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FORESTRY PLANNING & DEVELOPMENT PROJECT

Government of Pakistan-USAID

SOME FODDER TREES OF PAKISTAN



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Livestock is a very important component of the agricultural landscape of Pakistan. Its contribution to the national economy is tremendous. According to the Pakistan Statistical bulletin, 1983, livestock contribute up to 28% of the gross production value of agriculture in Pakistan. Feed for the livestock is produced in the farm lands but the shrubs and trees are a very important and potential source to make up for the forage deficiencies. For instance in arid and semi arid lands if the rains fail trees which grow in the ranges are the only source of feed because there is no grass. The prolonged droughts in Tharparker, Cholistan and Thal deserts have amply proved this point when in the absence of grass, thousands of livestock had to be sustained on tree foliage and branches. Had there been no trees of Jand, (Prosopis cineraria), Ber (Zizyphus mauritiana) and Lahura (Tecomella undulata) thousands of hungry sheep, goat and camel would have starved to death making the owners destitute and depriving the people of meat, milk and milk products. In the winter months the trees in the deserts and along the roads and canals are heavily lopped by the passing nomadic graziers as well as the local dwellers to keep their valued livestock alive.

In order to subsidize the meager production of grass from the overgrazed pastures the scientists have suggested practising of silvo-pastoral management. Planting of top-feed cum shade trees to improve livestock production and there by the economic lot of the people in conjunction with range reseeding has strongly been recommended. It means that range improvement must be complemented with planting of suitable fodder trees which would not only be a source of much needed forage during times of scarcity but also provide much needed shade and shelter for the livestock as well as wildlife.

Silvopastoral management of range lands which makes them more productive is essential from other points of view as well. The diets in the developing countries are alarmingly low in animal protein. Against the optimum level of 68.5 grams per head per day, the protein consumption figure of Pakistan is 45.5 grams, of which animal protein is only 12.2 grams. On the other hand due to mismanagement and over use, rangelands in Pakistan are producing hardly 10-50% of their potential. Deterioration in range productivity has naturally resulted in reduced quantitative and qualitative production of range livestock and its products. To halt this land degradation, establishment of single trees in blocks or in the form of windbreaks appears to be the easiest and the most practicable proposition. It has been estimated that leaf fodder of some trees is highly nutritious and as good as leguminous fodder crops. Fodder production from trees on area basis can be favorably compared with agricultural crops. It has also to be realized that as compared to agricultural crops trees can be grown more easily in difficult sites, with much less inputs, and can be managed as a sustained and veritable source of feed with comparative ease.

Forestry Planning and Development Project started jointly by USAID and GOP in all the provinces of Pakistan to motivate the farmers to plant trees on farm and marginal lands has made successful strides. The objective is to make the farmer not only self sufficient in his fuel wood, small timber and fodder requirements but also enable him to subsidize his current meager income from agricultural crops through sale of wood and other produce. Information on fodder potential of some trees has been compiled mainly from the book "Fodder trees of India" by R. V. Singh and some other related material, such as Fire wood crops of National Academy of Sciences, Washington, D.C. and Multipurpose Australian Trees and Shrubs, edited by John W. Turnbull and personal notes. No doubt common farmer would not be deeply interested in the chemical composition of the foliage but at least the foresters would be equipped with some more information and data to convince him about the usefulness of a certain tree species as fodder and convey the same to their clients with more conviction. Although under the project fodder species such as shisham (Dalbergia sissoo), Tut (Morus alba) (Bakain) (Melia azedarach), Nim (Azadirachta indica), simal (Bombax ceiba), Willows (Salix spp.), Poplar spp., iple iple (Leucaena leucocephala) etc. are being planted, information on fodder potential of some other important species has been given for reference, if and when necessary, as these could be included in the programs in the years to come.

M. I. Sheikh

ACACIA MODESTA WALL.

Common name: Phulai

Availability:

Foot hills of Pakistan in wild form, planted in nearby fields and waste land. Grown in eroded lands in Rawalpindi Division and other similar parts of Punjab and NWFP. Ascends up to 1200 m elevation.

