



Approaches and Measures for Managing Livestock Amid Floods: A Study in Udalguri District, Assam

Pallavi Deka¹, Pallabi Das², Diganta Sharmah¹, Pallavi Saikia³,
Himadri Rabha¹, Pradip Rajbangshi¹, Debasish Borah⁴

10.18805/IJAR.B-5609

ABSTRACT

Background: Assam accounts for 3.25 per cent of India's total livestock, with significant contributions from cattle, pigs and poultry. Udalguri, a of Assam with 4.97 lakh of total livestock population which is 3.83 per cent of the total in Assam has experienced severe floods yearly with 38488 ha flood inundated area (19 per cent of the of the district's total land area i.e 197518 ha). Considering the above facts, the present study was taken up to assess the livestock losses, identifying the problems faced and strategies adopted by the livestock growers, association among different strategies adopted along with the factors influencing farmers' strategies and actions for managing livestock during and after floods in Udalguri district of Assam.

Methods: For the present research work, statistical techniques namely purposive and random sampling were followed for selecting 25 numbers of farmers from each eight villages of the two revenue circles i.e Kalaigaon and Udalguri which make upto 200 respondents in total. The data were gathered using a pre-tested schedule through personal interviews conducted in November and December 2024. The data were subjected to frequency, percentage, rank, Pearson correlation coefficient, Binary logit regression and Pareto analysis.

Result: The results revealed that during 2023-24, there was a monetary loss of an average Rs. 30080.10 with an average of 8 livestock losses per household. The issues encountered by the livestock growers were loss of grazing areas (100%) and disease spread (94.5%) with rank I and II respectively. The mitigating strategies adopted were like construction of animal sheds in the highlands (94.5%), feeding of locally available crop residues and making hay/ bales (100%) and vaccination of animals before or after flood (48%). There was a strong correlation between feeding of locally available crop residues and making hay/bales ($r=1.00$), a moderate correlation between vaccination of animals before or after flood with the construction of animal sheds in highlands ($r=0.72$) and a weak correlation between silage making with the construction of pucca sheds for animals ($r=0.32$). Age (-0.091) and farm size (-9.214) are significantly negative while education (1.354), family income (0.0021) and training received (1.235) were found to positively influence farmers' strategies and actions for managing livestock during floods.

Key words: Binary logit regression, Flood, Livestock growers, Mitigating strategies, Pareto analysis, Pearson correlation coefficient.

INTRODUCTION

Livestock plays a pivotal contribution to the socio-economic fabric of rural India. It provides a relatively safe investment option and give the owner social importance (Rushton *et al.* 1999). India is home to one of the largest livestock populations in the world, with approximately 535.78 million animals, according to the 20th Livestock Census of 2019.

Assam adds substantially to the livestock population of approximately 19.3 million, encompassing cattle, buffaloes, goats, pigs and poultry (20th Livestock Census, Assam, 2019). Despite its significance, the livestock sector in Assam faces recurrent challenges due to the state's vulnerability to natural disasters, particularly floods.

Assam, located in the northeastern region of India, experiences annual monsoonal floods, with over 40 percent of its geographical area prone to inundation. The state recorded 1,264 flood events between 1953 and 2023, leading to significant socio-economic and environmental losses. The floods affect human settlements and wreak havoc on the livestock sector by causing loss of life, displacement, feed shortages and disease outbreaks. During the devastating floods of 2022, over 0.44 million livestock were affected across 34 districts in Assam (Assam Flood Memorandum, 2023).

¹Krishi Vigyan Kendra, Assam Agricultural University, Udalguri-784 509, Assam, India.

²Department of Extension Education, College of Agriculture, Assam Agricultural University, Jorhat-785 013, Assam, India.

³Krishi Vigyan Kendra, Assam Agricultural University, Golaghat-785 619, Assam, India.

⁴All India Coordinated Research Project on Integrated Farming Systems, Assam Agricultural University, Jorhat-785 013, Assam, India.

Corresponding Author: Pallabi Das, Department of Extension Education, College of Agriculture, Assam Agricultural University, Jorhat-785 013, Assam, India. Email: pallabi.das@aau.ac.in
ORCIDs: 0000-0001-9750-0287; 0000-0001-6247-4058; 0009-0002-4345-4332; 0009-0002-4916-9264; 0009-0003-6474-6688; 0009-0003-4345-4432; 0001-0002-8243-8051.

