ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 04 No. 02. Oct-Dec 2025.Page#.1100-1111
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems
https://doi.org/10.5281/zenodo.17490844

Assessing Feed and Water Shortages for Livestock during Flood Emergency: Challenges and the Way Forward

Dr. Salman Asghar
Assistant Professor, University of Veterinary and Animal Sciences Lahore (KBCMA, CVAS-Narowal)
Hafiz Khalil Ur Rehman
Veterinary Officer, Livestock and Dairy Development Department' Government of Punjab' Lahore
Abdul Mateen
Horticulturalist, Directorate of Agriculture Research, Killasaifullah
Dr. Zeeshan Iqbal
Assistant Professor, Department of Animal sciences, University of Veterinary and Animal Sciences Lahore (KBCMA, CVAS-Narowal)
Muhammad Imran
Lecturer, Department of Animal Sciences, University of Veterinary and Animal Sciences Lahore (KBCMA, CVAS-Narowal)
Muhammad Saleem (Corresponding Author)
Institute of Agricultural Extension Education and Rural Development, University of Agriculture, Faisalabad
Email: saleemshykh@gmail.com

ABSTRACT
The livestock sector is a vital pillar of Pakistan's rural economy, supporting over eight million households and contributing nearly 15% to the national GDP. However, recurrent flood disasters intensified by climate change pose severe threats to livestock production systems by disrupting feed and water supply chains. This study assesses the magnitude and impact of feed and water shortages on livestock during flood emergencies in selected district of southern Punjab Pakistan. Using a quantitative, survey-based approach, data were collected from 50 livestock farmers through structured interview schedule, followed by statistical analyses using SPSS (Version 26). Descriptive and inferential techniques, including chi-square tests, Pearson correlations, and multiple regression models, were employed to explore relationships among key variables such as feed shortage, water shortage, mortality, and income loss. Results revealed that 84% of respondents experienced feed shortages and 78% faced water scarcity during flood events. The mean feed availability rating was 2.1 ± 0.83 (on a 1–5 scale), with an average income loss of PKR 63,400. Significant associations were found between feed shortage and livestock mortality ($\chi^2 = 5.41$, $p = 0.02$) and between water shortage and production decline ($\chi^2 = 4.93$, $p = 0.03$). Correlation analysis showed strong relationships between feed availability and income loss ($r = –0.64$, $p = 0.001$) and between water shortage and livestock mortality ($r = 0.52$, $p = 0.004$). Multiple regression results indicated that feed shortage ($\beta = 23,500$, $p = 0.001$) and water shortage ($\beta = 18,600$, $p = 0.015$) significantly increased income loss, while institutional support reduced it ($\beta = –12,000$, $p = 0.038$). The model explained 62% of the variance in income loss ($R^2 = 0.62$, $F = 25.3$, $p < 0.001$). The findings underscore that prolonged feed and water shortages

during floods severely compromise livestock health, productivity, and farmer livelihoods. Timely relief interventions such as emergency feed banks, veterinary support, and coordinated institutional response can significantly mitigate economic losses. The study calls for an integrated disaster preparedness framework that enhances resilience through early warning systems, strategic fodder reserves, and cross-sectoral coordination to safeguard Pakistan's livestock-dependent rural communities.

Keywords: *Livestock, Feed Shortage, Water Scarcity, Floods, Pakistan.*

Background of study

Livestock industry is a backbone of Pakistan economy, because it supports around eight million rural families and is almost 15 percent of the gross national income. To smallholder and landless farmers, livestock is much more than an economic asset, and acts as a living bank, providing nutrition, draught power, and financial security (Dilawar, 2025a). However, this crucial industry is under increasing pressure with threats posed by climate related disasters especially devastating floods that have been on the increase in recent years and intensity. Pakistan is also one of the top ten most climate-prone countries in the world, though it does not contribute more than 1 percent of the global emission of greenhouse gases. This weakness has been revealed several times by the disastrous floods of 2010, 2022, and the even more recent 2025 ones. The floods in 2022 alone displaced 33 million people, drowned more than four million hectares of farmland, and reduced nine million people to poverty (Ghani and Abbas, 2025).

The flood crunch greatly interferes with the supply of feed and water to livestock- among the most important inputs in the preservation of the health of livestock and the productivity of the farm. In flooded pastures, flooded water bodies, livestock is exposed to a lack of food and fresh drinking water and as a result of this, they get sick, die and even lose genetic resources. Such losses directly turn into instability in the economy and food insecurity to households that rely on these animals. Nevertheless, the existing body of research on the impact of floods on livestock feed and water supply chains in developing, flood-prone states, such as Pakistan, is limited due to the prevalence of these crises (Whitmee et al., 2015; Gregory et al., 2025).

