Ethnobiology of coastal sand dune legumes of Southwest coast of India

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The information pertain to coastal sand dune (CSD) wild legumes of Southwest coast of India and their importance in traditional medicine, nutrition, bioactive compounds, industries and ecosystem restoration. The data were retrieved during 2003-2005 from 12 locations in 3 states of West coast (Kerala, Karnataka and Goa). The study includes direct interviews of ethnic groups dwelling in the proximity of CSDs, native traditional healers, Ayurvedic practitioners and botanists intimately in touch with CSD wild plants. The study has a rural bias and presents traditional knowledge on food, fodder, fertilizer, pharmaceutical, religious and cultural values of CSD legumes. Information on uses of legumes, mode of preparation, dosage, novelty and cure of ailment is given. To match the collected information, literature based information on each legume was also reviewed. Some legumes are edible, endowed with medicinal properties, generate a variety of bioactive compounds of health and industrial importance. Such CSD xeriscape vegetation needs protection in view of cultural and traditional heritage of coastal inhabitants and landscape.

Keywords: Coastal sand dunes, Legumes, Ethnomedicine, Traditional knowledge, Nutrition, Medicinal use, Bioactive compounds, Ecosystem restoration

IPC Int. Cl.: A01K61/00, A61P1/04, A61P1/10, A61P11/00, A61P11/04, A61P17/00, A61P29/00, A61P31/00, A61P39/02

Coastal sand dunes (CSDs) face moderate to severe sand displacements due to natural geomorphological process, which is essential to maintain the landscape in its dynamic state. In addition to disturbances, CSDs are usually deficient in nitrogen, phosphorus, potassium and organic matter, while calcium and magnesium are in adequate quantities for plant growth. In spite of disturbances and nutrient deficiencies, diverse flora, fauna and microbes have adapted to CSD habitat. Plant species on CSDs exhibit adaptation to disturbances such as sand burial, salinity and temperature (seed dormancy, seed germination, fast growth, tolerance to darkness, below ground spreading of roots, resistance to desiccation and enhanced mycorrhizal activity). Understanding the distribution and functions of plant species on the CSDs is necessary for their conservation and exploitation of stress tolerant traits. The CSD flora in temperate regions is predominantly the members of Poaceae, while in tropics members of Asteraceae, Convululaceae, Poaceae and Leguminoseae. Many seasonal, annual and perennial legumes contribute for dune enrichment particularly by nitrogen fixation in association with bacteria. Deep rooting and mat forming creeping legumes are of special importance in dune stability and management. Anthropogenic disturbances of CSDs have severe impact on flora and in turn dependent fauna and microbes.

Herbal and traditional medicine in global market is fetching approximately US $ 60 billion per annum (5-15% annual growth rate) with India’s share about US $ 400-500 million. Due to biopiracy threat, detailed documentation of the untapped CSD resources is of immense value. Thus, the major objectives of the study was to document the traditional knowledge on the CSD legumes distributed in Goa, Karnataka and Kerala based on survey of coastal ethnic groups to suggest strategies for their utilization and conservation for beneficial purpose and to draw attention towards the value of CSD plant species based on published data to strengthen the traditional knowledge to provide future outlook.

Methodology
Survey on CSD legumes have been carried in 12 locations in 3 states of west coast (Kerala: Kanhangad; and Kasaragod; Karnataka: Talapady;...
Someshwara; Tannirbhavi; Mukka; Hejmadi Kodi; Padubidri; Katpadi; Sasthan; and Karwar; Goa: Margoa) during 2003-2005 (Fig. 1). Legumes distributed on the mid and hind dunes were recorded. On each mid and hind dune of a location, 600 m transect was divided into 12 quadrants (50 m² each). Alternate quadrants (6 quadrants, 300 m² area) were considered to enumerate legumes. Altogether, 144 quadrants each in mid and hind dunes were assessed for legumes. The local people and fisher folk were interviewed to gather information on uses of legumes. About 60 individuals of different ethnic groups (Besta, Bovi, Gangamathasta, Mogaveera and Karvi), native traditional healers, Ayurvedic practitioners and botanists were interviewed for the purpose of documentation of various socioeconomic, religious, cultural, ethnomedicinal practices and biological activities of different legumes of CSDs. Among the individuals, around 30 senior citizens either using CSD plants or in touch with those to employ for medicinal or other uses were interviewed. Survey was performed systematically using a specific questionnaire (Table 1). The survey was oriented to extract information mainly on the uses of legumes, parts of the legume used, method of preparation, dosage and mode of administration with specific comments about its novelty. Questionnaire was to gather and document the traditional knowledge mainly on food, fodder, fertilizer, pharmaceutical, religious and cultural uses of CSD legumes. To match the collected information, literature based information on each legume was also reviewed and documented.
Results and discussion

