

Read report on Green Fodder Production - A Manual for Field Functionaries

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Contents

Introduction	1
Fodder production in India	1
Package of practices and fodder classification.....	3
Characteristics of green fodder.....	5
Fodder Cereals	8
Maize	8
Sorghum	10
Pearl millet.....	12
Oat	14
Fodder Grass	16
Hybrid Napier	16
Guinea Grass.....	18
Rhodes Grass	20
Para Grass.....	22
Anjan Grass (Buffel Grass)	24
Fodder Legumes	26
Lucerne (Alfalfa)	26
Berseem (Egyptian Clover).....	28
Hedge Lucerne	30
Stylosanthes.....	32
Cowpea (Lobia).....	34
Fodder Trees	36
Sesbania	36
Subabul.....	38
Glyricidia	40
Moringa (Drumstick).....	42

Fodder Sources on Field Bunds and	
Degraded Land	44
Acacia (Babul)	44
Melia Azadirachta.....	46
Spineless Cactus	48
Organizations involved in different aspects	
of fodder production	51

Introduction

Agriculture and animal husbandry in India are interwoven, with mixed farming and livestock rearing being integral to rural livelihoods. Although the agriculture sector's contribution to the Indian economy is steadily declining, both the agriculture and livestock sectors provide employment to 52% of the work force.

Livestock producers meet their fodder needs through a combination of crop residues, grazing (on common and private lands, forests, and fallow and harvested agricultural lands), and cultivated forage crops (grown mostly by large landholders), while some of them purchase fodder. However, the livestock sector has been grappling with issues of improving fodder production. Green fodder is critical as it provides nutrients for livestock health, which ultimately has a bearing on livestock output and the sector itself.

Fodder production in India

Growing livestock numbers and evolving animal husbandry practices require a corresponding increase in fodder to meet livestock needs. Current fodder availability in the country is well below its demand.

Given the large number of resource-poor households dependent on open grazing for their livestock, revitalizing degraded common fodder and pasture resources and improving their

productivity are imperative. Various studies have been carried out to assess the demand and supply of green and dry fodder resources. In this context, the Planning Commission's Working Group on Animal Husbandry and Dairying's estimation of the demand and supply of fodder resources in India are given in Table 1.

Fodder production and utilization depend on cropping pattern, climate, type of livestock, and socio-economic conditions. Deficit in fodder, dry crop residues and feed have to be met by either increasing productivity, utilizing untapped feed resources, increasing land area or through imports (Table 2).

The situation is aggravated by growing livestock numbers, particularly genetically improved ones. Moreover, available forage is poor in quality and deficient in energy, protein, and minerals.

Table 1. Demand and supply of fodder in India (in million tonnes) over the years and projected demand and supply.

Year	Demand		Supply		Deficit		Deficit as %	
	Green	Dry	Green	Dry	Green	Dry	Green	Dry
1995	947	526	379.3	421	568	105	59.95	19.95
2000	988	549	384.5	428	604	121	61.10	21.93
2005	1,025	569	389.9	443	635	126	61.96	22.08
2010	1,061	589	395.2	451	666	138	62.76	23.46
2015	1,097	609	400.6	466	696	143	63.50	23.56
2020*	1,134	630	405.9	473	728	157	64.21	24.81
2025*	1,170	650	411.3	488	759	162	64.87	24.92

* Figures are projections.

Source: Based on Xth Five-Year Plan Document, Government of India.

Table 2. Requirement, availability, and deficit of Crude Protein (CP) and Total Digestible Nutrients (TDN) in India (in million tonnes) over the years and projected figures.

Year	Requirement		Availability		Deficit (%)	
	CP	TDN	CP	TDN	CP	TDN
2000	44.49	321.29	30.81	242.42	30.75	24.55
2005	46.12	333.11	32.62	253.63	29.27	23.86
2010	47.76	344.93	34.18	262.02	28.44	24.04
2015	49.39	356.73	35.98	273.24	27.15	23.41
2020*	51.04	368.61	37.50	281.23	26.52	23.70
2025*	52.68	380.49	39.31	292.45	25.38	23.14

* Figures are projections.

Package of practices and fodder classification

A combination of soil types, climatic conditions, and large number of forage species suited to different agro-ecological conditions and input situations enable intensive forage production in India.

Forage production per unit area is a consequence of the interaction between genotypes and the environment. Selecting better varieties, seeds, application of fertilizers, and adoption of agronomic practices can lead to a significant increase in productivity.