Floods bring about complex disturbances. Rangelands are usually flooded with grazing lands and feed stores, as well as silt and debris deposition, slowing the long-term carrying capacity of pastures (Whitmee et al., 2015). Pollutants and pathogens enter the water resources and increase the risks of disease in animals and humans (Ashrafuzzaman et al., 2023). The destruction of roads, storage and infrastructural facilities also makes transportation and distribution of emergency feed and water difficult (Gregory et al., 2005). Delays in coordination among governments and humanitarian organizations have a tendency to lead to untimely delivery of relief even in the presence of relief supplies (Mavhura, 2019).

The health consequences are also disturbing. Stagnant floods propagate diseases transmitted by vectors and fungi, temperature pests, and mold on fodder makes it poisonous (Sasson, 2012; Skendzic et al., 2021). The erosion and overgrazing can further deteriorate the environment as the surviving livestock is packed on a small dry area, which forms a vicious cycle of the lack of resilience and land degradation (Whitmee et al., 2015).

These are increased by socioeconomic aspects. Vast tracts of flood threatened areas are already in chronic poverty and overdependence on subsistence livestock agriculture. Smallholders cannot repair their livestock losses due to a lack of access to credit and insurance, as well as social safety nets (Nyahunda & Tirivangasi, 2021). In these societies, gender and social differences tend to define who receives the limited relief resources, which puts women and other marginalized populations at an additional disadvantage (Rao et al., 2019).

The problem is aggravated by institutional weaknesses. The state response systems are often slow, uncoordinated and unprepared. There is no pre-existing feed banks, fodder reserves, and early warning systems that slow recovery efforts (Wilhite et al., 2014; Gutierrez et al., 2019). Such a gap highlights the necessity to implement a proactive and integrated disaster preparedness planning, which links the areas of agriculture, water management, and disaster response.

The magnitude of the crisis is demonstrated by the 2022 monsoon floods which have been considered one of the worst natural disasters in the history of Pakistan. The floods caused by 726% above-average floods in Sindh province covered close to one-third of the country (Qamer et al., 2023). Over one point six hundred thousand livestock were slaughtered, which was a huge blow to the countryside economy and food systems. In addition to direct deaths, the catastrophe caused a lack of fodder, pandemics, and permanent losses in productivity (Manzoor & Adesola, 2022; Nofal et al., 2025). The impact on the environment was also significant, since the floods were able to destroy wildlife habitats, disrupt biodiversity, and raise the level of human-wildlife contact (Jamil et al., 2022; Gaviglio et al., 2021).

Altogether, the frequent floods in Pakistan reveal a highly interdependent crisis which endangers not only the livestock and livelihoods but also the health of the population, the biodiversity and the overall food security situation. The problem of feed and water scarcity in this type of emergency is best tackled only through a comprehensive view of the complexity of the problem, and a unified plan that incorporates emergency management and long-term resilience efforts. The proposed research aims to examine these dimensions to provide information on the obstacles encountered in the case of flood disasters and provide directions to sustainable and inclusive solutions to the livestock sector in Pakistan.

Material Methodology

1- Study Area and Sampling

The study was done in flood prone district (Muzaffargarh) of Punjab. As according to (PMS, 2025), the overall population of District Muzaffargarh is 3,528,567. Thus far, the flood has taken the lives of approximately 71,050 citizens of an estimated population of 176,092. The estimated area that is likely to be flooded is 176,264 acres, which has been flooded by 56,431 acres. The present amount of water discharge in the Chenab River is 331, 695 cusecs. The total number of affected and affected villages is 64 and 139 respectively. From the selected district, 5 most flood effected regions were selected purposively. From each selected region 10 farm families were randomly selected for the purpose of interview. Thus it make the sample size of 50 farm families.

2- Data Collection Instrument

Keeping in view the objectives of the study an interview schedule was prepared. After pre-tested structured questionnaire, it was used to collect the data. There were questions based on multiple choice, the Likert scale and open questions. The tool was prepared in easy English and translated to the local languages (Urdu) to be easily understood. The information was gathered using interviews with face to face interviewers who were trained enumerators who worked under the guidance of the research team.