Legumes occurring on the CSDs with local names, habitat and distribution are given (Table 2). A total of 25 legume species belonging to 18 genera have been recorded on the hind dunes, while 12 species were common to mid and hind dunes. *Canavalia maritima* (Fig. 3) is restricted to only CSDs, while *Canavalia cathartica* (Fig. 2), *Derris trifoliata* (Fig. 4 & 5), *Sesbania bispinosa* (Fig. 6), *Tephrosia purpurea*, *Indigofera tinctoria*, and *Mucuna pruriens* were common to mangrove habitats. Other legumes (*Abrus precatorius*, *Acacia amplexeps*, *Alysicarpus* spp, *Caesalpinia pulcherrima*, *Cassia* sp, *Clitoria* sp, *Crotalaria* sp, *Erythrina variegata*, *Pongamia pinata*, *Tamarindus indica* and *Vigna* sp) have wide distribution. The CSD legumes have several value added properties and applications. Usefulness of CSD legumes have been broadly divided into medicinal, pharmacological, industrial, nutritional and ecosystem restoration. Based on the survey of traditional knowledge of coastal dwellers, medicinal properties of CSD legumes have been documented (Table 3). Various plant parts have been used for traditional treatments. Such plant parts are used directly or processed by traditional way for treatments. For instance, some parts are powdered or powdered and mixed with other ingredients or extracted in a specific way to use the active principle. Most traditional applications are related to treat skin diseases and skin injuries (wounds and snake/spider bites). Some specific applications are directed to treat muscle sprain, gynecological problems and to improve the immunological responses. Usually, topical applications are common to treat skin diseases or wounds and some also involve oral administration.

Bioactive compounds and phytochemicals of CSD plant species based on literature search have been presented (Table 4). Some legumes have pesticidal/insecticidal (*Canavalia maritima*, *D. trifoliata*, *Indigofera tinctoria*, *M. pruriens*, *T. purpurea*), cytotoxic (*T. purpurea*), antitumour (*T. purpurea*), antileukaemic (*Indigofera tinctoria*, *Mucuna pruriens*) and antiinflammatory (*M. pruriens*) properties. Some are valuable feedstock and raw materials for many scientific, technological and commercial applications. For instance, commercially important phytochemicals extracted from CSD legumes include, rotenone, tephrosin, and deguelin, which are used in limited quantities as pesticides. The use of pesticidal potential of specific plant species is widespread in the developing countries. Besides medicinal, bioactive and phytochemical values, CSD legumes have several ethnobiological and industrial applications. They have major influences in restoration of the dune habitat. Following species wise descriptions of Fabaceae members (with subfamily and common name) provide some general properties and important ecosystem services of CSD legumes based on survey of local people of Southwest coast of India.

*Abrus precatorius* Lam. (Papilionaceae; Indian liquorice)

The climbing shrub possesses white flowers and produce red seeds with black eye and seeds are poisonous. Goldsmiths use seeds as weights.

*Acacia amplexeps* Maslin. (Mimosaeae; Salt wattle)

Moderate sized tree and produce attractive yellow flowers. It is used as ornamental tree, firewood and to generate charcoal. Plant gum is employed in preparation of Ayurvedic tablets as binding agent.
**Table 2—Coastal sand dune legumes and their distribution on the Southwest coast of India**