Fodder crops can be grouped as follows:

Cereal fodder: Cereals are grown for their edible starchy seeds known as 'caryopsis'. Cereal fodders have a determinate growth habit and their herbage quality starts deteriorating after flowering. They have wider adaptability and

variability in terms of growth, regeneration potential, yield and quality of herbage. Maize, sorghum, pearl millet, and oat provide energy-rich herbage to livestock.

Legumes fodder: Legumes by and large are indeterminate in growth and maintain quality traits over longer periods. They have high herbage protein and nitrogen fixing ability.

Grass fodder: These include introduced and native grasses for pasture, grazing, and hay and can be either annual or perennial and either single cut or multi-cut.

Fodder trees and shrubs: Shoots or sprouts, tender twigs and stems of woody plants along with their leaves, flowers, fruits or pods are raised to feed livestock. They are hardy and provide year-round fodder for use during lean periods. Their leaves are high in protein, with 10-30% of Dry Matter (DM) and can replace concentrates. However, while the availability of tree leaves is seasonal, concentrates are available all year round.

In dry periods, trees and shrubs remain green longer than grasses because of their deep root system which can tap water. When grasses are scarce, fodder trees stay green and provide the required energy and protein. Some fodder tree species improve soil fertility by providing green mulch or by fixing atmospheric nitrogen and even provide construction material, firewood, shelter, shade or edible pods.

Other crops: Root crops such as turnip, carrot and fodder beet, *Brassica* spp., and vetches are supplementary sources of feed. Due to early

bulking capacity and short duration, they are often grown as catch crops.

Fodder crops can also be classified based on their nature and growth. Annuals such as maize and cowpea complete their life cycle in one season while perennials such as Guinea grass and Lucerne provide fodder for more than one season or year. Their classification based on family, splits them into leguminous (guar, berseem, cowpea, lucerne) and non-leguminous crops (maize, pearl millet, sorghum, and oat). There are also rainfed fodder crops (fodder pearl millet, Stylosanthes) and irrigated fodder crops such as Hybrid Napier, guinea grass, Lucerne, etc. Range species/grasses comprise of Dharaf grass, marvel grass, setaria grass, anjan grass, etc.

Characteristics of green fodder

- Quick growth
- Close spacing with optimum seed rate
- Dense plant stand smothers weeds and prevents soil erosion
- Improves soil health by adding organic residues
- Adjustable crop duration that minimizes risk due to aberrant weather
- High regeneration capacity reduces the need for frequent planting and tillage compared to perennial fodder crops
- Crop management differs with type of fodder crop and mode of utilization
- Wider adaptability: can grow under stress conditions
- High nutrient and water requirement under intensive cropping

- Multi-cut nature can provide fodder at regular intervals
- Economic viability depends on secondary production (livestock products)
- Storage, transportation, processing and conservation are cumbersome
- Cost of cultivation decreases with subsequent cuttings in the case of multi-cut and/or perennial fodder as well as in fodder-cum-seed crops.

Systematic breeding of fodder crops at different research institutions under the Indian Council of Agricultural Research (ICAR) and State Agricultural and Veterinary Universities have led to the development and release of a large number of improved varieties suitable for different agro-ecological zones. Krishi Vigyan Centers (KVK) produce fodder seeds and stem cuttings/root slips, apart from delivering information on green fodder production. The Department of Animal Husbandry and Veterinary Services in state governments, dairy cooperatives, Farmer Producer Organizations, Non-Government Organizations, Self-help Groups, and Farmers' Associations too are involved in this endeavor to benefit the farming community. The varieties released have led to substantial increase in the productivity and production of fodder in the country. This manual serves as a guide for field functionaries involved in promoting feed/fodder crops, and who are constrained by the lack of information about improved varieties suited to arid and semi-arid conditions. Together with details on the kinds of fodder crops suited to these areas, the accompanying agronomic practices provide a holistic look at improving fodder production.

Fodder Types

Fodder Cereals

Maize



Maize

Scientific name	<i>Zea mays</i> L.
Important features	Suitable for integration with other crops, this short-duration crop can be grown during <i>kharif</i> , <i>rabi</i> and <i>zaid</i> . The milk to early dough stage is preferred for higher yield and protein content.
Varieties	African Tall, APFM-8, Pratap Makka Chari 6, Ganga-4, J-1006.
When and how to plant	This is ideally planted during June-July, September-October or February-March, 40-50 kg seed/ha at 5 cm depth with 60 cm row to row spacing and 10 cm spacing between crops.
Chemical fertilizer (kg/ha)	15-30 kg Nitrogen (N): 40-60 kg Phosphorus (P): 40 kg Potassium (K) and 20 kg Zinc sulphate before planting and 60-90 kg N when the crop is 50-60 cm tall.
Farm Yard Manure (tons/ha)	15.0 t applied a month before planting.
Irrigation	Every 15-20 days in the rainy season and every 10-12 days in the summer.
When to harvest	Milky stage (60-75 days); 10 more days for silage making.
Green fodder yield (tons/ha)	Irrigated: 40-50 t; rainfed: 30-40 t.