How to cite this article: Deka, P., Das, P., Sharmah, D., Saikia, P., Rabha, H., Rajbangshi, P. and Borah, D. (2025). Approaches and Measures for Managing Livestock Amid Floods: A Study in Udalguri District, Assam. *Indian Journal of Animal Research*. 1-8. doi: 10.18805/IJAR.B-5609.

Submitted: 23-04-2025 **Accepted:** 22-07-2025 **Online:** 22-08-2025

Udalguri, a flood-prone district in the Bodoland Territorial Region of Assam, epitomizes the challenges faced by

livestock farmers during floods. The district, with 5 revenue circles and 323 village having 8.32 lakh human population and livestock population of approximately 0.36 million (20th Livestock Census, Assam, 2019), frequently grapples with inundation caused by rivers like the Dhansiri and their tributaries. These floods not only jeopardize the survival of livestock but also strain the livelihoods of farmers who depend on them. In the floods of 2020, Udalguri recorded substantial damage, with over 32,000 hectares of agricultural land submerged and significant livestock losses reported (Assam Flood Memorandum, 2023).

Given the critical role of livestock in rural livelihoods and the recurrent nature of floods in Assam, it is imperative to explore and implement effective strategies for livestock management during such disasters. Hence, this investigation was carried out to assess the livestock losses, identifying the problems faced and strategies adopted by the livestock growers, association among different strategies adopted along with the factors influencing farmers' strategies and actions for managing livestock during and after floods in Udalguri district of Assam.

MATERIALS AND METHODS

The present study was conducted during the month of November and December 2024 at Udalguri district situated at North Bank plain zone plain of Assam lies at 26°75'N latitude and 92°10'E longitude. The study was conducted under the supervision of Krishi Vigyan Kendra, Udalguri, Assam Agricultural University. Purposive and random sampling techniques were followed for selecting 25 numbers of farmers from each eight villages of the two revenue circles i.e Kalaigaon and Udalguri which make up an overall count of 200 respondents. The identified villages were *Geruagaon*, *Amguribagan*, *Sintagaon* and *Rupatol* from Kalaigaon circle and *Aminpara*, *Sidhakhowa*, *Singrimari bagicha* and *Amguri gaon no.2* from Udalguri circle. Eight numbers of socio-personal characteristics of the livestock growers were opted for the analysis. The data collection was done by personal interview method with a pretested schedule. To analyse the problems encountered by the livestock growers at the time of flood, open-ended questions were asked and then subjected to frequency, percentage and rank. To prioritize the main problems, subsequent analysis was conducted employing Pareto analysis. The management strategies were categorized into three sections i.e housing, feeding and health care management. To check the association between different strategies adopted by livestock growers, the Pearson correlation coefficient (r) was computed across the strategies. The results were grouped within three categories i.e strong, moderate and weakest correlation. The binary logit regression model was applied to examine the factors influencing farmers' strategies and actions for managing livestock during floods.

The formula for Pearson correlation coefficient is given by:

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

Where,

x and y = Frequencies of two different management practices.
 $\bar{x}$ and $\bar{y}$ = Their mean values.

This formula measures the strength and direction of the linear relationship between two variables. The value ranges from -1 to 1.

Binary logit regression was applied to determine the socio-economic factors influencing farmers' adoption of adaptive strategies, utilizing the functional form of the logit model as specified.

$$P_i = 1 / 1 + e^{-(\beta_0 + \beta_1 x_i)}$$

For simplicity equation 1 can be expressed as

$$P_i = 1 / 1 + e^{-z_i}$$

Where,

P_i = Probability of adaptation of the i^{th} respondent.

e^{z_i} = Stands for the irrational number e raised to the power of z_i .

z_i = Function of N -explanatory variables and expressed as:

$$z_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \mu_i$$

Where,

β_0 = Constant term.

$\beta_1, \dots, \beta_n$ = Regression co-efficient.

Therefore,

$$z_i = \beta_0 + \beta_1 (\text{AGE}) + \beta_2 ((\text{EDU})) + \beta_3 (\text{FARMSZ}) + \beta_4 (\text{FMLYSZ}) + \beta_5 (\text{FMLYIN}) + \beta_6 (\text{FOMBR}) + \beta_7 (\text{TRRE}) + \beta_8 (\text{MARAC}) + \mu$$

Before estimating the logit model, a contingency coefficient test was conducted to check the explanatory variables for multi-collinearity. As a result of this analysis, the variables of farming experience, number of plots and interaction with extension service agents were excluded from the final model.

