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Cactus-based fodder:

A water-rich lifeline for sustainable dairy production

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Livestock production is a vital component of agriculture in India, contributing significantly to food security, rural employment, and the national economy. More than 70% of rural households depend directly or indirectly on livestock for their livelihoods. Milk, meat, draft power, and manure are among the many services derived from cattle, buffalo, sheep, goats, and other farm animals. Despite the vast size of India's livestock population, the productivity of our animals remains comparatively low. One of the principal reasons is the persistent shortage of quality feed and fodder. As per ICAR-IGFRI vision bulletin-2050, India faces a deficit of about 35% in green fodder and 10–12% in dry fodder availability. This gap between demand and supply is widening with the increase in livestock population, shrinking pasture lands, and growing competition for arable land between food, feed, and fuel crops. Spineless cactus emerges as a highly effective solution to address green fodder scarcity, particularly, in arid, semi-arid, and drought-prone areas. Its unique biology, higher water use efficiency and wider adaptability makes it a climate-resilient forage crop capable of supporting livestock during the dry season.

Keywords: Fodder availability, Livestock, Semi-arid conditions, Water use efficiency

CONVENTIONAL fodder sources such as cultivated grasses, legumes, and crop residues are no longer adequate to sustain the nutritional requirements of our ruminant population. Farmers in drought-prone regions are especially vulnerable as the supply of green fodder is seasonal and highly dependent on rainfall. With the added challenges of climate change, recurrent droughts, and increasing land degradation, the need to explore non-conventional feed resources has become urgent. Non-conventional feed resources (NCFRs) are those that are not commonly used in standard feeding systems but have the potential to supplement or replace traditional feeds. Among the many options under study, cactus, particularly *Opuntia ficus-indica*, has emerged as a promising alternative.

Cactus is well adapted to arid and semi-arid environments, requires minimal management, and produces green biomass almost throughout the year. It has the unique advantage of storing water in its succulent cladodes, thus, serving both as feed and as a source of water for animals during dry periods. In the global context, countries such as Mexico, Brazil, South Africa, and Tunisia have already demonstrated the successful integration of cactus into livestock feeding systems. For India, with vast stretches of drylands in Rajasthan, Gujarat, Maharashtra, Telangana, and parts of Tamil Nadu, cactus represents a climate-resilient, cost-effective, and farmer-friendly option for bridging the fodder gap.

Adaptation and botanical description

Cactus belongs to the family Cactaceae, which includes around 1,500 species. The genus *Opuntia*, with nearly 300 recognized species, is of particular importance for fodder production. Among these, *Opuntia ficus-indica* is the most widely cultivated species for livestock feeding. Commonly referred to as prickly pear or cactus pear, it is a perennial, succulent plant characterized by flat, fleshy, and jointed stem segments called cladodes. These cladodes serve as the primary photosynthetic organs of the plant, since cactus leaves have evolved into spines to reduce water loss and protect against herbivory.

Cactus thrives in tropical and sub-tropical regions and is capable of withstanding high temperatures up to 45°C and short periods of frost down to -10°C. The plant prefers full sunlight and grows optimally at temperatures ranging from 23–26°C. Its shallow but extensive root

system allows it to absorb moisture from light rains and dew, enabling survival even in areas with less than 200 mm of annual rainfall. Cactus plantations are well suited to marginal and degraded lands where conventional crops fail, making them especially valuable for resource-poor farmers in drought-affected areas. The plant's perennial nature ensures that once established, it can continue to produce cladodes for several years without replanting. Unlike many seasonal fodder crops that require repeated sowing, cactus offers a continuous supply of green biomass, thereby reducing labour and input costs. It was also found that yields can range between 80–100 t/ha of green forage depending on the variety, age of plantation, and management practices. Compared to cereal fodders, which often suffer from water stress and erratic rainfall, cactus offers a reliable alternative for ensuring year-round fodder availability.