Sorghum



Photo: LRIC (Deoni), KVAFSU, Bidar

Sorghum

Scientific name	<i>Sorghum bicolor</i> (L.) Moench
Important features	It is drought resistant, can grow well under less fertile soils, with quick growth, high biomass accumulation and dry matter content, and the crop contains toxin hydrogen cyanide (HCN) till 45-50 days.
Varieties	Single cut: Pusa Chari-1, Pusa Chari-6, MP Chari, UP Chari-1. Multi-cut: CoFS 29, CoFS 31, Pusa Chari-615. Dual purpose: SPV 669, K-11; SSG 988, CSH 24 MF.
When and how to plant	This is planted in March or July, single cut at 10 kg seed/ha and multi-cut at 10-15 kg seed/ha.
Chemical fertilizer (kg/ha)	Single cut: 80 kg N:40 kg P Multi-cut: 100 kg N:60 kg P during planting and repeat after 30 days and 50 kg N after every cutting.
Farm Yard Manure (tons/ha)	Irrigated: 25.0 t. Rainfed: 10 t 20-25 days before planting.
Irrigation	Every 25-30 days in the rainy season and every 10-15 days in the summer and not required in the case of good rains.
When to harvest	Single cut: Flowering stage (60-75 days) Multi-cut: First cutting after 50-55 days and subsequent cutting after 40-45 days.
Green fodder yield (tons/ha)	Single cut: 35-40 t Multi-cut: 100-150 t

Pearl millet



Photo: ICAR-IGFRI-SRS, Dharwad

Pearl millet

Scientific name	<i>Pennisetum glaucum</i> L.
Important features	Grows in low fertile and water deficit soils, is highly drought tolerant and gives assured harvest even in areas with 25-75 cm rainfall.
Varieties	Avika Bajra Chari (AVKB – 19), Gaint Bajra, CO-8, Baif Bajra-1.
When and how to plant	Planted in March-April/July/October-November with the onset of monsoon in rainfed areas at 6-8 kg seed/ha with 30-45 cm spacing between rows.
Chemical fertilizer (kg/ha)	Irrigated: 100 kg N:60 kg P:40 kg K. Rainfed: 60 kg N:40 kg P:20 kg K.
Farm Yard Manure (tons/ha)	Irrigated: 10-12 t. Rainfed: 5-6 t 15-21 days before planting.
Irrigation	Every 8-12 days under irrigated conditions.
When to harvest	Single cut varieties: 50-60 days. Multi-cut varieties: First cutting at 40-45 days and subsequently after 30 days.
Green fodder yield (tons/ha)	Irrigated: 35-40 t. Rainfed: 25-30 t.

Oat



Photo: ICAR-IGFRI-SRS, Dharwad

Oat

Scientific name	<i>Avena sativa</i> L.
Important features	An important cereal fodder crop of the <i>rabi</i> season, it is soft and palatable, with fodder rich in crude protein (10-12%). Its grain is a good source of feed for horses, sheep and poultry due to its high fat, protein and mineral content.
Varieties	Single cut: HFO-114, JHO-2001-3, JHO-2000-4, OS-377. Double cut: JHO-851, JHO-822, HO-8, UPO-212, UPO-94, RO-19.
When and how to plant	Planted in October or November at 80-100 kg seed/ha at 20-30 cm row spacing.
Chemical fertilizer (kg/ha)	Single cut: 80 kg N:60 kg P:40 kg K. Double cut: 120 kg N:40 kg K. Top-dressing in double cut varieties after each cutting: 40 kg N.
Farm Yard Manure (tons/ha)	12-15 t 10-15 days before planting.
Irrigation	3-5 irrigations including pre-planting irrigation depending on soil type. If the soil is dry, first irrigation is given before preparing the seedbed. The next irrigation may be given 20-25 days after planting.
When to harvest	Single cut varieties: At 50% flowering Double-cut varieties: First cutting at 60-70 days; subsequently after 40-45 days. First cut is advised when the plant is 10-12 cm tall for good re-growth.
Green fodder yield (tons/ha)	Single cut: 30-45 t. Double cut: 40-55 t.