The Pareto analysis is a problem-solving tool that helps identify the most significant factors contributing to a problem or outcome. It's based on the principle that roughly 80 per cent of the effects come from 20 per cent of the causes. This principle was introduced by Italian economist Vilfredo Pareto. This principle suggests that, in many situations, roughly 80% of the effects come from 20 per cent of the causes.

RESULTS AND DISCUSSION

Livestock losses during 2023-24

It was disclosed from Table 1 that during floods in Udalguri and Kalaigaon, cows suffered the highest economic loss (58.07% and 54.90% respectively) due to their high unit value (Rs. 15,000 and Rs. 14,500 respectively). Pigs contributed 18.16% in Udalguri and 30.58% in Kalaigaon, while goats accounted for 22.51% and 13.13%, reflecting their moderate

Table 1: Livestock losses during 2023-24.

(N=200)

Livestock	Av. loss (no.)	Unit value (Rs)	Total loss (Rs)	Per cent loss (%)
Udalguri revenue circle				
Cow	1	15000.00	15000.00	58.07
Pig	1.02	4600.00	4692.00	18.16
Goat	1.66	3520.00	5813.20	22.51
Poultry	3.25	100.00	325.00	1.26
Total	6.98	23220.00	25830.20	100.00
Kalaigaon revenue circle				
Cow	1.30	14500.00	18850.00	54.90
Pig	2.10	5000.00	10500.00	30.58
Goat	1.50	3000.00	4500.00	13.13
Poultry	4	120.00	480.00	1.39
Total	8.90	22620.00	34330.00	100.00

Table 2: Problems faced by livestock growers during and after flood.

(N=200)

Problem identified	Frequency	Percentage	Rank
Loss of grazing areas	200	100	I
Disease spread	189	94.5	II
Animal treatment	185	92.5	III
Need for alternative feeds	151	75.5	IV
Need for fodder storage	125	62.5	V
Animal evacuation	99	49.5	VI
Damaged forage	65	32.5	VII
Animal waste disposal	19	9.5	VIII

valuation and population density. Despite higher household numbers, poultry had minimal financial impact (1.26% and 1.39%) due to their low unit value (Rs. 100-120). Total losses were Rs. 25,830.20 in Udalguri and Rs. 34,330.00 in Kalaigaon. Similar results were found in the studies of Borah *et al.* (2023) and Saikia *et al.* (2023).

Problems faced by livestock growers during and after the flood

It was concluded from the above Table 2 that eight important problems were identified by the livestock growers during and after flood situation. Problems like loss of grazing areas as mentioned by 100 per cent of respondents, spreading of diseases (94.5%) and animal treatment (92.5%) were ranked I, II and III respectively. Further, 75.5 per cent of growers faced the problems of alternative feeds (rank IV) followed by the need for fodder storage (rank V) as mentioned by 62.5 per cent of growers. It could be because the floodwaters submerge grazing lands, reducing available pasture for livestock. Floods disrupt infrastructure, hindering access to veterinary services. Inadequate fodder storage facilities often get flooded or washed away, leading to feed shortages and poor animal health.

Again, they faced problems like animal evacuation, damaged forage and animal waste disposal as mentioned by 49.5, 32.5 and 9.5 per cent growers with the rank of VI, VII and VIII respectively. Evacuating animals during floods is challenging due to limited resources and infrastructure.

Many animals are estimated to have drowned or been washed away in the floods and their immediate aftermath, highlighting the importance of improved disaster readiness and evacuation plans for livestock. These results align with the observations of Rasool *et al.* (2020), Kumar *et al.* (2021) and Prem (2023).

To prioritize the main problems, further analysis was done using Pareto analysis. Fig 1 shows that the cumulative percentage reach 100 per cent around the 7th bar "Damaged forage", which mean that all the categories to the left of this bar (included) accounts for all the vital factors.

Strategies adopted by livestock growers in flood-prone areas

The strategies adopted by the livestock growers were arranged into three sections *i.e housing management, feeding management and health care management*. It was identified from Table 3 that in housing management category, majority of livestock growers (94.5%) go for the construction of animal shed in highlands (rank I), construction of pucca sheds for animals adopted by 28.5 per cent growers (rank II) followed by 18 per cent using government buildings for shelter during flood (rank III). The reasons for adopting these management strategies may be that the highlands are less prone to waterlogging and provide a safe refuge for livestock during heavy rains or floods, ensuring their health and reducing losses and the government structures are often well-built and located in flood-resistant areas, providing immediate and reliable protection in emergencies. Similar findings were observed by Rasool *et al.* (2020), Rymes (2022), Anitha *et al.* (2023) and Hirkani *et al.* (2023).

