Strategic Feeding of Livestock for Maintenance Using Bypass Nutrients During Disasters

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Natural disasters such as droughts, floods, and landslides frequently disrupt the availability, accessibility, and quality of conventional livestock feed resources. In such emergency situations, the primary goal of livestock management shifts from optimizing productivity to ensuring the basic maintenance and survival of animals. Severe feed shortages, poor forage digestibility, and heightened environmental stress negatively affect rumen fermentation, nutrient absorption, and overall metabolic balance. These challenges, if unaddressed, can lead to weight loss, reproductive failure, immunosuppression, and even mortality. Under these conditions, maintenance feeding becomes a critical strategy. It focuses on supplying the minimum nutritional requirements needed to support vital physiological functions such as basal metabolism, thermoregulation, and immune response, rather than growth, lactation, or reproduction.

Bypass nutrients, also referred to as rumen-protected nutrients, provide a targeted solution during such feed-deficit periods. These include bypass protein, protected fats, and essential amino acids that escape ruminal degradation and are absorbed in the small intestine. By directly supplying nutrients in a bioavailable form, they help maintain animal condition and minimize performance losses. This article explores the role and application of bypass nutrients for maintaining livestock under disaster-prone conditions, supported by practical examples and scientific recommendations.

Nutritional Requirements for Maintenance

The approximate maintenance nutrient requirements for major livestock species under disaster conditions, such as droughts, floods, or cold stress. The values are adapted from NRC (2001), ICAR (2013), and relevant emergency feeding guidelines (FAO/LEGS, 2020), and are meant for adult animals at rest, with no production load (i.e., not lactating or pregnant).

Table 1: Maintenance Requirements for Adult Livestock under Disaster Conditions

Species	Body Weight (kg)	ME (MJ/day)	Crude Protein (g/day)	DMI (% of BW)	Calcium (g/day)	Phosphorus (g/day)	Reference(s)
Cattle	400	30	300	1.5–2.0	8–10	6–7	NRC (2001); ICAR (2013)
Buffalo	450	35	350	1.5–2.0	10	8	ICAR (2013); FAO (2020)
Sheep	40	4.2	50–60	2.5–3.0	1.5	1.2	NRC (2007); LEGS (2020)
Goat	40	4.5	60–70	2.5–3.0	1.5–2.0	1.5	ICAR (2013); Tiwari *et al.* (2022)
Poultry (Hen)	1.8–2.0	0.7–0.8	12–14	~10% of BW	0.8	0.6	NRC (1994)
Camel	500	25–30	250–300	1.3–1.8	7–9	6–7	FAO (2020)

- ME = Metabolizable Energy; DMI = Dry Matter Intake
- These are minimum estimates for survival and maintenance, not for production or growth.
- Values can vary ±10–20% based on environmental stress (e.g., cold or heat), breed, and feed quality.
- Water requirements increase significantly under heat or flood stress (>50 L/day for cattle).
  In disaster settings, these requirements must be met using low-volume, nutrient-dense feeds.

Bypass (Rumen-Protected) Protein (RPP) in Maintenance Feeding

Rumen-protected protein (RPP) refers to dietary protein sources that are chemically or physically treated to resist degradation by rumen microbes, allowing a significant portion to bypass the rumen and be digested and absorbed in the small intestine. Under normal conditions, rumen-degradable protein (RDP) is fermented to ammonia and used by microbes to synthesize microbial protein, which is the major source of amino acids for ruminants. However, during disasters such as droughts or floods, low-quality roughages with poor nitrogen content (<6% CP) limit microbial protein synthesis, leading to negative nitrogen balance and catabolism of body tissues.

Supplementation with RPP provides essential amino acids (EAA) such as lysine, methionine, and leucine directly to the host animal, ensuring muscle maintenance, immune cell function, and repair of damaged tissues. The digestibility coefficient of bypass proteins is typically 75–85%, depending on the treatment method (e.g., formaldehyde, heat extrusion, tannin coating).

In drought-hit Telangana (2019), maintenance feeding of non-lactating cattle with 300 g/day RPP (treated soybean meal) + crop residue-maintained body weight and rumen fill for 45 days, with reduced muscle loss compared to control (Andani *et al.*, 2020).