Nutritional and proximate composition

One of the striking features of cactus is its high-water content, which ranges from 80–95%. This makes it particularly useful as a feed resource in arid areas where water scarcity is acute. On a dry matter basis, cactus cladodes are rich in soluble carbohydrates, constituting around 60% of the total dry matter, which provide quick energy to ruminants. The crude protein content is generally low, ranging between 0.5–1%, while crude fibre is about 1–2% and fat content is negligible. Although cactus alone cannot provide a balanced ration due to its low protein and fiber levels, it is an excellent energy supplement when fed along with crop residues, hay, or protein-rich concentrates such as oilseed cakes and leguminous forages.

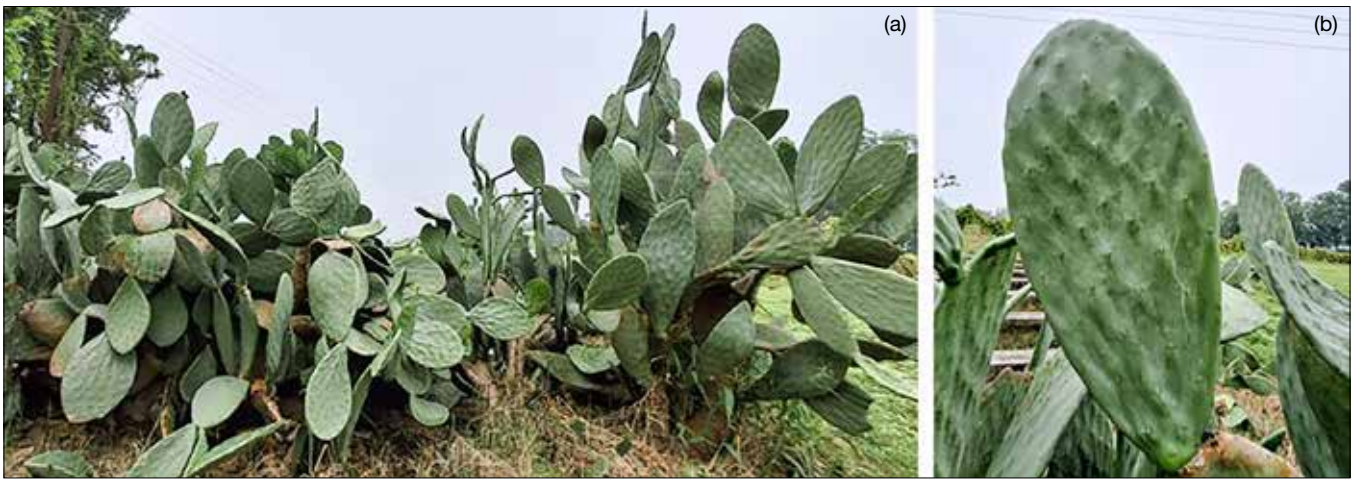
Another advantage of cactus is its mucilage content, a form of soluble fibre that aids in digestion. Unlike cereal grains such as maize or barley, which can lead to acidosis when consumed in excess, cactus feeding rarely causes metabolic disorders because mucilage enhances salivation and stabilises rumen *p*H. Studies conducted in Brazil and Tunisia have demonstrated that animals fed with cactus-based rations not only maintain good body condition during droughts but also show improvements in milk yield, meat quality, and reproductive performance when cactus is combined with balanced protein and mineral supplements.

Benefits to farmers and livestock

For farmers in dry regions, cactus emerges as a valuable option because of its multiple benefits. One of its greatest strengths lies in its ability to act as a water-saving fodder. The high moisture content of the cladodes reduces the drinking water requirement of cattle and buffalo, which is especially important during hot summers and prolonged droughts when water becomes a limiting factor. In such situations, cactus feeding helps ease the burden on farmers who otherwise spend considerable time and resources arranging water for their animals.

