, T.C., Sikder, B.B., 2022. Exploring farmers' perception of climate-induced events and adaptation practices to protect crop production and livestock farming in the Haor area of north-eastern Bangladesh. Theoretical and Applied Climatology 148, 1–14. https://doi.org/10.1007/s00704-021-03907-3.

Ferdushi, K.F., Ismail, M.T., Kamil, A.A., 2019. Perceptions, knowledge and adaptation about climate change: A study on farmers of Haor areas after a flash flood in Bangladesh. Climate 7(7), 85. https://doi.org/10.3390/cli7070085.

Gautam, U.S., Chand, R., Singh, D.K., 2007. Socio-personal correlation for decision-making and adoption of dairy practices. Indian Research Journal of Extension Education 7, 122–123. https://seea.org.

in/irjee/view-content/socio-personal-correlation-for-decision-making-and-adoption-of-dairy-practices.

Ghatak, M., Kamal, A., Mishra, O.P., 2012. Flood risk management in South Asia: Background paper for SAARC workshop. SAARC Disaster Management Centre, New Delhi, India. https://www.researchgate.net/publication/260455592_Background_paper_on_Flood_Risk_Management_in_South_Asia.

Gnanaraj, P.T., Silambarasan, P., Vanan, T.T., Churchil, R.R., Vengadabady, N., 2023. Flood vulnerability and livestock production risks: Hazard mapping of flood-prone areas of the Cuddalore District of Tamil Nadu, India. Biological Forum–An International Journal 15(5), 1124–1130. https://www.researchgate.net/publication/371788200_Flood_Vulnerability_and_Livestock_Production_Risks_Hazard_Mapping_of_Flood-_Prone_Areas_of_the_Cuddalore_District_of_Tamil_Nadu_India.

Gupta, S., Javed, A., Datt, D., 2003. Economics of flood protection in India. Natural Hazards 28, 199–210. https://link.springer.com/article/10.1023/A:1021142404009.

Heath, S.E., Kenyon, S.J., Zepeda Sein, C.A., 1999. Emergency management of disasters involving livestock in developing countries. Scientific and Technical Review 18, 256–271. DOI: 10.20506/rst.18.1.1158.

Hoegh-Guldberg, F., Visintin, C., Lentini, P., Selinske, M., Bekessy, S., 2024. Where is the nature in nature-based flood management? Biodiversity is not considered enough. Science of the Total Environment 957, 177698. https://doi.org/10.1016/j.scitotenv.2024.177698.

Hoq, M.S., Raha, S.K., Hossain, M.I., 2021. Livelihood vulnerability to flood hazard: Understanding from the flood-prone Haor ecosystem of Bangladesh. Environmental Management 67(3), 532–552. https://doi.org/10.1007/s00267-021-01441-6.

Kashyap, S., Prusty, S., Dubey, M., Santra, A.K., Jain, A., 2021. Feeding strategies during natural calamities. The Pharma Innovation Journal 10(1), 232–236. https://www.thepharmajournal.com/archives/2021/vol10issue1S/PartD/S-10-1-41-785.pdf.

Khan, N.S., Shawal, S., Hossain, M.A., Tasnim, N., Whitehead, P.G., Rahman, M., 2024. Assessing flooding extent and potential exposure to river pollution from urbanizing peripheral rivers within Greater Dhaka watershed. Scientific Reports 14, 29341. https://doi.org/10.1038/s41598-024-80063-4.

Khan, N., Rehman, A., Salman, M.S., 2013. Impact of livestock rearing on the socio-economic development in North India. Forum Geografic 12(1), 75–80. https://doi.org/10.5775/fg.2067-4635.2013.084.i.

Llewellyn, D., Walker, E., McLean, L., Nelson, M., 2016. Feeding livestock during and after a disaster. Washington State University Extension; U.S. Department of Agriculture. https://wpcdn.web.wsu.edu/wp-extension/uploads/sites/2128/2022/08/Feeding-Livestock-During-After-a-Disaster.pdf.

Mandal, D.K., Swain, S.K., Debbarma, A., Rai, S., Bhakat, C., Das, S.K., Ghosh, M.K., 2022. Sahyadri Panchamukhi: A Red Rice Variety Identified for Lowland Situation of Coastal Karnataka. In: Lama, T., Burman, D., Mandal, U.K., Sarangi, S.K., Sen, H. (Eds.), Transforming coastal zone for sustainable food and income security. Springer 83–100. https://doi.org/10.1007/978-3-030-95618-9_7.

Mane, D.U., Dhumal, M.V., Siddiqui, M.F., Kochewad, S.A., Meena, L.R., Kumar, S., 2016. Knowledge of dairy farmers about improved animal management practices. Agro Economist-An International 3(2), 87–90. https://doi.org/10.5958/2394-8159.2016.00017.7.

Meher, M.M., Bayazid, A.A., Harun, A.B., Afrin, M., 2024. Seroprevalence of *Mycoplasma gallisepticum* infection in poultry and impact of biosecurity practices. Veterinary Integrative Sciences 22(3), 1055–1072. https://doi.org/10.12982/VIS.2024.071.

