



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating: 4.61

VET 2025; 10(5): 34-37

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www.veterinarypaper.com

Received: 05-03-2025

Accepted: 08-04-2025

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Strategic nutritional interventions for livestock during environmental crises

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DOI: <https://www.doi.org/10.22271/veterinary.2025.v10.i5a.2234>

Abstract

Natural disasters such as floods, droughts, cyclones, and wildfires severely disrupt the availability of feed and water for domestic animals. These events often damage supply chains, grazing lands, and shelter, forcing both animals and caretakers to adapt feeding practices rapidly. This paper examines the alternative feeding strategies employed for domestic animals during such crises, including the use of emergency rations, crop residues, commercial feed substitutes, and modified feeding schedules. It also highlights the role of local knowledge, government support, and veterinary guidance in managing livestock nutrition under stress. Understanding and improving these adaptive strategies is vital for animal welfare, food security, and the resilience of rural livelihoods in disaster-prone regions.

Keywords: Alternate feeds, feeding regimes, livestock, natural disaster, nutrition

Introduction

A disaster is an unexpected and devastating event that causes major disruption, damage, or destruction to human life, property, and the environment. Natural disasters include events such as earthquakes, hurricanes, floods, and wildfires. Among these, floods are considered the most destructive, often leading to extensive loss of plant life. Livestock serves as a vital form of insurance in the face of unexpected natural calamities like droughts, famines, and other similar events (Patel *et al.*, 2023) ^[7]. These disasters can severely affect animals, posing a serious threat to both agriculture and wildlife. Animals may suffer injuries or death as a direct result of floods, earthquakes, hurricanes, wildfires, or tornadoes. Moreover, the devastation of natural habitats can result in the loss of shelter, food, and breeding areas for wildlife. Domesticated animals may also suffer due to destruction of grazing land or agricultural facilities. These disasters often lead to food and water shortages, which interrupt supply chains, leaving livestock undernourished or dehydrated, while wild animals face difficulties in finding adequate nourishment. In addition, disasters can lead to conditions that promote the spread of disease. For example, stagnant water left by floods can become ideal breeding grounds for pests, and overcrowded shelters can heighten the risk of illness. Displacement is also a major concern, as animals forced out of their habitats may experience stress and face challenges in accessing food and water. For farmers, the financial burden of losing livestock or repairing damaged infrastructure can be significant, often involving the expense of replacing animals and suffering a loss of income. The psychological stress caused by disasters can also impact both wild and domesticated animals, affecting their health and behavior and potentially resulting in long-term consequences. To reduce these impacts, it is essential to enhance disaster preparedness and response strategies for animals. This includes setting up emergency shelters, stockpiling feed and medical supplies, and implementing clear evacuation and care protocols (Pyne and Samanta, 2009) ^[9]. While man-made disasters may not directly harm animals, they can worsen existing conditions through events like bombings, industrial accidents, pollution, environmental damage, transportation risks, or political instability (Anonymous, 2011) ^[1]. During natural disasters, ensuring food security is crucial, as maintaining the health and survival of animals is key to recovery after events like droughts.

As a result, it is important to develop specialized feeding plans to support animal survival during and after natural disasters.

Nutritional approaches for animals during natural disasters

During natural disasters, it is vital to ensure animals have access to sufficient feed and clean water for their health and survival (Rasool *et al.*, 2021) ^[11]. Successful feeding strategies rely on a mix of preparedness, flexibility, and rapid action. Before a disaster strikes, it's important for farmers and animal caretakers to stockpile key feed items like hay, dry feed, silage, and concentrates in ways that protect them from moisture and mold. It's also helpful to identify and prepare alternative feed sources, such as crop residues or specially cultivated emergency forages, to use when usual supplies are cut off. Proper water management is equally important. This includes storing clean water in secure containers and having purification methods like water filters or tablets ready to ensure animals have a safe and reliable drinking supply.