Habitat:

Sub-Himalayan tract; 250-1350 mm av.ann. rainfall; temperature of 40°C max to below zero. Light demander, drought resistant. Can grow in eroded sites and barren land but much better growth is seen in deep fertile soil.

Fodder potential:

Almost evergreen, loses leaves in winter, while new leaves appear in early spring. Extensively lopped for fodder which is considered to be of good quality. Main stay of migrating winter livestock from the high hills.

ACACIA NILOTICA (LINN.) WILLD. EX DEL

Common name: Babul, Kikar

Availability:

Scattered throughout agricultural fields, road, canal and rail sides, riverain tracts and irrigated plantations, foot hills upto 600 m. elevation.

Habitat:

Within a range of 125-1250 mm annual rain fall; maximum and minimum temperature of 45°C to 0°C, avoiding frosty locations. Capable of growing in a wide variety of soils including kankar pans and saline areas. Strong light demander. Fairly drought resistant.

Fodder potential:

New leaves appear from March to May. Old leaf fall & new leaf formation is continuous process, so the tree is seldom leafless. Leaves excellent fodder for which heavily lopped and browsed by goats and camel. Highly palatable.

Chemical composition of leaves is as under:

<u>Constituents</u>	<u>Percent</u>
Crude protein	14.2
Crude fibre	9.20
N-free extract	69.80
Ash	7.00
Phosphorus	0.10
Calcium	2.60
Magnesium	0.40

No data are available on production of leaf fodder/unit area. Annual production of leaf litter/ha is reported to be 5.27 tonnes.

The pods are also used as fodder. Ripe pods on dry wt. basis contain 11.50 to 15.70% crude protein and 8.4 to 21.4 % crude fibre. On an average, one tree yields about 18 kg of pods/year. Annual yield of more than 4 tonnes/ha has been reported from the riverain forests of Sindh. Well stocked plantations should yield about 8-10 tonnes of pods/ha/year.

ALBIZZIA LEBBEK (LINN.) BENTH.

Common name: Siris, Sirin

Availability:

Wild in sub-Himalayan region upto 1200 m, farm lands, road sides, irrigated plantations and riverain tracts.

Habitat:

Tropical & sub tropical climate; av.ann. rainfall 500-1000 mm; maximum temperature 36°C to 4°C minimum. Variety of soils but deep loamy soil preferred, restricted growth in stiff clays, dry gravelly sites. Strong light demander.

Fodder potential:

Leaves good fodder, leaf shedding Oct-Dec. Chemical composition varies with locality and season.

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility coefficient</u>
Crude protein	16.8 - 26.50	67
Crude fibre	26.0 - 37.00	41
Nitrogen free extract	36.0 - 43.00	68
Ether extract	2.85 - 4.68	9
Total ash	7 - 11.50	--
Calcium	1.10 - 2.71	--
Phosphorus	0.14 - 0.25	--

Total digestible nutrients per quintal of leaves (on dry wt. basis) are 11.59 kg of crude protein, 37.23 kg of carbohydrate and 0.36 kg of ether extract. Pods formed in August are also fed to the livestock. One tree, it is said may provide 20 percent of a water buffalo's annual feed, or 27 percent of a cow's. The leaves also make useful green manure.

ALBIZZIA PROCERA BENTH

Common Name: Safed Siris

Availability:

Tree has been planted along roads in arboreta, CDA Islamabad and some irrigated plantations in the Punjab and Sindh. The tree needs more attention in the farm forestry project as it has a thin crown, open branches, is leafless in winter and is nitrogen fixer, thereby, reducing the effect of shade and root competition when planted on farm lands as single tree or as a windbreak.

Habitat:

Sub-Himalayan tract, moist and swampy places 500-1000 mm av. ann. rainfall; temperature range of 45°C max to 2°C min. Killed back by frost. Prefers well drained sandy or sandy loam soils. Can grow in poor soils also. Light demander.