Fodder Grass

Hybrid Napier



Photo: LRIC (Deoni), KVAFSU, Bidar

Hybrid Napier

Scientific name	<i>Pennisetum purpureum</i> x <i>Pennisetum glaucum</i>
Important features	A cross between Napier grass and fodder pearl millet, multi-cut varieties can yield fodder for 3-4 years. Its deep root system enables survival under drought. It can be cultivated on bunds and along water channels. Crude protein ranges from 8-11% and the immature crop contains Oxalates as toxin.
Varieties	DHN-6, Yashwant, NB 21, Co-4, IGFRI-7, BNH-10, APBN-1.
When and how to plant	Preferably planted during mid-February to July, 30,000 two-eye budded stem cuttings or root slips are planted at 60 cm × 60 cm distance. Can be planted throughout the year under irrigated conditions.
Chemical fertilizer (kg/ha)	50 kg N:50 kg P:40 kg P during planting and 50 kg N after every cutting.
Farm Yard Manure (tons/ha)	25-30 t 20-25 days before planting.
Irrigation	Every 15 days during the rainy season and every 7-10 days during the summer.
When to harvest	First cutting after 60-75 days and subsequent cuttings after 45-60 days.
Green fodder yield (tons/ha)	250-300 t annually from 6-8 cuttings.

Guinea Grass



Photo: LRIC (Deoni), KVAFSU, Bidar

Guinea Grass

Scientific name	<i>Panicum maximum</i> Jacq.
Important features	This is a tall (1-4.5 m), tufted, fast growing and highly palatable perennial grass. Multi-cut varieties can yield fodder for 3-4 years and can be integrated with horticultural crops. They can grow in waste water and marshy land. Their crude protein ranges from 8-13%.
Varieties	Bundel Guinea-1, Bundel Guinea –2, Dharwad Guinea Grass-1, Riversdale, Hamil.
When and how to plant	Preferably planted during mid-February to July by nursery/stem cuttings, 3-5 kg seed/ha or 30,000 stem cuttings with a spacing of 60 × 60 cm.
Chemical fertilizer (kg/ha)	50 kg N:50 kg P:40 kg K at planting and 50 kg N after every cutting.
Farm Yard Manure (tons/ha)	20-25 t 30 days before planting.
Irrigation	Every 15 days in the rainy season and every 7-10 days in the summer.
When to harvest	First cutting after 70-75 days and subsequently after 40-45 days.
Green fodder yield (tons/ha)	180-220 t annually from 7-8 cuttings.

Rhodes Grass



Rhodes Grass

Scientific name	<i>Chloris gayana</i> L.
Important features	A multi-cut fodder crop that consumes less water and can be cultivated as grassland or pasture. It produces high quality forage (protein of >15% on DM basis) when young. Its nutritional quality (low for stems compared to leaves) declines steeply with maturity. It is suitable for saline and alkaline soils.
Varieties	Rhodes 10.
When and how to plant	Planted in June-July. Rainfed: 5 kg seed/ha. Irrigated: 10 kg seed/ha or 40,000 root slips. Optimum planting distance of 45 × 45 cm.
Chemical Fertilizer (kg/ha)	30 kg P during planting, 20 kg N again after 3 weeks and after each cutting.
Farm Yard Manure (tons/ ha)	10-15 t 15 days before planting.
Irrigation	Every 15 days in the rainy season and every 7-10 days in the summer.
When to harvest	First cutting after 90 days for planted seed and 60 days for planted root slips and subsequently after 30-35 days.
Green fodder yield (tons/ha)	Irrigated: 80-120 t annually from 7-8 cuttings. Rainfed: 40-50 t.

Para Grass



Photo: ICAR-IGFRI-SRS, Dharwad

Para Grass

Scientific name	<i>Brachiaria mutica</i> L.
Important features	It is grown in seasonally flooded valleys and lowlands and can withstand waterlogging and long term flooding. It cannot grow in arid or semi-arid areas. Its protein content varies from 7-10% on dry matter basis.
Varieties	Para grass (local variety).
When and how to plant	It is preferably planted in May-July. Root slips with 2-3 nodes are planted in wet soil at 45-60 × 45-60 cm spacing, 40,000 root slips/ha.
Chemical fertilizer (kg/ha)	60 kg N:40 Kg P:40 kg K applied uniformly at planting and first and second cutting.
Farm Yard Manure (tons/ha)	8-10 t 8-10 days before planting.
Irrigation	Mostly grown as a rainfed crop, watered every 12-15 days if necessary.
When to harvest	First cutting after 70-80 days and subsequently after 40-45 days.
Green fodder yield (tons/ha)	40-50 t annually from 4-5 cuttings.