Disaster preparedness plans must incorporate clear feeding protocols tailored for emergency situations, along with regular updates and staff training to ensure smooth execution during crises. Participating in or forming local emergency response teams can improve the efficiency of feed distribution, while maintaining strong relationships with suppliers enables quicker access to necessary resources. Keeping a close watch on animals for any signs of dehydration or malnutrition allows for prompt modifications to feeding routines. Additionally, evaluating the condition of feed stocks and infrastructure after a disaster supports better decision-making regarding sourcing and distribution (Patel *et al.*, 2023) ^[7]. In the aftermath, prioritizing the restoration of feed supplies and infrastructure is essential for long-term recovery this includes replanting forage crops and repairing damaged storage areas. Evaluating the effectiveness of feeding strategies implemented during a disaster and making improvements based on those insights is key to strengthening future emergency preparedness. By adopting these approaches, farmers and animal caretakers can better manage feeding practices during natural calamities, ensuring animal health and survival despite difficult circumstances. It's important to maintain animals at a critical weight level, prioritizing the feeding of productive livestock such as pregnant and lactating cows (Thole *et al.*, 1993). Animals that lose more than 20% of their essential body fat are at high risk of death, although camels are more resilient and can endure up to a 30% loss of critical body weight (Young and Scrimshaw, 1971). In regions where nutrient-rich forage like alfalfa, hay is commonly used, it can serve as a reliable source of nutrition during emergencies. Additionally, in certain situations, feeding rations may be effectively balanced by supplying 25% of the energy from oats and 75% from forage.

Hydration needs

During natural disasters, ensuring animals have access to sufficient clean water is vital for their health and survival. Different animals have specific daily water requirements, influenced by factors such as age, size, and overall health. For example, an adult dairy cow may need between 30 to 50 gallons of water each day, whereas smaller animals like chickens require significantly less. It's important to plan for these needs, especially as water intake may rise during periods of stress or high temperatures. Emergency water supplies should be stored in secure, contamination-proof

containers, with quantities exceeding daily usage. Using food-grade, sealable containers helps maintain water quality and safety (Rasool *et al.*, 2020) ^[10].

If water sources are contaminated during a disaster, it's important to use purification methods such as filters, purification tablets, or boiling to make the water safe, along with routine testing for contamination. Ensuring easy access to water is crucial sources should be placed within reach of all animals, and automatic watering systems can help provide a consistent supply. Ongoing monitoring and management of water availability during the crisis, along with backup plans for sourcing and transporting water, are essential. After the emergency, efforts should focus on repairing and restoring damaged water infrastructure and replenishing supplies. Reviewing how well water management strategies worked during the disaster can highlight areas for improvement and strengthen readiness for future events. For mammals, water intake typically falls within the range of 2.5 to 4.5 liters per kilogram of dry matter consumed (Patil, 2006) ^[8]. This approach offers the benefit of lowering overall nutritional and water demands, while potentially enhancing the advantages of a healthy diet through improved food intake and more efficient feed conversion (Leng, 1986) ^[6].

Use of tree based fodder

During cyclones and floods, top feeds are gathered from the upper parts of trees such as Subabul, Avisa, and Acacia. These include leaves, pods, and branches, which are used as supplemental forage for livestock.

Top feeds are highly nutritious and generally free from disease-causing agents. They are also more palatable and particularly well-suited for browsing animals. As an alternative forage source, they are extremely valuable during severe droughts. Trees can be cut close to the ground without removing the roots for sustainable harvest. Lopping branches not only provides a surplus of feed during dry periods but also allows for rapid regrowth with minimal investment. Additionally, top feeds are rich in calcium and contain precursors of vitamin A. Certain species, like *Azadirachta* (neem), even offer antihelminthic properties, helping to control internal parasites in livestock.

Feeding urea-enriched molasses solution

Liquid urea-molasses feeding involves a mixture of molasses containing 2 to 3% urea, enriched with essential minerals and vitamins, and is commonly known as liquid feed. Typically, the mixture follows a ratio of about 1 part urea to 2-4 parts molasses, though the exact proportions may vary depending on the animals' nutritional needs and targeted feeding objectives (Sugarcane molasses: 92 parts, Urea: 2.5 parts, Fresh water 2.5 parts, Mineral mixture: 2 parts, Common salt: 1 part).