Fodder potential:

Leaf fall January-February, new leaves April-May. Leaves fairly good fodder and is heavily lopped leaves contain 5.54% ash, 1.55% calcium, 46.79% carbon and 3.21% nitrogen and are relished by the livestock.

AZADIRACHTA INDICA A. JUSS.

Common name: Nim, Nimb

Availability:

Grows in drier parts of the country, especially in Sindh. Common road side tree in the North also where it is susceptible to frost but gradually over-comes it. A good farm tree.

Habitat:

Wide climatic adaptability; av.ann. rain 300-1150 mm; 45°C max. to 2°C min. temperature. Sandy to clayey soils, even calcareous soils with pan. Can stand very adverse climatic conditions; demanding. Does not do well in waterlogged conditions but can stand salinity.

Fodder potential:

Regarded as a good fodder tree for goats. Chemical composition of leaves is as under.

<u>Constitutents</u>	<u>Percent</u>	<u>Digestibility Coefficient</u>
Crude protein	12.40-18.27	49.00
Crude fibre	11.40-23.08	65.00
N-free extract	43.32-66.60	51.20
Ether extract	2.27- 6.24	
Total ash	7.73-18.87	
Calcium	0.89- 3.96	
Phosphorus	0.10- 0.30	

Best lopping time varies with sites and season. Digestibility coefficient for organic matter is 53.20 while it is 53.90 for total carbohydrates. It shows satisfactory digestibility of leaves. Total digestible nutrients are 53.28 kg/100 kg of dry material. The leaves very well serve the purpose of green fodder supplement.

The seed cake is greatly valued as a manure because of high nitrogen content and insectidal properties. Seed cake is palatable to the live stock only at 25% level. Neem seed meal can be introduced in the diet of chicken at 10% level.

BAUHINIA VARIEGATA LINN

Common name: Kachnar

Availability:

Sub-Himalayan region and outer Himalayan Valleys upto an elevation of 1200 m. It is planted in farms, in parks, and as avenue tree in different parts of the country.

Habitat:

Broadly tropical & subtropical; ann. rainfall 500-2500 mm; temperature range of 40°C maximum and 0°C minimum. Avoids arid tracts. Wide range of soils, gravelly on mountain slopes, sandy loam to loam in valleys. Light demander. Avoids poorly drained sites. Killed by heavy frost.

Fodder potential:

Cultivated for leaf fodder production, av. yield 15-20 kg/ha/year. Chemical composition varies according to locality and season & is as under:

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility coefficient</u>
Dry matter	41.4 - 49.8	
Crude protein	10.73 - 15.91	36.0 - 58.0
Crude fiber	25.28 - 32.97	32.7 - 64.0
Ether extract	1.33 - 3.93	10.6 - 42.0
N-free extract	40.87 - 51.83	58.4 - 66.4
Total ash	6.27 - 12.31	
Calcium	1.76 - 4.13	
Phosphorous	0.20 - 0.38	

Crude protein and crude fibre content increase as the leaves mature.

BOMBAX CEIBA LINN

Common name: Semul, Simbal

Availability:

Grows almost everywhere; farm lands; irrigated plantations; along rivers and streams; eroded foot hills, ascending up to 1000 m in the Himalayas.

Distribution:

Thrives in moist tropical climate; 750 - 1750 mm av.ann. rainfall; 40°C max to 2°C min. temp. Grows in sandy loam, well drained soils with good moisture supply. Deep alluvial soils the best for growth. Strong light demander. Killed by severe frost. Root suckers are formed.

Fodder potential:

Leaf shedding from December to March. Coppices in early years, produces root suckers. Lopped for fodder which is of medium quality. Leaves have 10.40% ash and 2.86% nitrogen.

BUTEA MONOSPERMA (LAM) TAUB.

Common name: Dhak, Palas

Availability:

Ascends upto an elevation of 1200 m. Grows gregariously in dry deciduous forests in Pabbi hills & Shakargarh. Also grows as scattered tree in plains and hill slopes. Planted as avenue tree due to its large flamboyant scarlet flowers.