In feeding management strategies, 100 per cent of the growers go for feeding the locally available crop residues and making hay/ bales (rank I) followed by storage of a sufficient quantity of feed material adopted by 71 per cent of growers (rank II). Growing perennial forage crops in wasteland/highland and silage making were the strategies adopted by 32.5 and 10.5 per cent with rank III and IV respectively. The probable rationale for implementing these strategies could be that during floods, accessing regular feed becomes challenging. Livestock growers rely on

locally available crop residues as an immediate and cost-effective source of feed to sustain their animals. Hay and bales are prepared and stored during surplus seasons to ensure a supply of nutritious feed during floods. These are easy to transport and store, providing a reliable food source when fresh forage is unavailable. Perennial forage crops, such as Napier grass, planted in wasteland or highland areas, remain accessible during floods. These crops provide continuous feed even when lowland fields are submerged. These observations align with Pathak *et al.* (2006), Mahajan *et al.* (2015), Mishra *et al.* (2017) and Patel *et al.* (2023).

Further, in healthcare management strategies as shown in Table 3, vaccination of animals before or after flood was ranked I as 48 per cent of livestock growers go for it followed by stocking of emergency medicine during flood period adopted by 41 per cent (rank II) and keeping and maintaining emergency contact with veterinary officers/

doctors ranked III as only 12.5 per cent of them adopted it. The rationale behind these strategies may be to safeguard them against diseases that are likely to spread during or after floods, such as foot-and-mouth disease, leptospirosis and to keep a supply of common medicines, such as antibiotics, antipyretics, dewormers and antiseptics to address immediate health issues during floods (Pyne *et al.*, 2009, Vijay *et al.*, 2024, Tiwari *et al.*, 2025 and Vismaya *et al.*, 2024). In recent times, Artificial Intelligence (AI) has played a vital role in detecting animal diseases through its ability to analyse data, recognize patterns and make informed decisions (AlZubi, 2023).

Association between different strategies adopted by livestock growers in flood-prone areas

To check the association between different strategies, Pearson correlation coefficient (r) was calculated between the strategies. The results of the correlations were grouped

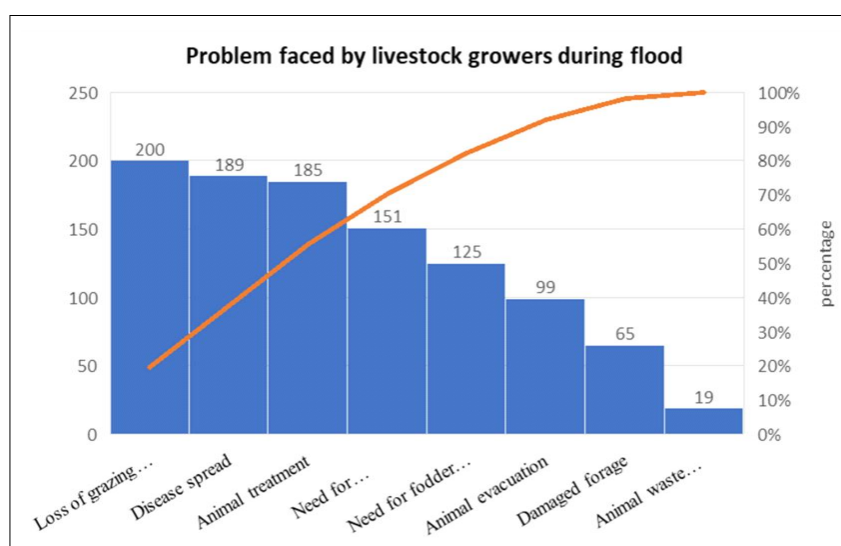


Fig 1: Problems faced by livestock growers during and after the flood.

Table 3: Strategies adopted by livestock grower in flood prone areas.