Complete feed block (CFB)

A complete feed block (CFB) is a compact form of animal feed designed to supply all the essential nutrients in a single, easy-to-use product especially useful during natural disasters. This system combines both roughages and concentrates into one balanced feed, typically made from a mix of fodder, concentrate ingredients, and necessary nutrients to meet the dietary needs of livestock (Bakshi *et al.*, 2018) ^[3].

CFBs offer several benefits: they are easy to transport, store, and handle, making them highly practical. This method is both cost-effective and efficient, enabling the use of low-quality agricultural by-products, local crop residues, and

unconventional feeds in a productive way. Materials like untreated or treated rice straw can serve as the base roughage, with additions such as mustard cake, rice bran, molasses, and binders, with or without green fodder, to enhance nutritional value.

This system is especially advantageous for landless laborers and small-scale farmers, providing them with a ready-made, balanced, and affordable feed option. Feed blocks can be stored for later use, particularly during feed shortages, and can be easily transported to areas experiencing deficits, helping to prevent large-scale livestock losses.

Urea Molasses Mineral Blocks (UMMBs)

Urea Molasses Mineral Blocks (UMMBs) are nutritional supplements primarily formulated for ruminants like cattle, goat, and sheep. These blocks combine urea a non-protein nitrogen (NPN) source that rumen microbes can convert into usable protein with molasses, which supplies quick energy and improves taste, encouraging intake (Wadhwa *et al.*, 2022) ^[14]. UMMBs are also enriched with vital minerals such as calcium, phosphorus, salt, and magnesium, along with essential vitamins that support animal health and productivity. Binders are included to maintain the block's solid form, while additional ingredients may be added to boost digestibility or provide extra health advantages (Wadhwa and Bakshi, 2011) ^[13]. UMMB maintenance should be avoided for young calves because their rumen are not well developed (FAO, 2007), (Molasses: 45%, Urea: 15%, Mineral mixture: 15%, Common salt: 8%, Calcite powder: 4%, Bentonite: 3%, vegetable oil cake: 10%).

Incorporation of Hay in Feeding Regimens

Hay is a preserved form of forage made by cutting, drying, and baling grasses or legumes, and it's commonly used as animal feed. The drying process removes moisture, which prevents spoilage and allows hay to be stored for long periods. In times of natural disasters such as droughts, floods, hurricanes, or wildfires hay becomes an essential alternative feed source when fresh pasture is damaged or unavailable. It provides key nutrients like fiber, protein, and energy, which are vital for maintaining livestock health and productivity. One of hay's major advantages in emergencies is its ability to be stockpiled ahead of time, thanks to its extended shelf life. This makes it a dependable option when access to fresh forage is limited. By supplying a consistent and nutritious diet during crises, hay plays a crucial role in keeping animals healthy and reducing the risk of nutrient deficiencies (Kashyap *et al.*, 2021) ^[5].

Urea-enriched straw or Stover compacted into blocks or bales

Urea-treated straw is a technique used to improve the nutritional quality of straw, which is commonly used as roughage in livestock diets. This process involves applying a 3.5% urea solution to the straw, moistening it to about 40% humidity. The treated straw is then stacked in an open heap and left to cure for nine days. Routine health check and modification of diet when necessary helps ensure that urea-treated straw is contributing positively to their well-being. In general, urea-treated straw serves as an effective method for enhancing the nutritional value of straw and other poor-quality forages. This makes it a cost-efficient and practical feeding solution, particularly useful during periods of feed shortages or financial constraints (Bakshi and Wadhwa, 1999) ^[2].