Habitat:

Tropical and sub-tropical climate; 630-1000 mm rainfall; temp. 45°C max. to 0°C min. Can thrive on a variety of soils, even weathered sand stone and eroded sites. Moderate light demander; frost resistant.

Fodder potential:

Leaf shedding takes place in November - December, new leaves appear in April - May. Leafless during winter. Classed as good fodder. Pollards and coppices well. Can stand heavy lopping year after year. Young leaves susceptible to browsing, but old coarse leaves not. Chemical composition is as under:

<u>Constituents</u>	<u>Percent</u>
Crude protein	11.50
neutral detergent fibre	71.40
Cell content	28.60
Acid detergent fibre	45.60
Hemicellulose	25.80
Lignin	11.90
Cellulose	30.30
Total minerals	9.25
Calcium	3.30
Phosphorous	0.24
Silica	3.20
Ash	6.78
Calcium	2.31
Nitrogen	2.80

Digestibility values are comparatively low although leaves are rich in nutrients. Annual lopping does not cause any appreciable effect on tree vitality.

CORDIA DICHOTOMA FORSTF.

Common name: Lasura

Availability:

Sub-Himalayan tract ascending upto 1530 m elevation. Found growing singly in moist shady sites, farm and waste lands.

Habitat:

Deciduous and moist deciduous forests; 300-600 mm av. ann. rainfall; 42°C max. to 2°C min. temp. Thrives along streams. Wide variety of soils, deep moist sandy loam; inadequate moisture limits its growth. Moderate shade bearer in early stages. Frost hardy.

Fodder potential:

Old leaves are shed during winter and reappear in early spring. Coppices and pollards well. Lopped for fodder which is rated as good. Analysis is as under:

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility coefficient</u>
Crude protein	12.37 - 15.13	71
Crude fibre	16.45 - 26.76	58
N-free extract	41.93 - 52.83	76
Ether extract	1.53 - 2.87	30
Total ash	12.56 - 17.41	--
Calcium	2.37 - 4.24	--
Phosphorus	0.24 - 0.30	--

Tannins account for 0.84% of dry matter in the leaves.

DALBERGIA SISSOO ROXB.

Common name: Shisham

Availability:

Entire sub-Himalayan tract upto 1500 m elevation. Indus basin, riverain tract, irrigated plantations, roads and canal avenues, land slips. Most popular tree with the farmers.

Habitat:

Sub-tropical climate; 500-2000 mm av. ann. rainfall; 50°C max. to -4°C min. temperature. Grows even in deserts with irrigation. Strong light demander. Frost hardy.

Fodder potential:

Leaf fall begins in November - December and the tree remains leafless till February. Leaves fed to cattle are a medium to good fodder. Succulent leaves comparatively more palatable. Generally speaking, the percentage of crude protein and phosphorus decreases while that of crude fibre, ether extract, calcium and total dry matter increases as the leaves grow older on trees. Chemical composition varies as under:

<u>Constituents</u>	<u>Percent</u>
Crude protein	2.71 - 24.10
Crude fibre	12.48 - 31.97
N-free extract	42.97 - 56.91
Ether extract	2.03 - 4.93
Total ash	6.44 - 13.48
Calcium	1.95 - 2.27
Phosphorus	0.16 - 0.21

Dry matter and cell wall digestibility values are reported to be 81.10% and 44.58% respectively. Based on these values, the leaves are reported to be highly nutritious.

Feeding green leaves sometimes causes digestive disorders in animals. Siloed leaves show no such disorder. Silage prepared from leaves is accepted by the animals. It can substitute the green fodder component. Pods are used as emergency feed in fodder scarcity months. Pods contain about 2% tannin.

EMBLICA OFFICINALIS GAERTN

Common name: Amla

Availability:

In deciduous forests, outer Himalayan ranges up to 1400 m. elevation. Planted on farm lands as single tree and in gardens for fruit.