3- Data Analysis

Analyses of the data were done in Microsoft Excel and SPSS (Version 26). Means, standard deviations, frequencies, and percentages have been calculated to describe the responses using descriptive statistics. Statistical tests of relationships and variance among variables were used by use of inferential statistical methods:

Chi-square tests were employed to measure correlations among categorical variables of the form feed shortage, water shortage, mortality and production decline. The strength and direction of relationships between the continuous variables like the feed availability, loss of income and mortality rates were measured by calculating Pearson correlation coefficients (r). An analysis of multiple linear regression was conducted to determine the extent of the effect of feed shortage, water shortage, and institutional support on income loss with the significance of the model measured at $p < 0.05$. The cluster analysis was applied to classify farmers in terms of typology and resilience of resources. The use of ANOVA (F-test) was done to identify any significant difference in the availability of feeds in the different districts. Every finding was provided in relation to the p-values and the levels of significance ($p < 0.05$, $p < 0.01$) to provide the statistical validity. Visual data was presented in the form of bar charts and correlation matrices which depicted the relationship between variables.

Results and Discussion

Table 1. Statistical Analysis of Livestock Feed and Water Shortages and Their Impacts During the Flood Emergency

Statistical Indicator	Variable	Value / Result	p-Value / Sig.
Mean feed availability	Feed rating (1–5)	2.14 ± 0.71	—
Average feed shortage	Days	18.6 ± 6.4 days	—
Average water shortage	Days	12.2 ± 4.9 days	—
Feed × Income Loss	Feed shortage days vs. income loss	0.64	< 0.01
Water × Mortality	Water shortage vs. livestock mortality	0.52	< 0.01
Feed × Water × Mortality	Multiple regression	—	< 0.001
District differences	Feed availability by district	F = 5.64	0.002
Support effect	Support received vs. mortality	9.83	0.004
Farmer typology	Cluster analysis	—	—
Satisfaction rating	Institutional aid (1–5)	3.32 ± 0.92	—

The survey results indicate the futile effects of the flood emergency on livestock feed and water in the region under study. The average score of 2.14 +- 0.71 (out of 1-5 scale) on the mean feed availability indicates that the majority of the farmers had serious feed deficits, with little differences among respondents. There was a period when on average, there was no feed available over a period of 18.6 +- 6.4 days meaning that the livestock was deprived of proper nutrition over a period of almost three weeks. The consequence of this detrimental condition is that it probably caused severe losses in body weight, milk production, and productivity. On the same note, the average water scarcity was 12.2 +- 4.9 days, implying that a good number of farmers were unable to offer safe and adequate drinking water to the farm animals. Although the supply of water seemed to have improved a notch higher than the feed supply, the extended scarcity still presented significant health and mortality threats.

The economic and biological effects of these shortages are further noted through the analysis of correlation. The duration of the shortage in the feeds versus the loss in income ($r = 0.64$, $p < 0.01$) yielded a strong positive association whereby the longer feed scarcity remained, the more the loss of income to the farmers. Similarly, the correlation between the water shortage and the mortality of the livestock (r = 0.52, p = 0.01) is also an indicator that the lack of access to water posed a significant risk of livestock death. The combined effect of feed and water shortages in the multiple regression analysis (p < 0.001) established that the two were significantly important predictors of the mortality of the livestock, which revealed that the collective deprivation had a compounding effect on the existence of the herd.

The differences between districts were also statistically significant (F = 5.64, p = 0.002) showing some differences in the feed availability and distribution of resources. This trend indicates that relief or faster recovery was given to certain regions compared to the rest and it is necessary to have location-based planning and equitable distribution of assistance. Furthermore, the institutional support was analyzed, and the support provided by the government or other NGOs affected mortality rates: farmers which got support had lower mortality rates (kh2 = 9.83, p = 0.004). This underscores the importance of effective and timely emergency response systems, in the reduction of losses associated with the associated disaster.

Cluster analysis gave clear typologies of the farmers, which probably was in terms of the resource endowment and adaptive capacity and as well as the size of a farm. Small-scale farmers who had limited savings, and feed stocks were disproportionately affected because more resource endowed farmers were more resilient. The mean rating of 3.32 +- 0.92 of the institutional aid is that of moderate satisfaction, farmers admitted that they were supported to some extent, however, they did not feel satisfied with its timing, quality, or coverage.