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Common name*</th>
<th>Habit</th>
<th>Mid-dune**</th>
<th>Hind-dune**</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Abrus precatorius</em> Linn.</td>
<td><em>Gulaganji</em> (VK)</td>
<td>Climbing shrub</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><em>Acacia ampiceps</em> Maslin.</td>
<td>Tree</td>
<td>5-7, 9, 11, 12</td>
<td>4-6, 9, 11</td>
<td></td>
</tr>
<tr>
<td><em>Alysicarpus rugosus</em> (Willd.) DC.</td>
<td>Herb</td>
<td>3-6</td>
<td>4-6, 8</td>
<td></td>
</tr>
<tr>
<td><em>Caesalpinia pulcherrima</em> (Linn.) Swartz.</td>
<td><em>Peacock flower</em></td>
<td>Small tree</td>
<td>4, 6, 8</td>
<td></td>
</tr>
<tr>
<td><em>Canavalia cathartica</em> Thouars</td>
<td><em>Maunaloa</em></td>
<td>Perennial creeper</td>
<td>1-7, 9, 12</td>
<td>4-8</td>
</tr>
<tr>
<td><em>Canavalia martitima</em> (Aubl.) Thouars</td>
<td><em>Beach bean</em></td>
<td>Perennial creeper</td>
<td>1-12</td>
<td>1-12</td>
</tr>
<tr>
<td><em>Cassia occidentalis</em> Linn.</td>
<td>Under shrub</td>
<td>1-4-8</td>
<td>1-4, 8</td>
<td></td>
</tr>
<tr>
<td><em>Cassia siamea</em> Lam.</td>
<td>Under shrub</td>
<td>4-7, 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cassia tora</em> Linn.</td>
<td><em>Thajank</em> (VT)</td>
<td>Herb</td>
<td>1-2, 4-8, 11</td>
<td></td>
</tr>
<tr>
<td><em>Clitoria</em> sp.</td>
<td><em>Shankapushpa</em> (VK)</td>
<td>Perennial creeper</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><em>Crotalaria goreensis</em> Guill et Perr.</td>
<td>Undershrub</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Crotalaria pallida</em> Aiton.</td>
<td><em>Gijigiji gida</em> (VK)</td>
<td>Herb</td>
<td>1-4, 8</td>
<td>1-8</td>
</tr>
<tr>
<td><em>Crotalaria retusa</em> Linn.</td>
<td><em>Sunhemp</em></td>
<td>Under shrub</td>
<td>4-6</td>
<td>3-7</td>
</tr>
<tr>
<td><em>Crotalaria verrucosa</em> Linn.</td>
<td><em>Gijigiji gida</em> (VK)</td>
<td>Herb</td>
<td>2-4, 7</td>
<td>4-6, 7</td>
</tr>
<tr>
<td><em>Derris trifoliata</em> Loure.</td>
<td>Woody creeper</td>
<td>1-6, 8-12</td>
<td>4-6, 8, 9, 11</td>
<td></td>
</tr>
<tr>
<td><em>Erythrina variegata</em> Linn.</td>
<td><em>Indian coral tree</em></td>
<td>Small tree</td>
<td>1-4, 7, 9</td>
<td>2-4, 7, 8</td>
</tr>
<tr>
<td><em>Indigofera tinctoria</em> Linn.</td>
<td><em>Common indigo</em></td>
<td>Under shrub</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><em>Mimosa pudica</em> Linn.</td>
<td><em>Touch-me-not</em></td>
<td>Herb</td>
<td>2.5</td>
<td>1.5-6.8, 10, 12</td>
</tr>
<tr>
<td><em>Mucuna pruriens</em> (Linn.) DC.</td>
<td><em>Velvet bean</em></td>
<td>Perennial creeper</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><em>Pongamia pinnata</em> (Linn.) Pierre</td>
<td><em>Hoge</em> (VK)</td>
<td>Tree</td>
<td>2.6, 8, 9</td>
<td>7, 8, 10-12</td>
</tr>
<tr>
<td><em>Sesbania bispinosa</em> (Jacq.) W.F.</td>
<td><em>Dhaincha</em></td>
<td>Shrub</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><em>Tamarindus indica</em> Linn.</td>
<td><em>Tamarind</em></td>
<td>Tree</td>
<td>1-4, 6, 8, 11</td>
<td></td>
</tr>
<tr>
<td><em>Tephrosia purpurea</em> (Linn.) Pers.</td>
<td><em>Fish poison bean</em></td>
<td>Under shrub</td>
<td>4, 5</td>
<td>4-6, 8, 10</td>
</tr>
<tr>
<td><em>Vigna radiata</em> (Linn.) Wilczek</td>
<td>Creeping herb</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Vigna</em> sp.</td>
<td>Creeping herb</td>
<td>14, 5, 9</td>
<td>3, 4, 8</td>
<td></td>
</tr>
</tbody>
</table>