Habitat:

Tropical and sub-tropical dry hot summers, mild winters; 750-1250 mm.av.ann. rainfall; 45°C max to below 0°C min temp. wide variety of soils. Light demander. Sensitive to heavy frost and droughty conditions.

Fodder Potential:

Old leaves fall November-December, leafless January-February. Pollards and gives out root suckers. Fairly good fodder tree, heavily lopped. Leaves contain 4.48% ash, 1.93% calcium, 47.99% carbon and 1.94% nitrogen.

LEUCAENA LEUCOCEPHALA (LAM.) DE WIT

Common name: Koo babul, Ipil ipil

Availability:

The tree has been introduced in Pakistan from Hawaii and Philippines. Has been planted on farm and marginal lands, along road sides and some irrigated plantations. Goes up to 500 m and above elevation.

Habitat:

Tree of the tropics and sub-tropics; av.ann. rainfall 600-1700 mm; max 40°C to 2°C min temp. Can stand draughty conditions. Adaptable to a wide range of sites, the best growth is however on deep fertile soils. Doing well in Pabbi hills where it has been planted to supplement grass fodder. Natural to slightly alkaline soils are suitable. Tolerates only partial shade. Seedlings frost tender.

Fodder potential:

Evergreen except in colder climates or under draughty conditions. Foliage is relished by livestock as well as wildlife. High mimosive content however limits its use as sale feed and cattle should not be fed on leucaena for long time. Drying of leaves at high temperature reduces mimosive content. At 2m spacing, 2 and 4 year old trees give 0.75 and 1.94 kg leaves. Reportedly Hawaiian giant K8 planted at the density of 5000 plants/ha yielded 7.5 tonnes of forage/ha. at 1.5 years age. A typical analysis of the leaf forage gave the following figures:

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility</u> <u>co-efficient</u>
Dry matter	89.60	51.05 - 71.36
Crude protein	24.20	66.91 - 78.00
Ether extract	4.40	48.90 - 47.62
Crude fibre	13.30	57.39 - 56.00
Ash	10.80	-
Calcium	1.89	-
Phosphorus	0.27	-
Digestible protein	19.70	12.64 - 16.37
Total digest.nut.	75.30	57.88 - 70.22
Tannin	1.92	

Leucaena leaf forage makes more or less a complete ruminant food comparable to alfalfa forage. Leaves are a rich source of carotene and vitamins, especially vitamin 'A' is among the highest recorded in plant specimen. Chemical composition varies in different months. Leucaena leaves are only slightly inferior to lucern leaves as far as chemical composition and digestibility of different nutrients is concerned.

MANGIFERA INDICA LINN

Common name: Aam, Amb

Availability:

Cultivated, found in wild state also, up to 900 m. Grown in parks, along roads and canals.

Habitat:

Grows under a wide variety of climates, right from the foot hills through the plains of Punjab and Sindh up to Karachi; 750-1500 mm av.ann.rainfall; 40°C max to -5°C min temp., variety of soils, deep well drained loamy soil preferred. Shade bearer. Cannot grow without irrigation in dry localities. Damaged by hot winds.

Fodder potential:

Ever green, new flush of leaves appears simultaneously with the fall of old ones. Lopped for fodder. Chemical analysis is as under:

<u>Constituents</u>	<u>Percent</u>
Crude protein	7.75 - 9.75
Crude fibre	21.01 - 24.35
N-free extract	51.63 - 54.33
Ether extract	2.11 - 3.65
Total ash	11.83 - 13.06
Calcium	1.87 - 2.24
Phosphorus	0.17 - 0.33

Mango seed kernel is also used as feed. It can also be used for chicken feed up to 25% mix.

MELIA AZEDARACH LINN

Common name: Bakain

Availability:

Widely planted on farm land borders in the Punjab. Planted singly else where in the country. Ascends up to 1700 m. in the hills. Planted in irrigated plantations.

Habitat:

Sub-tropical climate of wide variation; 600 - 1000 av. ann. rainfall, happy on moist sites; 40°C to below zero temp. Variety of soils, sandy loam deep fertile soil supports the best growth. Light demander.