Anjan Grass (Buffel Grass)



Photo: ICAR-IGFRI-SRS, Dharwad

Anjan Grass (Buffel Grass)

Scientific name	<i>Cenchrus ciliaris</i> L.
Important features	A perennial grass highly drought tolerant and well adapted to arid and semi-arid areas. It thrives well in light textured soils and grows easily on all types of well drained and even low pH soils. It is highly suitable for pastures under rainfed conditions. Both annual and perennial plants have solid culms and fibrous roots.
Varieties	Bundel Anjan 1, Bundel Anjan 3, Co-1, Marwar Anjan.
When and how to plant	Planting is preferred in the monsoon season at the rate of 6-8 kg seed/ha. Seeds should be 6-18 months old as fresh seeds (0-6 months) are often dormant. Seedlings of 6-7 weeks can be transplanted when it is drizzling, at 45-60 × 45-60 cm spacing. About 30,000-40,000 seedlings are required per hectare.
Chemical fertilizer (kg/ha)	Apply an initial dose of 40 kg N and 20 kg P mixed in soil as a basal dose. Apply 20 kg N to the one-month old crop. In subsequent years, a top dressing of 40 kg N and 20 kg P is required at the start of rains.
Farm Yard Manure (tons/ha)	Apply 5 t mixed in soil before planting.
Irrigation	Mostly grown as a rainfed crop, irrigation is required every 12-15 days if necessary.
When to harvest	First harvest at 70-75 days after planting and subsequently after 50-60-days.
Green fodder yield (tons/ha)	30-40 t in 3-4 cuttings per year depending on growth.

Fodder Legumes

Lucerne (Alfalfa)



Lucerne (Alfalfa)

Scientific name	<i>Medicago sativa</i> L.
Important features	Termed Queen of forages, it is a perennial (3-4 years), persistent, productive and irrigated fodder legume that contains 16-20% crude protein with 72% dry matter digestibility. It helps in soil nitrogen fixation and its deep root system makes it well adapted to dry areas with irrigation facilities.
Varieties	Anand 1, Co 1, RL 88, Anand Lucerne-3, Co3, Chetak.
When and how to plant	It is preferably planted in October or November. About 12-15 kg seed/ha is treated with rhizobium and planted at 30-45 cm spacing at 2-3 cm depth.
Chemical fertilizer (kg/ha)	20 kg N:100 kg P during planting to be followed by 80 kg P: 40 kg K per year.
Farm Yard Manure (tons/ha)	20-25 t mixed in soil 25-30 days before planting.
Irrigation	Every 15-20 days in the rainy season and every 10-12 days in the summer season.
When to harvest	First cutting at flowering stage (45-60 days) and subsequently after 25-35-days.
Green fodder yield (tons/ha)	80-100 t annually from 10-12 cuttings.

Berseem (Egyptian Clover)



Photo: ICAR-IGFRI-SRS, Dharwad

Berseem (Egyptian Clover)

Scientific name	<i>Trifolium alexandrinum</i> L.
Important features	This is a prominent legume fodder crop of <i>rabi</i> season that adds organic carbon, phosphorus, and nitrogen to the soil. It is highly suitable in temperate or winter conditions and has 20-24% crude protein and 70% dry matter digestibility. It is the most potent milk multiplier in dairy animals.
Varieties	Wardan, Bundel Berseem-2, Bundel Berseem 3, Pusa Giant, Mescavi, Berseem Ludhiana-1.
When and how to plant	It is preferably planted in October or November. About 25-35 kg seed/ha is planted by broadcast method after flooding the beds with 5-6 cm deep water.
Chemical fertilizer (kg/ha)	20 kg N and 80 kg P as basal dose.
Farm Yard Manure (tons/ha)	20-25 t for saline or light textured soils and 15-20 t under normal conditions.
Irrigation	5–6 days after planting following germination. The crop may be irrigated after 15-20 days and after each cutting.
When to harvest	First cutting at 55-60 days and subsequent cutting after 30-35 days.
Green fodder yield (tons/ha)	65 - 90 t.