*K, Vernacular Kannada; VT, Vernacular Tulu

**Locations:** Kerala: 1, Kanhangad; 2, Kasaragod; Karnataka: 3, Talapady; 4, Someshwara; 5, Tannirbhavi; 6, Mukka; 7, Hejmaidi Kod; 8, Padubidri; 9, Katpadi; 10, Sasthan; 11, Karwar; Goa: 12, Margoa

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**Table 3—Medicinal uses of CSD legumes based on local survey and literature**

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Traditional knowledge</th>
<th>Literature information</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Abrus precatorius</em></td>
<td>Leaves are used for mouth boils (chew and spit), seeds burnt and ash applied on wounds.</td>
<td>Seeds consumed directly to expel unwanted embryo and also to induce sterility of women. Flower infusion is used as a pectoral and febrifuge and in the treatment of bronchitis, asthma, intestinal worms and malarial fever. Powdered seeds are used for stomachache.</td>
</tr>
<tr>
<td><em>Caesalpinia pulcherrima</em></td>
<td>Dry seeds are eaten after frying.</td>
<td></td>
</tr>
<tr>
<td><em>Canavalia cathartica</em></td>
<td>Roots are used for skin diseases.</td>
<td>Leaves, roots and seeds are used for cuts, purifying blood, worms, and skin diseases. Root infusion is used to treat pain, rheumatism and leprosy. Plant decoction is used to treat tuberculosis. Leaves help to relieve pain and promote healing of burns.</td>
</tr>
<tr>
<td><em>Canavalia martitima</em></td>
<td>Roots are used for skin diseases.</td>
<td></td>
</tr>
<tr>
<td><em>Cassia occidentalis</em></td>
<td>Roots are used in treating snake bites. Seeds and leaves are used to cure skin diseases.</td>
<td>The leaf is used as a salad for cooling effect and stomach upset.</td>
</tr>
<tr>
<td><em>Cassia tora</em></td>
<td>Tender leaves are edible and used as blood purifier, removes toxic components from body and increase iron content. Leaf decoction is used thrice a week to develop immunity against cold, sneezing and fever common in coastal area. Seeds are used to treat asthma.</td>
<td>Pills are prepared by mixing seed powder with jaggery and one pill is taken everyday with water up to seven days. Leaf paste is applied in skin diseases; leaves have antibacterial activity. Crushed leaves are</td>
</tr>
</tbody>
</table>
Table 3—Medicinal uses of CSD legumes based on local survey and literature—Contd.