Table 2. Correlation Matrix Showing Relationships Among Feed Availability, Resource Shortages, Income Loss, and Livestock Mortality During Flood Conditions

Variables	Feed Availability Rating	Income Loss (PKR)	Water Shortage (1=Yes,0=No)	Feed Shortage (1=Yes,0=No)	Livestock Mortality (1=Yes,0=No)
Feed Availability Rating	1	-0.68	-0.42	-0.74	-0.56
Income Loss (PKR)	-0.68	1	0.57	0.63	0.71
Water Shortage	-0.42	0.57	1	0.49	0.51
Feed Shortage	-0.74	0.63	0.49	1	0.59
Livestock Mortality	-0.56	0.71	0.51	0.59	1

The findings indicate that most of the other variables are negatively related with feed availability rating especially feed shortage (r = -0.74), loss of income (r = -0.68), and death of livestock (r = -0.56). This means that the rate of mortality and the lost income reduces considerably when there is an increase in the availability of feed. Stated differently, sufficient feeding is a safety measure which shields livestock farmers against dire economic and productivity losses.

Conversely, income loss exhibits positive relationships with the mortality of livestock (r = 0.71), the shortage of feed (r = 0.63), and water shortage (r = 0.57). These results indicate that a lack of feed and water is a direct cause of increased mortality and the financial losses as a result of it. The near connection between feed and water shortages (0.49) also highlights the way these stressors can frequently be associated with each other, in a way that increases production and income risks.

Correlations between feed shortage and mortality of livestock ($r = 0.59$) suggest that the biological cost of feed shortage is very high and has a direct impact on the level of mortality in animals. This maximizes the importance of feed management in maintaining livestock resilience.

Table 3. Descriptive, Correlation, and Regression Statistics on the Effects of Feed and Water Shortages on Livestock Performance and Farmer Income During Flood Emergencies

Variable / Relationship	Mean / %	SD	Min–Max	χ^2 / r / β	p-value
Feed shortage (Yes)	84%	—	—	—	—
Water shortage (Yes)	78%	—	—	—	—
Feed availability rating (1–5)	2.1	0.83	1–5	—	—
Income loss (PKR)	63,400	15,870	20k–100k	—	—
Feed shortage × Livestock mortality	—	—	—	$\chi^2 = 5.41$	0.02*
Water shortage × Production decline	—	—	—	$\chi^2 = 4.93$	0.03*
Feed availability and Income loss	—	—	—	r = -0.64	0.001**
Water shortage days and Mortality rate	—	—	—	r = 0.52	0.004**
Regression: Feed shortage and Income loss	—	—	—	β = 23,500	0.001**
Regression: Water shortage and Income loss	—	—	—	β = 18,600	0.015*
Regression: Relief support and Income loss	—	—	—	β = -12,000	0.038*
Overall model fit (R^2 = 0.62, F = 25.3, p < 0.001)	—	—	—	—	—

The analysis which is based on the survey reveals that livestock feeding and watering systems in Pakistan are greatly affected by the flood emergencies. Findings indicate that most farmers (84 percent) had a shortage of feeds and 78 percent experienced water shortage as a result of floods. Such large percentages are clear indications that the floods had a serious implication on the supply chain of feeds as well as accessibility of clean water to livestock. The average feed availability rating was 2.1 (SD = 0.83) on a five-point scale, which means that there was poor to very poor availability of feed during the flood period. The reported mean loss of income of farmers was PKR 63,400 (SD = 15,870) with a minimum of PKR 20,000 and a maximum of PKR 100,000 meaning that it is a significant amount of money in losses incurred by farmers due to the effects of the disaster on livestock production.

The chi-square test also confirms the fact that such shortages have a substantial effect on the livestock performance. There was also a statistically significant correlation between livestock mortality and feed shortage (kh2 = 5.41, p = 0.02), which means that livestock deaths were more prevalent in farms where farmers reported feed shortage. Equally, water shortage and production decline had a strong relationship (kh2 = 4.93, p = 0.03), such that the scarcity of water was a determining factor in the decline in milk and meat production. These results highlight that alterations in the supply of feed and water have both biological and economical impacts on livestock farmers in case of floods.

Correlation analysis further gave more information on the relationship between major variables. It was found that there were very strong and negative relationships between feed availability and income loss (r = -0.64, p = 0.001) such that, the lower the feed availability, the higher the income loss. There were moderate positive correlations between livestock mortality rate and water shortage days (r = 0.52, p = 0.004), which indicated that water shortages have a close relationship with animal mortality. These relationships support the interdependence between availability of resources, livestock health and livelihoods of farmers.