(N=200)

Management practices	f	%	Rank
Housing management			
Construction of animal shed in highland	189	94.5	I
Construction of pucca shed for animals	57	28.5	II
Using government buildings for shelter during flood	36	18	III
Feeding management			
Feeding of locally available crop residues	200	100	I
Making hay/ bales	200	100	I
Storage of sufficient quantity of feed material	142	71	II
Growing perennial forage crop in wasteland/highland	65	32.5	III
Silage making	21	10.5	IV
Health care management			
Vaccination of animals before or after flood	96	48	I
Stocking of emergency common medicine for flood period	82	41	II
Keeping emergency contacts with veterinary officers/ doctors	25	12.5	III

Table 4: Association between different strategies adopted by livestock growers in flood prone areas. (N=200)

Practices	Highland Shed	Pucca Shed	Govt Shel-ter	Crop Residue	Hay/ Bale	Stor-ed Feed	Peren-nial Crop	Sila-ge	Vaccination	Stock- medicine	Vet. contact
Highland shed	1.00	0.61	0.52	0.80	0.80	0.75	0.58	0.45	0.72	0.65	0.48
Pucca shed	0.61	1.00	0.42	0.50	0.50	0.55	0.47	0.32	0.55	0.50	0.38
Govt shelter	0.52	0.42	1.00	0.45	0.45	0.48	0.40	0.29	0.50	0.45	0.42
Crop residue	0.80	0.50	0.45	1.00	1.00	0.80	0.60	0.55	0.72	0.68	0.52
Hay/bale	0.80	0.50	0.45	1.00	1.00	0.80	0.60	0.55	0.72	0.68	0.52
Stored feed	0.75	0.55	0.48	0.80	0.80	1.00	0.65	0.50	0.70	0.66	0.50
Perennial crop	0.58	0.47	0.40	0.60	0.60	0.65	1.00	0.38	0.55	0.52	0.42
Silage	0.45	0.32	0.29	0.55	0.55	0.50	0.38	1.00	0.48	0.45	0.35
Vaccination	0.72	0.55	0.50	0.72	0.72	0.70	0.55	0.48	1.00	0.78	0.60
Stocked medicine	0.65	0.50	0.45	0.68	0.68	0.66	0.52	0.45	0.78	1.00	0.62
Vet contact	0.48	0.38	0.42	0.52	0.52	0.50	0.42	0.35	0.60	0.62	1.00

into 3 sections *i.e* strong, moderate and weakest correlation. For the foremost category, it was disclosed from Table 4 that a significant relationship was found between feeding of locally available crop residues and making hay/bales ($r=1.00$), construction of animal sheds in highlands with feeding of locally available crop residues and making hay/bales ($r=0.80$) and storage of sufficient amount of feeding material with feeding of locally available crop residues and making hay/bales ($r=0.80$). Again, vaccination of animals before or after flood and stocking of emergency medicine for flood period ($r=0.78$). Farmers who opt for highland sheds are more likely to ensure feed security. Using locally available crop residues and producing hay are cost-effective strategies. They minimize the need for purchasing external feed resources, which can be expensive and scarce during flood times. This economic efficiency is crucial for farmers in flood-prone regions, where financial resources may be limited. Disease outbreaks during floods can lead to significant economic losses due to increased treatment costs and livestock mortality. By vaccinating animals and stocking emergency medicines, farmers can prevent or mitigate these losses, ensuring the sustainability of their livelihoods. Similar findings were found in the study of Sen *et al.* (2003) and Kumar *et al.* (2021).

For the second category, there was a moderate correlation between vaccination of animals before or after flood with the construction of animal sheds in highland ($r=0.72$), feeding of locally available crop residues ($r=0.72$), making hay/ bales ($r=0.72$) and storage of sufficient quantity of feed material ($r=0.70$). Stocking of emergency common medicine for flood period by establishing animal shed in highland ($r=0.65$), feeding of locally available crop residues ($r=0.68$) and making hay/ bales (0.68). Again, storage of proper quantity of feed material with construction of animal shed in highland ($r=0.75$), stocking of emergency common medicine in flood ($r=0.66$) and growing perennial forage crop in wasteland/highland ($r=0.65$). Consolidating livestock and feed storage in highland sheds allows for centralized management, making it easier for farmers to monitor feed consumption and animal health during floods. These results correlate with the findings of Rasool *et al.* (2021) and Borah *et al.* (2022).

Silage making showed weak correlation with pucca shed construction ($r=0.32$) and using government buildings for shelter ($r=0.29$). High costs and labor demands for pucca sheds may shift farmers' focus to immediate shelter over feed preservation.