Fodder potential:

Leaves are shed in Nov-Dec, new leaves appear March-April. Pollards well and produces root suckers. Leaves and young tender shoots are lopped for fodder. Chemical composition is as under:

<u>Constituents</u>	<u>Percent</u>
Crude fibre	13.30
Dry matter	29.80
Natural detergent fibre	81.48
Acid detergent fibre	13.10
Hemis cellulose	5.42
Lignin	5.40
Cellulose	7.00
Total minerals	9.70
Calcium	0.23
Silica	0.86

Leaves are taken to be highly nutritious as dry matter and cell wall digestibility values are 91.30 and 53.03 percent respectively.

MORUS ALBA LINN

Common name: Tut, Shahtoot

Availability:

Farm lands, irrigated plantations, upto 2500m elevation in the Himalayas. In hills, confined mostly to stream beds where moisture is available.

Habitat:

Subtropical, mild temperate climate; 750-1250 mm av. ann rainfall with irrigation in less than 1200mm rain; temp. 40°C - below 0°C. Sandy loam to clayey loam soils; cannot tolerate alkaline/water logged conditions. Shade bearing.

Fodder:

Leaves are shed in Nov-Dec, which are relished by sheep and goat; new leaves March-April. Coppices & pollards very well. Leaf fodder of good quality, utilized as a supplement to poor quality roughages: 10-28 tonnes of leaves/hectare in 5 pickings for silk worm. Chemical constituents differ in different months.

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility coefficient</u>
Crude protein	15.00 - 27.64	71.20
Crude fibre	9.07 - 15.27	54.13
N-free extract	47.98 - 49.70	83.47
Ether extract	2.30 - 8.04	3.59
Total carbohydrates	63.25	46.43
Ash content	14.32 - 22.87	-
Calcium	2.42 - 4.7	-
Phosphorus	0.23 - 0.97	-

Nitrogen content is highest during Feb-Mar (4.97) while ash content is very high during Dec. Mulberry leaves can be used in poultry feed also by incorporating the same in layer's mash. Leaf stalks can be fed to cattle without harm.

MORINGA OLEIFERA LAMK

Common Name: Sohanjana

Availability:

Sub-Himalayan tract up to 500 m elevation. In Punjab and Sindh on farm and waste lands. Also in Parks and gardens. Stray trees along road sides.

Habitat:

A tree of sub tropical climate in the av.ann. rainfall zone of 750 - 2000 mm and temp. range of 38°C max. 1°C min. Prefers alluvial sandy soils with sufficient moisture. Susceptible to drought. Strong light demander.

Fodder potential:

Leaves turn yellow and fall in December-January. Pollards and coppices well. Shoots heavily browsed being excellent fodder. On dry matter basis the leaves contain the following

<u>Constituents</u>	<u>percent</u>	<u>Digestibility</u> <u>co-efficient</u>
Protein	15.32 - 20.67	71
Crude fibre	7.12 - 17.89	58
N-free extract	48.71	76
Ether extract	4.35 - 11.07	30
Total ash	11.80 - 14.18	
Calcium	3.22 - 3.81	
Phosphorus	0.27 - 0.51	

Total digestible nutrient content is 61.49 kg. per 100 kg. of dry material. Tender pods are used as vegetable which have 2.5% protein and 3.7% carbohydrates. Pods contain carotene, nicotinic acid and ascorbic acid also.

OLEA FERRUGINEA ROYAL

Common name: Kahu, Kau

Availability:

Foot hills of Rawalpindi and Hazara Division, parts of Balochistan, mixed with other species, 500-2000 m elevation; farm land borders, marginal lands.

Habitat:

Hot and dry summers, cold winters; av.ann. rainfall 250 - 1000 mm; 40°C max to below zero temp. Shallow gravelly to deep loamy soils. Grows on lime stone and stone formations. Best growth on deep, moist soils. Shade bearer in early life.