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Traditional knowledge</th>
<th>Literature information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crotalaria retusa</td>
<td>Bark of the roots is peeled, ground with rice washed water (gruel) and administered orally (whole plant root is used at once). Root paste is applied on wounds and bites. Seed decoction is used in treating poison of saw scaled viper and tiger spider.</td>
<td>Seeds are used for snakebites by grinding with lime juice and the paste is applied repeatedly on the wound caused by the bite. The leaf is ground with salt and 2 teaspoons of paste taken orally early morning to eliminate intestinal worms.</td>
</tr>
<tr>
<td>Crotalaria verrucosa</td>
<td>Bark of the roots is peeled, ground with rice washed water (gruel) and administered orally (whole plant root is used at once). Root paste is applied on wounds and bites. Seed decoction is used in treating poison of saw scaled viper and tiger spider.</td>
<td>Seeds are used for snakebites by grinding with lime juice and the paste is applied repeatedly on the wound caused by the bite. The leaf is ground with salt and 2 teaspoons of paste taken orally early morning to eliminate intestinal worms.</td>
</tr>
<tr>
<td>Derris trifoliata</td>
<td>Leaves are added to hot water and used to bathe for treating cold. Leaf paste is applied on forehead to treat cold. Leaves are fomented and kept on forehead to treat headache and on carbuncle for curing.</td>
<td>Leaves and roots are used as laxative. Crushed leaves and bark applied externally to skin diseases.</td>
</tr>
<tr>
<td>Erythrina variegata</td>
<td>Roots are used to treat cobra bite (ground roots in lemon juice). Leaves added to coconut oil are kept in sunlight for 2–3 days to get blue colour, the colour is used for paintings and drawings. Oil prepared from the plant is used to treat psoriasis. Oil (Neelabringaditaila) is used as hair oil.</td>
<td>Root decoction has antiseptic properties, used for washing wounds and skin complaints; stimulates immune system and effective against bacterial infection. Root is antiseptic, astringent and laxative, infusion is used in treating respiratory infections; leaves are used in skin infections. Plant decoction is used as mouth wash or gargle to treat mouth ulcers, gum infections and sore throat. Common indigo has been found to contain indirubin, which is useful for the treatment of chronic myelocytic leukaemia. Leaf juice consumed for lactation in nursing mothers.</td>
</tr>
<tr>
<td>Indigofera tinctoria</td>
<td>Roots are used to treat cobra bite (ground roots in lemon juice). Leaves added to coconut oil are kept in sunlight for 2–3 days to get blue colour, the colour is used for paintings and drawings. Oil prepared from the plant is used to treat psoriasis. Oil (Neelabringaditaila) is used as hair oil.</td>
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</tr>
<tr>
<td>Mimosa pudica</td>
<td>Leaves (two handful) + cumin (one teaspoon) decoction is taken orally to stop any type of bleeding. Leaves boiled in coconut oil are applied to treat skin injury.</td>
<td>Root juice is applied locally in skin diseases like boils and scabies. Whole plant has antiviral activity.</td>
</tr>
<tr>
<td>Mucuna pruriens</td>
<td>Seed decoction is used as nerve tonic (probably seeds consist of L-DOPA, which is used to treat Parkinson’s disease). Mucuna seeds kept in jaggery or plaintain are made to swallow by children to remove intestinal worms.</td>
<td>In India, Venezuela and Mexico, plant is used to treat asthma, snakebite, cancer, cough, diarrhoea, mumps, ringworm, syphilis and tumour and as scorpion antidote. Seeds are used as aphrodisiac.</td>
</tr>
<tr>
<td>Pongamia pinnata</td>
<td>Bark and leaf decoction is used to wash wounds and skin diseases (possess antibacterial properties). Oil + ghee are used to treat skin diseases (leprosy).</td>
<td>Leaves are tied around neck to relieve whooping cough. Bark, leaf and stem are used for skin lesions and genitalia; leaves used for piles, scabies, wounds, rheumatism; bark for stomach pain and intestinal disorders; whole plant to treat ulcers and tumours. Seed powder mixed with honey is taken orally to treat cough; seed paste ground with lime juice is applied on forehead to relieve headache and oil extracted from the seed is used to treat bodyache. Tamarind pulp has laxative properties. It is used to treat fever.</td>
</tr>
<tr>
<td>Sesbania bispinosa</td>
<td>Flowers are used to treat skin problem.</td>
<td>Leaves are tied around neck to relieve whooping cough. Bark, leaf and stem are used for skin lesions and genitalia; leaves used for piles, scabies, wounds, rheumatism; bark for stomach pain and intestinal disorders; whole plant to treat ulcers and tumours. Seed powder mixed with honey is taken orally to treat cough; seed paste ground with lime juice is applied on forehead to relieve headache and oil extracted from the seed is used to treat bodyache. Tamarind pulp has laxative properties. It is used to treat fever.</td>
</tr>
<tr>
<td>Tamarindus indica</td>
<td>Roots are used in treating snakebite. Stem bark decoction is used for wound washing. Leaves, fruits and seeds are used to treat skin diseases; Leaf juice + coconut oil + pepper powder mixed and boiled is applied to treat muscle sprain or pulling of nerves. Fruit squeezed in water (seeds discarded) mixed with a small quantity of jaggery is orally administered to treat headache.</td>
<td>Tamarind pulp has laxative properties. It is used to treat fever.</td>
</tr>
<tr>
<td>Tephrosia purpurea</td>
<td>Root bark paste when taken in small quantity relieves stomach pain and other upsets.</td>
<td>Root bark paste when taken in small quantity relieves stomach pain and other upsets.</td>
</tr>
</tbody>
</table>
Alysicarpus rugosus Willd. DC. (Papilionaceae)
It is a common strong mat forming herb on the dunes. Grow profusely during monsoon and is used as fodder.

Caesalpinia pulcherrima (Linn.) Sw.
(Caesalpiniaceae; Pride of Barbados)
It is an armed shrub used as forage and produces attractive orange flowers useful in festivals. The dry seeds are fried and eaten.