Factors influencing farmers' strategies and actions for managing livestock during floods

The findings from Table 5 indicate that age (-0.091) with farmers' adaptive strategies for managing livestock during floods. Older farmers are less likely to adopt new technologies and strategies due to reduced flexibility, innovation and risk tolerance. A comparable result has been observed in the work done by Maddison, (2007), Acquah (2011), Quayum *et al.* (2012) and Tambo *et al.* (2013). Larger farms

Table 5: Binary logit regression on factors influencing farmers' strategies and actions for managing livestock during flood. (N=200)

Variables	Coefficient	Robust std. error	P value
Constant	0.882	2.89201	0.638
Age	-0.091*	0.06238	0.081
Education	1.354**	0.61277	0.041
Farm size	-9.214**	0.56899	0.030
Family size	3.554	2.21450	0.123
Family income	0.0021**	0.00110	0.033
Member of farmers organization	6.214*	2.14700	0.081
Training received	1.235**	0.61895	0.033
Market access	0.021	1.0123	0.784
Pseudo R ²		0.889	

(-9.214) are less likely to adopt flood management strategies due to implementation challenges and complex management structures. Similar findings were given by Bradshaw *et al.* (2004) and Gebrehiwot *et al.* (2013).

Again, education (1.354), family income (0.0021) and training received (1.235) were found positive and member of farmers organization (6.214) was positive. Higher education increases the likelihood of adopting flood management strategies due to better awareness, access to information and decision-making skills. This finding was supported by Deressa *et al.* (2009) and Asfaw *et al.* (2004). This finding goes the same with the findings of Seo *et al.* (2008) and Deressa *et al.*, (2011). Training improves farmers' awareness and ability to adopt flood management strategies. Farmers who participate in groups have a higher tendency to choose adaptation measures. These findings were endorsed by the findings of Knowler *et al.* (2007), Kassie *et al.* (2011), Tazeze *et al.* (2012) and Bryan *et al.* (2013). Family size (3.554) and market access (0.021) showing minimal impact on farmers' flood management decisions (Below *et al.*, 2012, Ndambiri *et al.*, 2012 and Khanal *et al.*, 2018).

CONCLUSION

The study examines the economic toll of floods on livestock in Udalguri and Kalaigaon, with cows bearing the highest financial loss due to their valuation. Key challenges include loss of grazing land, disease outbreaks and limited veterinary services, alongside difficulties in providing feed and shelter. Farmers adopted mitigation strategies such as elevated shelters and stored fodder, showing a strong link between housing management and feed security. Adoption of flood resilience measures varied by age, education, farm size, income and training, with older farmers and those with larger farms being less likely to adapt. The findings highlight the need for targeted policies to strengthen disaster resilience in flood-prone livestock areas.

ACKNOWLEDGEMENT

The authors express their gratitude to the livestock-growing farmers from Udalguri and Kalaigaon revenue circle and

the staff of Krishi Vigyan Kendra, Udalguri for their generous support with respect to data collection for the study and completing the whole research work.

Disclaimers

The opinions and findings presented in this article reflect the perspectives of the authors and do not necessarily align with those of their associated institutions. While the authors ensure the accuracy and completeness of the information, they disclaim any responsibility for any direct or indirect losses arising from its use.

Declaration

The author(s) affirm that the content is entirely original and has not appeared in another publication.

Conflict of interest

The authors confirm the absence of any conflicts of interest.

REFERENCES

- 20th Livestock Census (2019). Department of Animal Husbandry Dairying and Fisheries, Ministry of Agriculture. Government of Assam.
- Acquah, H.D. (2011). Farmers' perception and adaptation to climate change effects: A willingness to pay. *J. Sustain. Dev. Afr.* **13**: 150-161.
- AlZubi, A.A. (2023). Artificial intelligence and its application in the prediction and diagnosis of animal diseases: A review. *Indian Journal of Animal Research.* **57(10)**: 1265-1271. doi: 10.18805/IJAR.BF-1684.
- Anitha, M., Jagadeeswary, V. and Shilpa Shree, J. (2023). Flood: Mitigation measures adopted by livestock farmers and strategies developed for livestock management. *Agro Economist – An International Journal.* **10(3)**: 299-305.
- Asfaw, A. and Admassie, A. (2004). The role of education on the adoption of chemical fertilizer under different socio-economic environments in Ethiopia. *Agricultural Economics.* **30(3)**: 215-228. doi: 10.1016/j.agecon.2002.12.002.
- Assam Flood Memorandum (2023). Assam State Disaster Management Authority, Revenue and Disaster Management. Government of Assam.