Messner, F., Penning-Roswell, E., Green, C., Tunstall, S., Veen, A., Tapsell, S., Haase, D., 2007. Evaluating flood damages: Guidance and recommendations on principles and methods. Flood Risk Management: Hazards, Vulnerability and Mitigation Measures, 178. https://www.floodsite.net/html/partner_area/project_docs/T09_06_01_Flood_damage_guidelines_d9_1_v2_2_p44.pdf.

Patnaik, N.M., 2021. Livelihood analysis of livestock farmers in disaster prone areas of Odisha. Doctoral dissertation, ICAR-National Dairy Research Institute, Karnal, Haryana, India. http://ndri.res.in/sites/default/files/Annual_report_2019.pdf.

Prem, H.T., 2023. Livestock emergency guidelines and standards (LEGS). Vesey Farm, Little Clacton Road, Great Holland, Essex, United Kingdom. https://www.livestock-emergency.net/wp-content/uploads/2023/03/LEGS-Floods-and-Tropical-Storms-Briefing-Paper.pdf.

Rahman, M.A., Mallick, F.H., Mondal, M.S., Rahman, M.R., 2015. Flood shelters in Bangladesh. In: Shroder, J.F. (Ed.), Hazards, risks, and disasters in society. Academic Press, pp. 145–159. https://doi.org/10.1016/B978-0-12-396451-9.00009-3.

Rathod, P., Landge, S.N., Nikam, T.R., Vajreshwari, S., 2009. Socio-personal profile and constraints of dairy farmers. Karnataka Journal of Agricultural Sciences 24, 619–621. https://www.researchgate.net/

publication/279501638_Socio-personal_profile_and_constraints_of_dairy_farmers.

Rozaki, Z., Wijaya, O., Rahmawati, N., Rahayu, L., 2021. Farmers' disaster mitigation strategies in Indonesia. Review of Agricultural Science 9, 178–194. https://doi.org/10.7831/ras.9.0_178.

Sachin, B.P., Biya, A.J., Reeja, G.P., Harikumar, S., Gleeja, V.L., Joseph, M., 2022. The Kerala floods of 2018–Exploring the socio-economic characteristics of flood affected dairy farmers in Ernakulam and Thrissur districts. Journal of Veterinary and Animal Sciences 53(1), 7–12. https://doi.org/10.51966/jvas.2022.53.1.7-12.

Saini, P., Gupta, A., Rathore, B., Meena, A.K., Kumari, K., Saini, P., Saini, P., 2024. Prevalence and risk factor assessment of gastrointestinal parasitic infections in cattle of flood-prone eastern plains of Rajasthan. International Journal of Bio-resource and Stress Management 15(5), 1–10. https://doi.org/10.23910/1.2024.5276.

Sen, A., Chander, M., 2003. Disaster management in India: The case of livestock and poultry. Revue Scientifique et Technique 22, 915–930. DOI: 10.20506/rst.22.3.1453.

Sharma, P.K., Shekhawat, B.S., Chaudhary, M.K., 2012. Knowledge of dairy farmers about improved animal husbandry practices in Kheda district of Gujarat. Journal of Krishi Vigyan 1(1), 49–53. https://iskv.in/wp-content/themes/iskv/volume-pdfs/8a753ce4bbcd316a913bac3482c6e713jkv-1-1-012.pdf.

Silambarasan, P., Vanan, T.T., Kumaravel, N., Churchil, R.R., Vengadabady, N., Rajkumar, N.V., 2022b. Level of adoption of flood disaster mitigation strategies by livestock farmers during flood disaster in Cuddalore District of Tamil Nadu. Biological Forum–An International Journal 14(2a), 420–424. https://www.researchgate.net/publication/364322570_Level_of_Adoption_of_Flood_Disaster_Mitigation_Strategies_by_Livestock_Farmers_during_Flood_Disaster_in_Cuddalore_District_of_Tamil_Nadu.

Silambarasan, P., Vanan, T.T., Kumaravelu, N., Vengadabady, N., Churchil, R.R., Rajkumar, N.V., 2022a. A study on the mortality of livestock and poultry during flood disaster in Cuddalore district. The Pharma Innovation Journal SP-11(8), 2046–2049. https://www.thepharmajournal.com/archives/2022/vol11issue8S/PartAA/S-11-8-86-929.pdf.

Singh, M.K., Dixit, A.K., Kumar, N., Ramachandran, N., Singh, S.K., Singh, S.V., Roy, A.K., Yadav, J.S., Singh, A.K., Singh, R., Singh, P., 2015. Goat – For nutritional and livelihood security in Bundelkhand region. Indian Farming 63(10). https://epubs.icar.org.in/index.php/IndFarm/article/view/49416.

Tajpara, M.M., Kalsariya, B.N., Dadhania, V.P., 2020. Knowledge of dairy farmers towards improved animal husbandry practices. Gujarat Journal of Extension Education 31(2), 163–168. https://www.gjoee.org/papers/1150.pdf.

Wozniak, M., Stablein, C., Zuk, N., Kreisler, R., 2018. A student-run free mobile veterinary clinic in the Phoenix metropolitan area. Journal of Student-Run Clinics 4(1), 1–5. https://doi.org/10.59586/jsrc.v4i1.63.