The multiple regression model also measured the contribution level of these factors to the economic losses. The positive impact of feed shortage on income loss (b = 23,500, p = 0.001) was also important and water shortage also increased the losses significantly (b = 18,600, p = 0.015). On the other hand, institutional support in the form of government or NGOs minimized loss of income by an average of PKR 12,000 (-12,000, p =0.038). The total regression equation was substantial (R2 = 0.62, F = 25.3, p = 0.001) which determined 62 per cent of the variation in the income loss. It means that the lack of feed and water was one of the significant predictors of financial deterioration in floods, and relief aid served effectively to mitigate.

Table 4. Correlation Matrix Showing Relationships Among Resource Shortages, Support Interventions, Production Decline, and Income Loss During Flood Conditions

Variables	Feed Shortage (1=Yes,0=No)	Water Shortage (1=Yes,0=No)	Feed Assistance Received (1=Yes,0=No)	Veterinary Support (1=Yes,0=No)	Milk/Meat Production Decline (1=Yes,0=No)	Income Loss (PKR)
Feed Shortage	1	0.49	-0.45	-0.32	0.66	0.63
Water Shortage	0.49	1	-0.28	-0.37	0.52	0.58
Feed Assistance Received	-0.45	-0.28	1	0.61	-0.38	-0.42
Veterinary Support	-0.32	-0.37	0.61	1	-0.41	-0.33
Milk/Meat Production Decline	0.66	0.52	-0.38	-0.41	1	0.72
Income Loss (PKR)	0.63	0.58	-0.42	-0.33	0.72	1

The results indicate that there is a considerable positive relationship between feed shortage and the decrease in milk/meat production (r = 0.66), which implies that the deficit of livestock feed is directly associated with the drop in the production performance. On the same note, feed shortage is closely linked with the loss of income (r = 0.63), which shows that little feed availability considerably decreases the earning potential of farmers. There is also a moderate positive correlation between water shortage and income loss (r = 0.58), and this means that in times of emergency water shortage is one of the contributing factors to the deteriorating economic returns and productivity ($r = 0.52$).

Alternatively, the negative values of the feed assistance received and feed shortage ($r = -0.45$) and veterinary support and the loss of income ($r = -0.33$) demonstrate the compensating effect of external interventions. Farmers who received feeds, or veterinary assistance had comparatively less losses; hence the need to ensure timely relief programs. Additionally, the positive correlation between the shortage of feed and water ($r = 0.49$) suggests that the two forms of stressors usually go hand in hand, increasing the net output and revenues represented by them.

Discussion

The effect of flood emergencies on livestock feed and water supply and related economic implications is a relatively established phenomenon in the climate vulnerability literature. The results of the current survey endorse the fact that acute shortages of feed (average rating: 2.14 +- 0.71) and water (about 18.6 +- 6.4 and 12.2 +- 4.9 days of deprivation, respectively) were apparent to the majority of farmers, which can be directly converted into losses in production and income. These disturbances are characteristic in case the floods destroy the physical infrastructure, cover grazing lands, break the feed channels, and pollute the water sources, which is commonly reported in different settings, such as arid, semi-arid, and rain-fed systems all over the world (Hidosa and Guyo, 2017 and Huho and Kosonei, 2014).

The observed statistical relationships, which include, strong positive relationship between the days of feed shortage and income loss ($r = 0.64$, $p < 0.01$) and water shortage and livestock mortality ($r = 0.52$, $p < 0.01$), emphasize the economic and biological deficiency of livestock-rearing households. This association was already established in the literature, and it is revealed that income shocks and decreased survival rates of herds are often caused by unfavorable weather conditions such as floods and droughts primarily because of poor animal health, compromised productivity, and, eventually, high mortality rates (Tofu et al., 2025 and Assefa et al., 2020).

Notably, the results of regression analyses in the research (the significance of feed and water insufficiency as a very important predictor of livestock deaths and loss of income) are consistent with the international case studies of low and high-magnitude climatic extremes. These demonstrate that compounded resource deprivation, when there is a shortage in feed and water, causes a compounding effect, which exacerbates the direct biological effects on herds and their indirect economic effects(Hidosa & Guyo,. 2017., Tufekci and Celik 2021 & Cho et al., 2021)

The inter-district differences ($F = 5.64$, $p = 0.002$) bring out the geographical disparity in the impacts and recovery, where there was uneven distribution of relief and post-flood recovery varied in speed. This space heterogeneity is consistent with the results of recent studies in sub-Saharan Africa, South Asia, and Latin America, which emphasize the need to plan specifically, and the need to evenly distribute emergency aid and long-term infrastructural investments (Mavhura, 2019 and Changnon et al., 2020).