Table 2: Recommended RPP Sources in Emergencies

Feedstuff	CP (%)	Bypass Protein (%)	Treatment
Soybean meal (treated)	45–48	60–65	Formaldehyde 1–1.2%
Cottonseed cake (treated)	40–42	55–60	Heat + tannin coating
Maize gluten meal	60	70+	Naturally high bypass

Bypass Fat (Rumen-Protected Fat) RPF in Maintenance Feeding

Bypass fats, also known as rumen-protected fats (RPFs) or inert fats, are specially formulated fat sources that resist degradation by rumen microbes and are instead digested and absorbed in the small intestine. These fats provide a concentrated energy source (8.5–9.5 Mcal/kg of metabolizable energy), which is 2.25 times more energy-dense than carbohydrates, with minimal adverse effects on rumen fermentation when used appropriately. Flood-relief shelters in Assam supplemented 150–200 g/cow/day of rumen protected fat, resulting in maintenance of body condition score (BCS ~2.75), compared to BCS loss of 0.5 units in supplemented animals (Gogoi *et al.*, 2021).

Table 3: Recommended RPF Sources in Disasters

Product	Fat Content (%)	Rumen Bypass (%)	ME (Mcal/kg)	Form
Calcium salts of palm oil (Ca-PFA)	85–90	80–85	8.5–9.2	Powder/flake
Prilled fats	98–99	70–75	9.0–9.5	Granules
Saturated fatty acid blends	80–85	60–70	~8.5	Blocks or pellets

Rumen-Protected Amino Acids (RP-AA)

Rumen-Protected Amino Acids (RP-AA) for maintenance feeding during disasters, particularly focusing on their role in immune function, protein sparing, and field application in cold-stressed goats during Himalayan landslides: Even under maintenance feeding (i.e., when production is not the goal), essential amino acids (EAAs) like methionine and lysine play critical roles beyond muscle accretion. These include:

- Immune modulation (e.g., lymphocyte proliferation, cytokine production)
- Antioxidant defense (especially methionine via glutathione synthesis)
- Preservation of lean tissue during caloric stress or negative nitrogen balance
- Maintenance of gut integrity and mucosal protein turnover

Field Evidence: During the 2021 landslides and cold wave in the Uttarakhand region, a field intervention was carried out involving 40 cold-stressed Gaddi goats in makeshift shelters, fed primarily on low-quality hay and limited concentrate. Provision of 10 g RP-methionine + 10 g RP-lysine/day in cold-stressed goats during Himalayan landslides improved resilience, with reduced morbidity (Tiwari *et al.*, 2022).

Table 4: Recommended Maintenance Feeding Regimen for Various Livestock During Disasters

Species	Body Wt (kg)	Dry Roughage (kg/day)	Bypass Protein (g/day)	Bypass Fat (g/day)	RP Amino Acids (g/day)	Mineral Mixture (g/day)	Water (L/day)	Remarks
Cattle	400	3–4 (e.g., straw or hay)	300–350 (cotton seed/SBM)	150–200	10–15 (Methionine + Lysine)	30–50	30–50	Focus on condition score and immunity
Buffalo	450	4–5	350–400	200–250	15–20	50	40–60	More prone to heat stress; ensure adequate water
Goat	40	0.8–1.2	60–70	40–60	5–7	15	4–5	Provide shelter from cold and wet stress
Sheep	40	0.8–1.0	50–60	30–50	4–6	10–15	3–4	Cold stress and parasitic control are important
Camel	500	5–6	300–350	200–300	Optional	50	40–60	Salt and water access are critical
Poultry (Hen)	~2	90–100 g balanced mash	Not required (use intact protein)	~2–3	Not typically used	2–3	0.25–0.5	Include vitamins A, D, E in feed

- **Dry roughage:** Preferably chopped straw, hay, or stover. Soak during drought or pre-treat for digestibility.
- **Bypass Protein:** Rumen-protected sources like treated soybean meal, cottonseed cake, maize gluten.
- **Bypass Fat:** Calcium salts of palm fatty acids or commercial prilled fat.
- **RP Amino Acids:** Useful in cold stress or immune-compromised animals.
- **Mineral Mixture:** Use region-specific formulations (e.g., with selenium or zinc).
- **Water:** Always provide clean and unrestricted access.

Benefits of Using Bypass Nutrients During Disaster Feeding

- Minimizes weight loss during feed scarcity
- Reduces metabolic stress and immune suppression
- Maintains body condition score (BCS) and reproductive potential
- Improves survival and recovery post-disaster

Practical Considerations

- Use regionally available RPP sources: cottonseed cake, sunflower cake, maize gluten
- Store bypass fat and RP-AA in dry, cool places for emergencies
- Encourage community-level feed banks to stock bypass feeds
- Include bypass supplements in disaster relief kits for livestock

In disaster-prone areas, maintaining livestock through nutrient-dense, rumen-protected feed supplementation is not only cost-effective but essential for survival and long-term productivity. Integration of bypass nutrients into emergency feeding strategies enhances livestock resilience, particularly in resource limited and extreme environments.

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