Hedge Lucerne



Hedge Lucerne

Scientific name	<i>Desmanthes virgatus</i> (L.) Willd.
Important features	This legume crop contains 22% crude protein and is rich in vitamins and minerals. It aids atmospheric nitrogen fixation in soil and can yield fodder for 3-4 years.
Varieties	Hedge Lucerne (local variety).
When and how to plant	It is grown throughout the year under irrigation and during June - October as a rainfed crop. Soak 20 kg seeds in sulphuric acid for 8-10 minutes and plant at a distance of 45-60 cm in rows.
Chemical fertilizer (kg/ha)	15 kg N:50 kg P:20 kg K during planting to be followed every year with 80 kg P and 40 kg K.
Farm Yard Manure (tons/ha)	12-15 t 30 days before planting.
Irrigation	Mostly grown as a rainfed crop under harsh conditions, with irrigation every 12-15 days if necessary.
When to harvest	First cutting at 80-90 days (crop height of 50-55 cms) and subsequent cutting at 35-40-day interval.
Green Fodder Yield (tons/ha)	60-80 t annually from 6-8 cuttings.

Stylosanthes



Stylosanthes

Scientific name	<i>Stylosanthes</i> sp.
Important features	A legume fodder crop rich in crude protein that can be cultivated as grassland or pasture. Animals can feed on it directly. It is adapted to tropical climates and tolerant to low fertility, drought, acidic soils and poor drainage. The highly palatable <i>Stylosanthes hamata</i> species is preferred by animals.
Varieties	<i>Stylosanthes hamata</i> (suitable in orchards but can be grown otherwise), <i>Stylosanthes scabra</i> (low rainfall areas), <i>Stylosanthes seabrana</i> (black soil), <i>Stylosanthes guinensis</i> (high rainfall areas), <i>Stylosanthes humilis</i> (annual type), PhuleKranti (low rainfall areas).
When and how to plant	Planting is preferred in June - July to September - October when 10 kg seeds are treated with rhizobium culture. These seeds are mixed in a paste of dung and soil and planted at 30 × 15 cm spacing at 2-3 cm depth.
Chemical fertilizer (kg/ha)	20 kg N:40 kg P:40 kg P during planting to be followed every year with 40 kg P and 15 kg N.
Farm Yard Manure (tons/ha)	5-8 t 30 days before planting.
Irrigation	Suited to rainfed conditions but needs irrigation every 12-15 days if necessary.
When to harvest	First cutting at 90 days and subsequent cutting depends on the growth.
Green fodder yield (tons/ha)	30-35 t annually.

Cowpea (Lobia)



Photo: ICAR-IGFRI-SRS, Dharwad

Cowpea (Lobia)

Scientific name	<i>Vigna unguiculata</i> L.
Important features	Important in dryland farming and usually grown as a <i>kharif</i> crop, it is used as a pulse, for fodder and green manure and can be grown year round.
Varieties	UPC- 625, UPC-622, Fodder Cowpea-CO (FC)-8, Konkan Fodder Cowpea-1, Bundel Lobia-2, Sweta, Kohinoor, EC 4216, MFC 09-1, MFC-08-14.
When and how to plant	It is preferably planted in June-July (rainy crop) and march-April (summer crop), 30-40 kg seed/ha at a spacing of 30-45 cm. It thrives well between 21°C and 35°C.
Chemical fertilizer (kg/ha)	15 kg N:60 kg P:30 kg P at planting. Apply less than 10 ppm sulphur in sulphur-deficient soils.
Farm Yard Manure (tons/ha)	5-8 t 8-10 days before planting.
Irrigation	Every 12-15 days during the rainy season and every 7-10 days in the summer.
When to harvest	Rainy season: 50-60 days (50% flowering stage). Summer season: 70-75 days.
Green fodder yield (tons/ha)	35-45 t annually.

Fodder Trees

Sesbania



Sesbania

Scientific name	<i>Sesbania grandiflora</i>
Important features	This tree grows throughout the year even in less fertile and saline soils, is drought resistant, and suitable for all livestock, but highly preferred by small ruminants. It is fast growing. It must constitute only 8-10% of the feed. Its protein content is about 25%.
Varieties	Local selection.
When and how to plant	Though preferably planted in June-August, it also grows throughout the year under irrigated conditions. About 7.5-8.0 kg seed/ha is planted either at 1 m distance or at 1m × 1m spacing. It can also be transplanted with nursery raised seedlings.
Chemical fertilizer (kg/ha)	10 kg N:20 kg P:12.5 kg K at planting to be followed with 12.5 kg P every two years.
Farm Yard Manure (tons/ha)	20-25 t before planting.
Irrigation	At planting and every 15 days depending on soil moisture.
When to harvest	First cutting at 5-6 months and subsequent cutting after 50-60 days.
Green fodder yield (tons/ha)	50-60 t annually.