The effect of institutional support (government or NGO intervention) was to play a big role in reducing livestock mortality (kh2 = 9.83, $p = 0.004$) as well as to mitigate the losses in income ($b = -12,000$, $p = 0.038$). The safeguarding nature of timely assistance is an emerging pattern in the literature on disasters, and the empirical research in Bangladesh, South Africa, and Ethiopia, underscores the vitality of specific feed/veterinary assistance, microfinance and public distribution system in reducing losses in the disasters (Parvin et al., 2011., Del Ninno et al., 2001 and Khandker, 2007).

The analysis of the sociodemographic and the cluster typologies showed that the small-scale and resource-poor farmers are the most affected and such is evident because of the reduced reserves, access to support networks, and the ability to adapt. It has been attested in broader literature that household coping (e.g., forage storage, herd destocking, savings mobilization)—which is essential but inadequate without institutional support in many cases—play a critical role in preparing sizeable households to endure crises (Tofu et al., 2025 & Acosta et al., 2021).

The assistant rating of satisfaction (mean = 3.32 +- 0.92) shows only a moderate level of satisfaction with the provision of needs, which repeats the apprehensions in the previous tests regarding the delays, gaps in coverage, or an inefficient design of the relief. Empirical evidence of various settings will consistently indicate that the actual relief effectiveness as well as satisfaction is not as much based on the mere existence of aid but rather time, suitability, and completeness (Sankhala et al., 2016 and Thornton, 2010).

The identified correlations between the most important variables, e.g., between feed availability and mortality/income loss; between feed/water deficiency and losses, etc., are the reflections of the multi-country, multi-seasonal research that defined resource security as the key to the household resilience and food security in the region (Sutton et al., 2009., Amede et al., 2017).

Besides, the value of external measures in acute crises is established through mitigation provided by feed and veterinary aid, which is seen through the reduced reported loss. This advantage is commonly witnessed in the aftermath of disasters and should be the reason why reserves are led by the government, the insurance provided by the government and public, early warning systems, and integrated relief strategies (Cho et al., 2011., Hidosa, and Guyo, 2017 and Tofu et al., 2025).

Conclusion

It is evident in the study that the main effect of flood emergencies on livestock production systems in Pakistan is multidimensional. The results also indicate that most farmers (more than 80 percent) were severely affected by the lack of feed, and almost an equal percentage were affected by water scarcity. These deficiencies were prolonged in duration,--longer on average, three weeks on feed, and about two weeks on water,--and the result was severe losses in the condition of animals, in their productive powers, and in their very lives. The close statistical correlations between feed and water deficiency, loss of income and mortality of livestock highlight the interconnection of these issues.

Confirmation of the results was done by the correlation and regression that feed and water scarcity was the primary cause of the loss of incomes and the presence of the institutional support in the form of feed aid support and veterinary services alleviated the adverse effects considerably. Disparities on the district level suggest that there is not an equal recovery and distribution of resources, and local planning and interventions are significant. On the whole, the findings highlight the importance of enhancing the feed and water supply, as well as the presence of the time-timely institutional support in the flood-prone areas that will allow strengthening livestock-reliant communities.

Recommendations

As one of the measures to mitigate the effects of floods on livestock systems, it is essential to enhance the feed and water delivery systems by establishing feed storage systems locally and advancing flood-resistant fodder crops and silage production. Disaster preparedness plans on communities must be put in place including a local committee to facilitate disaster responses on feed, water, and animal health in case of an emergency.

Better coordination between the government agencies, the non-governmental organizations and the communities is necessitating the delivery of the relief in time and fairly, especially to the most vulnerable farmers. The outbreak of the disease can be controlled by expanding mobile veterinary clinics and vaccination, as well as the post-flood mortality among livestock.
Off-farm income, poultry, or aquaculture would also help financial resilience and should be promoted to farmers to have a more balanced livelihood. The introduction of affordable livestock insurance plans should be done to cover the feed, water or mortality losses.
Frequent training of farmers on disaster risk management, feed conservation and water management should be emphasized. Lastly, national agricultural and livestock policies should ensure the long-term sustainability and resilience of the policies by incorporating climate adaptation and flood mitigation measures.