- Below, T., Mutabazi, K. D., Kirschke, D., Franke, C., Sieber, S., Siebert, R. and Tscherning, K. (2012). Can farmers' adaptation to climate change be explained by socio-economic household-level variables? *Global Environmental Change*. **22(1)**: 223-235. doi: 10.1016/j.gloenvcha.2011.11.012
- Borah, D. and Deka, P. (2022). Management of Fodder Crops to mitigate flood situation in Assam. Book chapter in Current Research on Forage Crops of India. Akinik Publication.
- Borah, S. and Buragohain, A. (2023). Assam flood and financial loss in agricultural production: A study on mitigation strategy adopted by the farmers of Dhemaji district. *Agricultural Reviews*. **46(3)**: 500-506. doi: 10.18805/ag.R-2625.
- Bradshaw, B., Dolan, H. and Smit, B. (2004). Farm-level adaptation to climatic variability and change: Crop diversification in the Canadian prairies. *Climatic Change*. **67(1)**: 119-141. doi: 10.1007/s10584-004-0710-z
- Bryan, E., Ringler, C., Okoba, B., Roncoli, C., Silvestri, S. and Herrero, M. (2013). Adapting agriculture to climate change in Kenya: Household strategies and determinants. *Journal of Environmental Management*. **114**: 26-35. doi: 10.1016/j.jenvman.2012.10.036
- Deressa, T. T., Hassan, R. M. and Ringler, C. (2011). Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia. *Journal of Agricultural Science*. **149(1)**: 23-31. doi: 10.1017/S0021859610000687.
- Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T. and Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change*. **19(2)**: 248-255. doi:10.1016/j.gloenvcha.2009.01.002.
- Gebrehiwot, T. and van der Veen, A. (2013). Farm level adaptation to climate change: The case of farmer's adaptation in Ethiopia. *Environmental Management*. **52(1)**: 29-44. doi: 10.1007/s00267-013-0039-3.
- Hirkani, H., Korlekar, P.N. and Kohale, K.N. (2023). General perspectives for management of animal facilities during pandemics or similar crisis: A review. *Agricultural Reviews*. **44(4)**: 501-508. doi: 10.18805/ag.R-2276.
- Kassie, M., Shiferaw, B. and Muricho, G. (2011). Agricultural technology, crop income and poverty alleviation in Uganda. *World Development*. **39(10)**: 1784-1795. doi: 10.1016/j.worlddev.2011.04.023
- Khanal, U., Wilson, C., Hoang, V. N. and Lee, B. (2018). Farmers' adaptation to climate change, its determinants and impacts on rice yield in Nepal. *Ecological Economics*. **144**: 139-147. doi: 10.1016/j.ecolecon.2017.08.006.
- Knowler, D. and Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy*. **32(1)**: 25-48. doi: 10.1016/j.foodpol.2006.01.003
- Kumar, A., Kumar, K. and Sharma, R. K. (2021). Strategies of livestock management during flood. *Indian Farming*. **71(7)**: 39-43.
- Maddison, D. (2007). The perception of and adaptation to climate change in Africa. World Bank Policy Research Working Paper No. 4308. doi: 10.1596/1813-9450-4308.
- Mahajan, S., Papang, J.S., Singh, S. and Datta, K.K. (2015). Adaptation and mitigation strategies for dairy cattle: Myths and realities in Indian condition - A review. *Agricultural Reviews*. **36(4)**: 287-295. doi: 10.18805/ag.v36i4.6665.
- Mishra, G.R., Das, B.C., Swain, P. and Sardar, K.K. (2017). Awareness and preparedness level of livestock farmers during flood in Odisha, India. *International Journal of Agricultural Science and Research*. **7(1)**: 6774.
- Ndambiri, H.K., Ritho, C.N. and Ng'ang'a, S.I. (2012). Climate change adaptation strategies by small-scale farmers in Kenya. *Journal of Agricultural Science*. **4(10)**: 202-216. doi: 10.5539/jas.v4n10p202.
- Patel, S.D., Pata, B.A. and Mathukiya, G.P. (2023). Feeding strategies of livestock during natural calamities: A review. *The Pharma Innovation Journal*. **12(6)**: 3253-3255.
- Pathak, S.K., Tripathi, N.K., Sharma, V.K. and Mishra, A.K. (2006). Fodder production and feeding pattern studies in livestock production system. *Indian Journal of Animal Research*. **40(2)**: 147-150.
- Prem, H.T. (2023). Floods and tropical storms: A guide to livestock-based emergency preparedness, response and recovery (LEGS Technical Briefing Paper).
- Pyne, S.K. and Samanta, G. (2009). Livestock management at different levels of disaster strategy and execution. *Indian Journal of Animal Research*. **43(2)**: 99-102.
- Quayum, M.A., Ali, A.M. (2012). Adoption and diffusion of power tiller in Bangladesh. *Bangladesh J. Agric. Res.* **37**: 307-325.
- Rasool, S., Hamdani, S.A., Fayaz, A., Hai, A., Ayman, N. and Akand, A.H. (2020). Effects on feeds and housing management of livestock during 2014 floods in Jammu and Kashmir, India. *Journal of Krishi Vigyan*. **8(2)**: 98-103.
- Rasool, S., Hamdani, S.A., Ayman, N., Fayaz, A., Shubeena, S., Thahaby, N., Nabi, B., Hai, A. and Akand, A.H. (2021). The Impact of natural disasters on livestock sector: A review. *Journal of Biomedical Research and Environmental Science*. **2(8)**: 669-674. doi: 10.37871/jbres1295.
- Rasool, S., Hamdani, S.A., Fayaz, A., Jan, A., Sajad, S. and Akand, A.H. (2020). Potential risks and their management strategies adopted by livestock owners during natural calamity in Jammu and Kashmir, India. *The Pharma Innovation Journal*. **9(9)**: 27-29.
- Rushton, J., Thornton, P.K. and Otte, M.J. (1999). Methods of Economic Impact Assessment. In: The Economics of Animal Disease Control. [B.D. Perry (Ed.)], *Revue Scientifique et Technique de l'Office International des Epizooties*. **18(2)**: 315-342.
- Rymes, B. (2022). Post-disaster interventions related to livestock and livelihood. In *Post-disaster Interventions* (pp. 87-98). doi: 10.1007/978-981-16-9392-2_9.
- Saikia, M. and Mahanta, R. (2023). Does livestock loss affect livelihood? An investigation on Char residing Mishing community of Assam. *International Journal of Community Well-Being*. doi: 10.1007/s42413-023-00198-6.
- Sen, A. and Chander, M. (2003). Disaster management in India: The case of livestock and poultry. *Rev. sci. tech. Off. int. Epiz.* **22(3)**: 915-930.
- Seo, S.N. and Mendelsohn, R. (2008). An analysis of adaptation to climate change in African agriculture. *Ecological Economics*. **68(1-2)**: 355-368. doi: 10.1016/j.ecolecon.2008.04.002