Subabul



Subabul

Scientific name	<i>Leucaena leucocephala</i> (Lam.) De Wit
Important features	This is a fast spreading fodder tree that produces enormous seeds. In drought prone areas, allow the tree to grow for two years to ensure deep root penetration before commencing harvest. Since the leaves contain the toxin mimosine, care must be taken while feeding it to young animals.
Varieties	Hawaiian type (K-341), K-8 (Salvador type), Subabul CO-1 (P), FD 1423.
When and how to plant	Planting is preferred in June-August. About 5-6 kg seeds/ha soaked in hot water overnight should be planted with rhizobium culture at 1m × 1m spacing.
Chemical fertilizer (kg/ha)	25 kg N:60 kg P:40 kg K.
Farm Yard Manure (tons/ha)	8-10 t mixed in soil before planting.
Irrigation	Mostly rainfed, every 15-20 days depending on soil moisture.
When to harvest	5-6 months (90-100 cms) and subsequent cuttings after 50-60 days.
Green fodder yield (tons/ha)	The initial year yields 12-15 t and later 40-50 t annually.

Glyricidia



Glyricidia

Scientific name	<i>Glyricidia sepium</i>
Important features	It is a small, semi-deciduous tree with a pale bark that tolerates a wide range of climatic and edaphic conditions and can grow in regions with annual rainfall of 400-900 mm. It grows in heavy clay soils and on rocky eroded sites and is intolerant to waterlogging. The plant is used as fuel wood, animal feed, green manure, etc.
Varieties	Local selection.
Planting	Planting is preferred in June-August. Soak 2 kg seed/ha in water before planting. Stem cuttings 1 foot long may be planted at 1m × 1m spacing during the rainy season.
Chemical fertilizer (kg/ha)	30 kg P:20 kg K.
Farm Yard Manure (tons/ha)	1-2 t.
Irrigation	Mostly rainfed, every 15-20 days depending on soil moisture.
When to harvest	12-18 months at first cutting followed by an interval of 3 months.
Green fodder yield (tons/ha)	20-25 kg from each tree depending on its age.

Moringa (Drumstick)



Photo: ICAR-IGFRI - SRS, Dharwad

Moringa (Drumstick)

Scientific name	<i>Moringa oleifera</i>
Important features	It is mainly used as a vegetable and has numerous industrial, medicinal and agricultural uses, including as animal feed. It is nutritious, fast growing, drought tolerant and with protein content ranging from 15-30% on dry matter basis at different stages of maturity.
Varieties	Local selection.
When and how to plant	Preferably planted in June-August. About 250-400 g/ha of 50-60-day seedlings planted in 30-50 cm deep and 20-40 cm wide pits.
Chemical fertilizer (kg/ha)	50 kg N: 25 kg P.
Farm Yard Manure (tons/ha)	18-22 t.
Irrigation	Every 12-15 days depending on soil moisture.
When to harvest	Harvested in 5-6 months for its leaves and in 8-9 months for its pods. Subsequent cuttings every 45 days at 1.5 m height.
Green fodder yield (tons/ha)	Leaves: 6-8 t annually.

Fodder Sources on Field Bunds and Degraded Land

Acacia (Babul)



Acacia (Babul)

Scientific name	<i>Acacia nilotica</i>
Other names	Thorny acacia, Arabica gum tree
Important features	This is a medium sized, thorny, nearly evergreen tree and useful fodder source in dry regions in periods of scarcity. It may remain a shrub under poor growing conditions. Its leaves and pods are used at different periods by different types of animals. These trees are highly suitable in agroforestry systems. The crude protein content of the leaves is 14-20% and for the highly palatable pods 11-16%. While the pods and shoots comprise the chief diet of goats and sheep, its seeds are a valuable cattle feed.
When and how to plant	It propagates by seeds carried in animal droppings or by direct seeding. Planting can also be done at 5 m distance on bunds and farms at of 4-6 kg seed/ha. For good germination, soak the seeds in water 48 hours before planting.
Chemical fertilizer (kg/ha)	50 kg P and 25 kg K as a basal dose.
Farm Yard Manure (tons/ha)	2-3 t as spot application.
Green fodder yield (tons/ha)	The trees bear fruits within 4-6 years and yield about 15-18 kg pods/year. The yield of leaves varies from 0.2-2.0 t/ha/year.