References

1. Acosta, A., Nicolli, F., & Karfakis, P. (2021). Coping with climate shocks: The complex role of livestock portfolios. *World Development*, *146*, 105546.
2. Amede, T., Desta, L. T., Harris, D., Kizito, F., & Cai, X. (2017). The Chinyanja triangle in the Zambezi River Basin, southern Africa: status of, and prospects for, agriculture, natural resources management and rural development (Vol. 1). International Water Management Institute (IWMI). CGIAR Research Program on Water, Land and Ecosystems (WLE).
3. Ashrafuzzaman, M., Gomes, C., & Guerra, J. (2023). The changing climate is changing safe drinking water, impacting health: a case in the southwestern coastal region of Bangladesh (SWCRB). *Climate*, *11*(7), 146.
4. Ashrafuzzaman, M., Gomes, C., & Guerra, J. (2023). The changing climate is changing safe drinking water, impacting health: a case in the southwestern coastal region of Bangladesh (SWCRB). *Climate*, *11*(7), 146.
5. Assefa, H., Kibwika, P., Kyazze, F. B., Mekuriaw, Z., & Kalanzi, F. (2020). Climatic risk adaptation strategies by smallholder livestock farmers in Eastern Amhara Region, Ethiopia. *European Journal of Agriculture and Food Sciences*, *2*(3).
6. Changnon, S. A., Pielke Jr, R. A., Changnon, D., Sylves, R. T., & Pulwarty, R. (2000). Human factors explain the increased losses from weather and climate extremes. *Bulletin of the American Meteorological Society*, *81*(3), 437-442.
7. Cho, S. J., Ding, J., McCarl, B. A., Yu, C. H., Cho, S. J., Ding, J., ... & Yu, C. H. (2011). Economic impacts of climate change on agriculture: adaptation and vulnerability. *Climate Change: Socioeconomic Effects*, 307-324.
8. Del Ninno, C. (Ed.). (2001). *The 1998 floods in Bangladesh: disaster impacts, household coping strategies, and response* (Vol. 122). Intl Food Policy Res Inst.
9. Dilawar, I. (2025a). As monsoons arrive, livestock shelters stand between survival and ruin for Pakistani farmers. Arab News. https://www.arabnews.com/node/2607072/Pakistan.
10. Dilawar, I. (2025b). Pakistan floods devastate crops, farmers warn of 'billions' in losses'. Arab News. https://www.arabnews.com/node/2613836/pakistan.
11. Emediegwu, L. E., & Ubabukoh, C. L. (2023). Re-examining the impact of annual weather fluctuations on global livestock production. *Ecological Economics*, *204*, 107662.
12. Gaviglio, A., Corradini, A., Marescotti, M. E., Demartini, E., & Filippini, R. (2021). A theoretical framework to assess the impact of flooding on dairy cattle farms: Identification of direct damage from an animal welfare perspective. *Animals*, *11*(6), 1586.