Fodder potential:

Evergreen, new leaves appear before the old ones are shed in Jan-Feb. Browsed heavily by domestic and wild animals. Coppices and pollards well, root suckers plentiful. Valued as fodder for cattle. Feeding is believed to increase milk production. The tree has to bear the heavy pressure to browse for the livestock which comes to the foothills plains from high hills in the winter season.

POPULUS DELTOIDES AND HYBRID POPLARS

Common name: Poplar

Availability:

Introduced in Pakistan during the last 30 years. Planted widely on farm lands in NWFP and the Punjab, irrigated plantations, road and canal sides and river banks, up to 2000 m. elevation.

Habitat:

Very wide range according to clones, starting from the Himalayas right up to Sindh and throughout the Indus valley under irrigated conditions; 750-1250 mm av.ann. rainfall. 40°C max and -10°C min.temp. Light demander. Deep alluvial well drained soils are preferred.

Fodder potential:

Leafless during winter except Australian clones which do not shed their leaves in the plains. Pollards and coppices vigorously. Root suckers are also formed. Dry leaves are collected from forest floors for feeding the livestock.

PROSOPIS CINERARIA (LINN.) DRUCE

Common name: Jand

Availability:

Dry arid regions; an important feature of all the desert landscapes in Southern & South-Western Pakistan, goes upto 450 m elevation.

Habitat:

Grows in areas characterized by extremes of temp, 50°C - 0°C; 75-650 mm av.ann rainfall; coarse sandy soils, growth better in level "patties" between the dunes. Can grow on slightly alkaline soils. Strong light demander; drought resistant.

Fodder:

Almost evergreen. New leaves appear soon when old leaves start falling. Considered to be the most important tree of the desert as its leaves and branches are a favourite food of the livestock, especially in winter when no other fodder or grass is available. Heavily lopped during winter. A single tree yields 59, 28 & 20 Kg of fodder when completely lopped, partially lopped, and when 1/3rd of lower crown is lopped. Chemical composition varies with the season. Leaves are of average palatability.

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility coefficient</u>
Crude protein	13.90 - 14.20	32.25
Crude fibre	17.52 - 22.06	50.90
N-free extract	53.24 - 59.20	41.13
Ether extract	3.10 - 4.35	34.82
Total ash	3.80 - 9.95	-
Calcium	1.90 - 3.62	-
Potassium	0.20 - 0.52	-

The pods have a sweetish pulp and are also used as a fodder for livestock. Pod yields 1.5 quintals/hectare. Yield of pods increases in dry locations.

In view of heavy pressure on the tree in the arid and semi arid areas, it is essential that artificial plantations of this multipurpose tree are created. New leaves Jan-Mar. Lopped for fodder of sheep and goats. Leaves contain 10.05% ash, 2.71% calcium, 45.06% carbon and 2.07% nitrogen. Branches lopped in autumn are stored to feed dry leaves during winter months. The tree coppices and pollards very well and tender shoots and leaves are quite palatable.

SYZYGium CUMINI (Linn) SKEEL

Common Name: Jaman

Availability:

A common tree throughout the plains of Pakistan going to sub-Himalayan level up to 1200 m. Very commonly planted in farm lands.

Habitat:

Gregarious in damp and moist locations, also along rivers; 875 - 1000 mm av. ann. rainfall; temperature 40°C to -5°C minimum. Though can grow on a wide variety of soils but clayey-loamy are preferred. A moderate shade-bearer. Can stand frost.

Fodder potential:

Tree is rarely leaf less as the new leaves appear before the old ones fall from January-March. Coppices very well. Useful fodder tree. Different parts are put to different uses. Chemical composition varies from locality to locality.

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility co-efficient</u>
Crude protein	7.76 - 10.76	1
Crude fibre	15.96 - 26.44	70
N-free extract	55.97 - 68.44	45
Ether extract	1.87 - 4.32	33
Total ash	5.39 - 7.05	
Calcium	1.15 - 1.82	
Phosphorus	0.09 - 0.38	

Seed is rich in protein and is also a good feed for the cattle. Seed is fed in combination with oil cakes or grain up to 5-15% of the concentrates. Seed can be used to replace oil cakes to about 75% in animal rations. One tree on the average yield 75 to 150 kg of seed.