Melia Azadirachta



Melia Azadirachta

Scientific name	<i>Melia Azadirachta (Melia azedarach) L.</i>
Other names	Bead tree, Pride of India, Maha neem
Important features	Melia is a highly adaptable tree native to India, the leaves of which are lopped for fodder and are highly nutritious. It is a fast-growing, deciduous tree that can reach a height of around 10-45 m. It grows well in most well-drained soils and in hot dry conditions and tolerates quite poor growing conditions, including shallow soils, saline, alkaline soils etc. The crude protein and crude fiber content of the aerial part is 14-20% and 12-14% respectively.
When and how to plant	Planting can be done at 5 m distance on bunds and farms at 3-5 kg seed/ha.
Chemical fertilizer (kg/ha)	20 kg N:40 kg P: 20 kg K applied in spots.
Farm Yard Manure (tons/ha)	1-2 t as spot application.
Green fodder yield (tons/ha)	Trees commence flowering when 5-6 years old. A mature tree can produce about 300-500 kg of leaves annually.

Spineless Cactus



Spineless Cactus

Scientific name *Opuntia ficus-indica*

Important features Commonly known as prickly pear, it survives and propagates well in arid and semi-arid regions of India, in severely degraded soils and under severe dry conditions. It is characterized by better water use efficiency (267 kg of water/kg dry matter) and rain use efficiency (40 kg DM/mm/year) than any other conventional fodder crops. Parts of the plant can be used as fruit and vegetable for human consumption, as fodder for livestock, and as raw material for various industries. The nutritive quality of cacti cladodes depends on plant type (species, varieties), cladode age, season, and agronomic conditions (soil type, climate, and growing conditions). Since cladodes are an unbalanced feed nutrient-wise, diets containing cactus should be balanced with appropriate supplements. It is composed of nearly 90% water on a fresh weight basis, 5-12% of crude protein, and about 10% fiber of dry weight. Since the plants contain a high percentage of water (up to 95% when fresh), when fed to livestock their water needs can be reduced by 40-100%. While cattle may consume 50-70 kg fresh cladodes/day, goat and sheep have 6-8 kg/day. The energy content of cladodes is about 3,500 to 4,000 kcal/ kg dry matter, just over half of which is digestible, coming mainly from carbohydrates.

When and how to plant	It is mainly propagated by cuttings or grafting in the postrainy season from October to March. Remove one-year-old fresh mature cladodes from the mother plant and cure them under the shade for 15 days before planting. A temperature ranging from 18–30°C is suggested for regeneration and soil temperature of around 22°C for best root growth.
Chemical fertilizer (kg/ha)	60 kg N:30 kg P:30 kg K at planting. Application of 20 kg N enhances new sprouts after every harvest for biomass.
Farm Yard Manure (tons/ha)	5-6 t.
Irrigation	Mostly rainfed.
Green fodder yield (tons/ha)	Mature cladodes may be harvested when one year old. Biomass yield is about 15-20 kg/plant and 80-100 t/ha of cladodes. Biomass yield increases in subsequent years. Freshly harvested thornless cladodes may be fed to goat/sheep/cattle as a 30% replacement for other green fodder.

Organizations involved in different aspects of fodder production

Institution/ organization	Details
ICAR-Indian Grassland and Fodder Research Institute (IGFRI)	Near Pahuj Dam, Gwalior road, Jhansi - 284 003, Uttar Pradesh
ICAR-IGFRI-Southern Regional Research Station	Officer In-Charge, IGFRI-Southern Regional Research Station, University of Agricultural Science Campus, Dharwad, Karnataka - 580 005
ICAR-IGFRI-Hilly Regional Research Station	Officer In-Charge, IGFRI-Hilly Regional Research Station, Srinagar, Jammu & Kashmir
ICAR-IGFRI-Western Regional Research Station	Officer In-Charge, Avikanagar, Tonk, Rajasthan
Central Fodder Seed Production Farm	Under the Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, New Delhi, with regional stations for forage production and demonstration in Hissar (Haryana), Avadi, Chennai (Tamil Nadu), Pahadi sharif, Hyderabad (Telangana), Nadia (West Bengal), Palej (Gujarat), Suratgarh (Rajasthan), and Gandhinagar (Jammu).
National Seeds Corporation Ltd. (NSC)	Functions under the Ministry of Agriculture and Farmers Welfare, Government of India, with 10 regional offices, 8 farms, and 65 area offices/sub-units spread across India.
State Seeds Corporation Ltd.	Present in a majority of states like Bihar, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Telangana, etc.).

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ICRISAT works in agricultural research for development across the drylands of Africa and Asia, making farming profitable for smallholder farmers while reducing malnutrition and environmental degradation.

We work across the entire value chain from developing new varieties to agribusiness and linking farmers to markets.

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