Silage for periods of fodder shortage

Storing surplus fodder as silage during periods of abundant greenery is an excellent feeding strategy for ruminants in drought-prone regions (Hussain *et al.*, 2023) ^[4]. Fruit by-products are typically high in soluble carbohydrates and contain only a small amount of protein which supports bacterial fermentation. Ensiling paddy straw and chicken droppings, a dry matter-based ratio of 40:40 including green grass and molasses produces high-quality silage. This method is considered one of the best ways to preserve fodder crops for feeding livestock during periods of scarcity. Silage can be stored for up to a year; however, once the silo pit or silage bag is opened, it should be consumed within three weeks.

Tree leaves and vegetable leaves

Moreover, fodder trees and shrubs on dairy cattle farm can provide additional feed rich in macro and micronutrients. As perennial species, fodder trees are resilient to abrupt climatic variations and consistently yield high-quality fodder, even during drought years when grasses and other annual forages have withered away. Their rapid growth rate allows them to generate substantial biomass, which can be utilized both as animal feed and as mulch in agricultural systems. After reaching full maturity, fodder trees are pruned 4 to 6 times each year, producing around 1 kg of dry fodder per tree annually. Leaves from trees like neem, mango, pipal, banyan, babul, subabul, mahuva, banana, and bamboo can serve as alternative green fodder, especially when fresh forage is scarce. These tree leaves are readily available and can be fed directly as raw fodder. They offer a valuable nutritional profile, containing 6-20% crude protein (CP), 0.5-2.5% calcium, and are also rich in Vitamin A.

Unconventional feeds

These alternative feed resources can be especially beneficial for enhancing livestock diets when conventional feeds are lacking. Some examples are marine by-products, shrimp by-products, oyster meat meal, crab meat meal, snail meat meal, and sunflower seed meal. Duckweed, another unconventional feed is a valuable plant-based protein source, containing 40% protein, carotene, xanthophylls and lysine. Sesame oil cake provides nearly all essential amino acids in sufficient quantities, with a crude fiber content of 8% and lipid content of 8.7%. Fish meal is produced from the tissues of decomposed fish or fish trimmings that lack fish oil. It contains 60-70% crude protein and serves as a rich source of B-complex vitamins (Patil, 2006) ^[8].

Food banks

Feed and food banks play a vital role in promoting animal welfare, especially during crises or periods of economic difficulty. Feed banks are dedicated initiatives that supply livestock owners and farmers with essential feed and nutritional supplements. They become particularly important during emergencies like natural disasters, droughts, or financial hardships, when access to sufficient and affordable feed is limited. By providing necessary feed, these banks help sustain animal health and productivity, which in turn supports farmers' income and helps ensure food security for communities reliant on livestock. To maintain feed safety, options like UMMB (Urea Molasses Mineral Blocks) or green fodder are utilized. However, a significant challenge in establishing livestock banks is storage, as roughages used for feeding animals require large storage spaces.

Hydroponic forage cultivation

Hydroponic fodder production is a modern approach to growing animal feed without the use of soil. It involves cultivating fodder crops in a controlled environment using a nutrient-enriched water solution, enabling fast and efficient growth of high-quality feed. Hydroponic systems offer significant benefits in areas where conventional farming is difficult, such as regions facing poor soil quality, limited water resources or frequent natural disasters.

Conclusion

During natural disasters, it is important to avoid certain types of feed to protect the health and safety of livestock. Feed that is spoiled, moldy, or contaminated should not be used, as it can lead to serious health issues, including disease outbreaks and poisoning. Such feed may harbor toxins, harmful bacteria, or pathogens that can negatively affect animal health and productivity. Moreover, feed exposed to floodwaters or other environmental hazards may absorb dangerous substances or microbes, making it unsafe for consumption. Newly grown grass, which often contains high levels of nitrite and nitrate, should be provided in limited quantities and mixed with dry roughages like paddy straw or hay to reduce the risk

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article

Lakshmi JJ, Deepthi B. Strategic nutritional interventions for livestock during environmental crises. International Journal of Veterinary Sciences and Animal Husbandry. 2025;10(5):34-37.

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