In addition to saving water, cactus assures feed security throughout the year. Unlike many conventional green fodders that are available only in certain seasons, cactus continues to produce even under dry spells. Its quick regeneration after cutting allows repeated harvests, providing farmers with a steady supply of green biomass. Once established, plantations require very little care. They do not need costly fertilisers, irrigation, or plant protection measures, and the crop thrives even on degraded soils. This makes cactus particularly suited to the needs of smallholders and resource-poor farmers.

Beyond its role as an economical fodder, cactus also supports environmental sustainability. Cultivation on wastelands helps in checking soil erosion and rehabilitating degraded areas. When planted along field boundaries, cactus functions as a live fence that protects crops from stray animals. The crop also contributes to climate resilience by storing carbon and producing high biomass under conditions where other species fail. Another important feature is its high palatability. Farmers have observed that cattle, buffaloes, goats, sheep, camels, and even horses consume cactus cladodes over straw or other dry crop residues. When fed gradually and in combination with fibrous and protein-rich materials,



(a) Spineless cactus plants grown as fodder in farmers' field (b) Cladodes of cactus used as a non-conventional feed resource for livestock

Table 1. Recommended feeding schedule of cactus (*Opuntia* spp.) for dairy cows

Stage of animal/ Feeding situation	Recommended quantity of cactus (kg fresh/day)	Stage of feeding/ Introduction	Method of feeding (Cutting, de-spining, mixing)	Remarks/ Precautions
Lactating cows [350–450 kg body weight (BW), avg. yield 8–12 L/ day]	10–15 kg (20–25% of daily green fodder requirement)	Introduce gradually (2–3 kg/day for first week, then increase)	Chop into small pieces (2–3 cm), preferably de-spined; mix with dry fodder (wheat straw, sorghum stover)	Ensures good palatability, prevents diarrhea; always balance with protein-rich source (e.g. oilseed cake, concentrate)
Dry cows (non-lactating, 350–400 kg BW)	8–12 kg	Start with 2–3 kg/day and increase	Chop and feed mixed with dry fodder	Useful for maintaining body condition in drought; avoid feeding as sole roughage
Heifers (200–300 kg BW, 12–24 months age)	5–8 kg	Introduce gradually (1–2 kg/day)	Chop finely, de-spine if needed; mix with dry roughage	Supports growth during fodder scarcity; always provide mineral mixture
Calves (>6 months, 80–150 kg BW)	2–4 kg	Very gradual introduction	Finely chopped, ensure spines removed	Supplement with concentrate and good quality hay; do not feed to calves <6 months
Emergency / Drought feeding (all categories)	Up to 30–40% of total ration DM (not sole feed)	Can be introduced as survival feed	Always chopped and mixed; provide additional protein and minerals	Prevents dehydration and starvation; high moisture content (80–90%) can dilute ration if not balanced

cactus improves both feed intake and digestibility, enhancing animal performance under otherwise difficult feeding conditions.

Feeding methods and farmers' practices

Despite its many advantages, cactus feeding requires certain precautions. Farmers should avoid allowing animals to graze directly on cactus plantations. Direct grazing not only destroys the plants but also reduces the longevity of the plantation. The preferred practice is the cut-and-carry method, in which cladodes are harvested, chopped into small pieces, and then offered to animals. Spineless varieties are most desirable for fodder purposes as they eliminate the need for spine removal. However, in the absence of spineless types, farmers can use simple methods such as slightly burning the pads over fire or mechanically scraping to remove spines before feeding. Cladodes should always be chopped into small pieces to facilitate chewing and reduce wastage.

Since cactus is deficient in protein and fibre, it should not be fed alone. Farmers are advised to mix cactus with dry fodder such as wheat straw, paddy straw, or hay, and with protein sources such as groundnut cake, cottonseed cake, or leguminous fodder. This not only balances the ration but also improves the efficiency of nutrient utilization. The safe feeding level for cattle and buffalo is about 20–30% percent of the total ration dry matter. Feeding should begin gradually, allowing animals to adapt to the new feed.