- Tambo, J.A. and Abdoulaye, T. (2013). Smallholder farmers' perceptions of and adaptations to climate change in the Nigerian savanna. *Regional Environmental Change*. **13**(2): 375-388. doi: 10.1007/s10113-012-0351-0.
- Tazeze, A., Haji, J. and Ketema, M. (2012). Climate change adaptation strategies of smallholder farmers: The case of southern Ethiopia. *Journal of Agricultural Extension and Rural Development*. **4**(10): 347-355. doi: 10.5897/JAERD12.088.
- Tiwari, A., Swamy, M., Shrivastav, N., Mishra, P., Rajput, N., Dubey, A. and Verma, Y. (2025). Occurrence of multi-drug-resistant avian *Salmonellae* in commercial poultry. *Indian Journal of Animal Research*. **59**(6): 1019-1025. doi: 10.18805/IJAR.B-4779.
- Vijay, L., Mohammad, A., Chatterjee, A., Yangzom, C., Lepcha, G. and Girish, C.E. (2024). Exploring the adaptation strategies to meteorological disasters followed by dairy farmers of Indian Sundarbans. *International Journal of Environment and Climate Change*. doi: 10.9734/ijecc/2024/v14i84359.
- Vismaya, K.C., Dolli, S.S., Manjula, N. and Patil, A. S. (2024). Adoption of health care and feeding management practices by the flood-affected dairy farmers. *International Journal of Agriculture Extension and Social Development*. **7**(3): 20-23. doi: 10.33545/26180723.2024.v7.i3a.392.