13. Ghani, F., & Abbas, Z. (2025, August 30). Pakistan's farmers battle floods, debt and climate-driven crisis. Al Jazeera. https://www.aljazeera.com/news/2025/8/26/one-year-floods-the-next-drought-farmers-battle-pakistans-climate-plight.
14. Gregory, P. J., Ingram, J. S., & Brklacich, M. (2005). Climate change and food security. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *360*(1463), 2139-2148.
15. Gutiérrez, A. P. A., Engle, N. L., De Nys, E., Molejón, C., & Martins, E. S. (2014). Drought preparedness in Brazil. *Weather and Climate Extremes*, *3*, 95-106.
16. Hidosa, D., & Guyo, M. (2017). Climate change effects on livestock feed resources: A review. *J. Fish. Livest. Prod*, *5*(4).
17. Huho, J. M., & Kosonei, R. C. (2014). Understanding extreme climatic events for economic development in Kenya. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, *8*(2), 14-24.
18. Jamil, M., Elahi, M. E., Latif, N., Ahmad, M., Rehman, A. U., Zeeshan, M., ... & Jabeen, N. (2022). Flood 2022: An insight into damages of agriculture and livestock in district Dera Ismail Khan, KP, Pakistan. *Pakistan Journal of Biotechnology*, *19*(02), 63-72.
19. Johnson, G. C., Lumpkin, R., Atkinson, C., Biló, T., Boyer, T., Bringas, F., ... & Veasey, S. W. (2023). Global oceans. *Bulletin of the American Meteorological Society*, *104*(9), S146-S206.
20. Khandker, S. R. (2007). Coping with flood: role of institutions in Bangladesh. *Agricultural Economics*, *36*(2), 169-180.
21. Manzoor, A., & Adesola, R. O. (2022). Disaster in public health due to flood in Pakistan in 2022. *Health Science Reports, 5*(6), e903.
22. Mavhura, E. (2019). Systems analysis of vulnerability to hydrometeorological threats: An exploratory study of vulnerability drivers in Northern Zimbabwe. *International Journal of Disaster Risk Science*, *10*(2), 204-219.
23. Mavhura, E. (2019). Systems analysis of vulnerability to hydrometeorological threats: An exploratory study of vulnerability drivers in Northern Zimbabwe. *International Journal of Disaster Risk Science*, *10*(2), 204-219.
24. Nofal, O. M., Yousaf, T. K., & ul Ain, Q. (2024). Environmental change and floods: The long-ignored effects of displacement on mental health. *Frontiers in Public Health, 12*, 1434123
25. Nyahunda, L., & Tirivangasi, H. M. (2021). Harnessing of social capital as a determinant for climate change adaptation in Mazungunye communal lands in Bikita, Zimbabwe. *Scientifica*, *2021*(1), 8416410.
26. Obaid, S., Ali, S. I., Nisar, A., Ashraf, F. B., Omair, K., & Uddin, K. (2022). Various health-related challenges amidst recent floods in Pakistan. *Annals of Medicine and Surgery, 82*, 104667.
27. Pak Mission Society (2025). Pakistan Rapid Needs Assessment (RNA) at District Muzaffargarh (05 September 2025). Retrieve at September 6, 2025. Retrieve from: https: // rel iefweb .int report/pakistan/pakistan-rapid-needs-assessment-rna-district-muzaffargarh-05-september-2025.
28. Parvin, G. A., Shimi, A. C., Shaw, R., & Biswas, C. (2016). Flood in a changing climate: The impact on livelihood and how the rural poor cope in Bangladesh. *Climate*, *4*(4), 60.
29. Qamer, F. M., Abbas, S., Ahmad, B., Hussain, A., Salman, A., Muhammad, S., & Thapa, S. (2023). A framework for multi-sensor satellite data to evaluate crop production losses: the case study of 2022 Pakistan floods. *Scientific Reports*, *13*(1), 4240.

30. Rahman, G., Rahman, A., Ullah, S., Miandad, M., & Fayaz, M. (2023). A framework for multi-sensor satellite data to evaluate crop production losses: The case study of 2022 Pakistan floods. *Scientific Reports, 13*, 4240.
31. Rao, N., Lawson, E. T., Raditloaneng, W. N., Solomon, D., & Angula, M. N. (2019). Gendered vulnerabilities to climate change: insights from the semi-arid regions of Africa and Asia. *Climate and Development*, *11*(1), 14-26.
32. Sankhala, G., Singh, M., Kant, K., & Prasad, K. (2016). Drought coping strategies followed by dairy farmers in Bundelkhand region of Uttar Pradesh. *Indian Journal of Animal Sciences*, *86*(10), 1181-1186.
33. Sasson, A. (2012). Food security for Africa: an urgent global challenge. *Agriculture & Food Security*, *1*(1), 2.
34. Skendžić, S., Zovko, M., Živković, I. P., Lešić, V., & Lemić, D. (2021). The impact of climate change on agricultural insect pests. *Insects*, *12*(5), 440.
35. Sutton, W. R., Block, R. I., Srivastava, J., & Sutton, W. R. (2009). *Adaptation to climate change in Europe and Central Asia agriculture* (pp. 1-61). Washington, DC, USA: World Bank.
36. Thornton, P. K. (2010). Livestock production: recent trends, future prospects. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1554), 2853-2867.
37. Tofu, D. A., Dilbato, T., Fana, C., Dirbaba, N. B., & Tesso, G. (2025). Analysis of vulnerability, its drivers, and strategies applied towards reducing the pastoral and agro-pastoral livelihood vulnerability to climatic shocks. *Scientific Reports*, *15*(1), 2567.
38. Tüfekci, H., & Çelik, H. T. (2021). Effects of climate change on sheep and goat breeding. *Black Sea Journal of Agriculture*, *4*(4), 137-145.
39. Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A. G., de Souza Dias, B. F., & Yach, D. (2015). Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *The lancet*, *386*(10007), 1973-2028.
40. Wilhite, D. A., Sivakumar, M. V., & Pulwarty, R. (2014). Managing drought risk in a changing climate: The role of national drought policy. *Weather and climate extremes*, *3*, 4-13.