Storage and conservation methods

Although cactus is usually fed fresh, surplus biomass can be conserved for later use. One effective method is ensiling, where chopped cactus is mixed with dry roughages and stored in silos under anaerobic conditions. The high moisture content of cactus makes ensiling challenging, but when combined with dry materials, the process produces good-quality silage. Farmers in Brazil and Tunisia have successfully adopted this practice, and it can be promoted in Indian conditions as well.

Another promising approach is the preparation of complete feed blocks. Chopped cactus can be combined with molasses, urea, crop residues, and minerals to form compressed blocks. These blocks are convenient to transport, store, and distribute, making them particularly useful during drought relief operations. In addition, cactus can be integrated with other unconventional feeds such as saltbush. The high salt content of saltbush is balanced by the water and sugars of cactus, resulting in a complementary feed mixture that improves livestock performance.

Future prospects and challenges

The potential of cactus as a non-conventional feed resource in India is immense, yet its adoption has been limited so far. Lack of awareness among farmers, inadequate availability of planting material of spineless varieties, and absence of large-scale demonstrations are some of the barriers. Research institutions and extension agencies need to work together to promote cactus cultivation through farmer field schools, training programmes, and distribution of quality planting material. At the policy level, cactus can be included in fodder development schemes for arid and semi-arid regions. Linking cactus plantations with watershed development and wasteland reclamation projects can further enhance its impact. Moreover, integrating cactus into mixed farming systems, such as agroforestry or silvopastoral models, will provide multiple benefits in terms of fodder, soil conservation, and additional income from fruit and vegetable uses. The scientific community also needs to address challenges such as improving the nutritive value of cactus through selection and breeding, developing efficient processing and storage technologies, and establishing feeding standards specific to Indian livestock breeds. Collaboration with international research bodies and

knowledge exchange with countries experienced in cactus utilisation can accelerate the process.

Cactus is more than a hardy desert plant; it is a sustainable and climate-smart feed resource that holds great promise for addressing India's fodder deficit. By integrating cactus into livestock feeding systems, farmers can reduce their dependence on scarce water and expensive concentrates, ensure year-round fodder supply, and enhance the resilience of their farming enterprises.

SUMMARY

India faces a severe shortage of quality fodder for its large cattle and buffalo population. Conventional feed resources are insufficient, especially in drought-prone regions. Cactus (*Opuntia ficus-indica*) is a promising non-conventional feed resource that can thrive in arid and semi-arid areas with minimal inputs. It provides water-rich, energy-rich cladodes that are relished by livestock. Farmers should harvest and chop cladodes before feeding, mix them with straw or protein sources, and introduce gradually. Surplus cactus can be preserved as silage or feed blocks. With proper adoption, cactus can play a key role in ensuring fodder security, reducing production costs, and improving the sustainability of livestock farming in India.

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Articles invited for Special Issues of *Indian Farming* and *Indian Horticulture*

On the occasion of the 98th ICAR Foundation Day

ICAR invites articles for two Special Issues of its flagship magazines, *Indian Farming* and *Indian Horticulture*, to be published on the occasion of the 98 ICAR Foundation Day. Researchers, scientists, and subject matter experts are encouraged to contribute high-quality articles aligned with the themes given below.

1. Special Issue of *Indian Farming* on "Environmental Sustainability"

This issue will focus on innovations, technologies, and products that contribute to Environmental Sustainability and support the attainment of the Sustainable Development Goals (SDGs). Articles should present a clear and complete storyline demonstrating how the described method advances specific SDGs and promotes sustainable agricultural practices.

Authors are requested to follow the submission guidelines available on the *Indian Farming* ePubs portal: https://epubs.icar.org.in/index.php/IndFarm/about/submissions

2. Special Issue of *Indian Horticulture* on "Nutrition and Health"

This issue will highlight advancements that enhance nutrition, improve health outcomes, and promote sustainable food systems, contributing to relevant SDGs. Articles should present a coherent narrative demonstrating how the work supports better nutrition and health through horticultural innovations.

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While submitting the article, please clearly mention that the submission is for the **Special Issue**.

Last date for submission: 28th February 2026