TAMARINDUS INDICA LINN.

Common name: Imli

Availability:

Introduced in farm lands and as avenue tree in lower Punjab and Sindh province.

Habitat:

Essentially a tree of tropical climate; av. ann. rainfall 350-2500 mm; max 40°C to 1°C min temp. Frost free winters and mild summers. Not very exacting on soils, can grow on gravelly, alluvial soils, best on deep loamy soils. Light demander.

Fodder potential:

Evergreen except in dry localities, leaf fall April-May when new leaves are already there. Thick pods with dark brown acid pulp, ripe ones are collected by shaking the tree. Chemical composition of leaves changes with locations and seasons and is as under on dry weight basis.

<u>Constituents</u>	<u>Percent</u>
Crude protein	13.43 - 15.43
Crude fibre	15.93 - 21.95
N-free extract	46.01 - 60.46
Ether extract	1.88 - 8.95
Total ash	7.94 - 10.44
Calcium	1.65 - 3.18
Phosphorus	0.12 - 0.55

Kernal of the seed can also be used as cattle feed and nutritive value of Kernal protein compares very well cereal protein. For cattle, use of Kernals to form about a third of total feed is largely recommended. It can replace the concentrate mixture to the extent of 50%.

The tree has lot of scope in Sindh irrigated forestry and social forestry programs and should be introduced artificially on a large scale.

TERMINALIA ARJUNA BEDD

Common name: Arjan

Availability:

Planted along roads and canals, especially in waterlogged and saline sites. Moist cool places along streams are preferred.

Habitat:

Mainly the sub-Himalayan tract; av. ann. rainfall 1000-1750 mm; max. temp 45°C max. to 2°C min. Does not do well in dry localities. Soil under this tree becomes rich in calcium. Moderate shade bearer. Seedlings frost tender.

Fodder potential:

Almost evergreen. Pollards and coppices well. Lopped for fodder which is of medium quality. Chemical composition is as under:

<u>Constituents</u>	<u>Percent</u>
Crude protein	5.75 - 11.37
Starch	5.75
Ash	7.23 - 14.03
Calcium	1.17 - 4.20
Magnesium	0.48
Phosphorus	0.1 - 0.29
Nitrogen	1.36 - 2.05
Dry matter	28.20 - 42.70
Crude fibre	13.54 - 19.43
N-free extract	56.76 - 62.58
Tannin	4.20 - 8.55

Produces lot of fruit which is also chewed by the livestock.

ZIZYPHUS MAURITIANA LAMK.

Common name: Ber

Availability:

Almost throughout the country up to an elevation of about 1000 m. A very prominent feature of the rural landscape in Punjab and NWFP. Has been planted in irrigated plantations on sand dunes or un-commanded areas.

Habitat:

Dry tropical and subtropical climates. It thrives in hot and dry climates with adequate soil moisture; 125-1000 mm av.ann. rainfall; 50°C max to -5°C min temperature. Can grow on a variety of soils, even moderately saline ones. Deep sandy loam for best growth. Light demander, grows much better in the open. Frost hardy.

Fodder potential:

Old leaves fall in March-April, new ones appear almost simultaneously. Coppices and produces suckers relished by the browsers. Good fodder

<u>Constituents</u>	<u>Percent</u>	<u>Digestibility</u>
		<u>co-efficient</u>
Crude fibre	12.86 - 16.93	36
Ether extract	1.52 - 3.23	62
N-free extract	55.33 - 57.90	34
Total minerals	6.66	
Total Ash	7.57	
Starch	16.84	
Total ash	10.24	
Calcium	1.42 - 3.59	
Phosphorus	0.21 - 0.33	

Leaves have a very high nutritive value. Since the tree is gradually disappearing from the rural landscape due to heavy lopping and browsing, it should be reintroduced on the marginal lands.