Canavalia cathartica Thouars (Papilionaceae; Maunaloa)
It is a common perennial mat forming creeper on the dunes. It has deep taproot system and its vines produce nodal and intra-nodal roots and facilitate sand binding. The tender pods and ripened beans are occasionally consumed by the fisher folk as dry season food after processing as it is a rich source of proteins and essential amino acids. One of the methods of processing is soaking long time in water. There seems to be specific traditional knowledge to process tender pods and ripened beans as food as they consist of the lectin concanavalin A (con A). This creeper also extends growth to adjacent plantations (coconut, cashew, cocoa). Another germplasm of this legume also grows luxuriously in mangroves. In and around estuaries and mangroves, farmers allow this plant to grow deliberately in agricultural fields after harvesting (sugarcane and paddy) in view of enriching the nitrogen and phosphorus in soil. Seeds are sturdy due to hard seed coat and useful for children to play. This plant is used as forage legume for cattle and rabbits.

Canavalia maritima (Aubl.) Thouars (Papilionaceae; Beach bean)
It is the most common perennial mat forming creeper possessing properties similar to C. cathartica. Unlike C. cathartica, it is restricted to CSDs than estuaries and mangroves. The tender pods as well as ripened beans are used occasionally as food by fishermen community and other coastal dwellers. Aboriginals used the green beans of C. maritima by soaking in water to remove toxins. Root infusion is used to treat aches, pains, rheumatism and for leprosy while plant decoction is used to treat tuberculosis. The leaves help to relieve pain and promote healing of burns. Roasted and powdered seeds substitute for coffee powder. Tender flat pods were roasted/boiled.
for consumption and sprouted seeds were also consumed. The young pods and seeds were used as food in northern Australia and Australian aboriginals use the seeds as food and other parts of the plant for medicinal purposes. The fresh and dried flowers were used as a garnish and for flavoring. *Canavalia maritima* is smoked as marijuana substitute. The L-betonicine has been isolated from leaves of *C. maritima*.

*Cassia siamea* (Lam.) H.S. Irwin & Barneby (Papilionaceae; Siamese senna)
Tender leaves are used as vegetable during scarcity of food in Gujarat.

*Cassia tora* Linn. (Caesalpiniaceae; Foetid cassia)
An annual shrub with yellow flowers consisting of kaempferol glucoside. Seeds, leaves and roots consist of several phytochemicals. Young leaves as well as tender twigs are used as vegetable during scarcity of food in Gujarat.

*Crotalaria pallida* Aiton. (Papilionaceae; Smooth rattle box)
The annual under shrub produces yellow flowers. Juice obtained by crushing leaves is applied for mumps.

*Derris trifoliata* Lour. (Papilionaceae)
The woody creeper twines around shrubs and trees on dunes and occasionally produce fragile white flowers. If no plants around, they stay dwarf with strong bunch of stem and deep root. Local people use crushed leaves to stun or kill fish and shrimp for easy catch and strong and fibrous stem as cordage.

*Erythrina variegata* Linn. (Papilionaceae; Indain coral tree)
A small deciduous tree; used as hedge plant as well as for shade. Its leaves are used in traditional food preparation (food will be wrapped in leaves and backed to give a specific aroma). Its intense red flowers are attractive and the sturdy seeds are useful to children in games.

*Indigofera tinctoria* Linn. (Papilionaceae; True indigo)
An under shrub produce attractive purple flowers in racemes; a source of indigo dye. The growing plant is harvested and hung up by local people to repel flies.

*Mucuna pruriens* (Linn.) DC. (Papilionaceae; Velvet bean)
A climber produces purple flowers and hairy pods. The pod hairs possess itching properties. It is a storehouse of several phytochemicals including L-DOPA used to treat parkinson’s disease.

*Pongamia pinnata* (Linn.) Pierre (Papilionaceae; Indian beech tree)
An evergreen tree produce purplish white flowers; an important in energy plantations as its seeds yield combustible oil (biodiesel). Wood is useful as fuel and to produce charcoal. Native people use the twigs as tooth brush; leaves and flowers serve as good natural organic manure.

*Sesbania bispinosa* (Jacq.) W.F. Wight (Papilionaceae; Canicha)
An erect seasonal shrub grows luxuriantly during post monsoon season on the dunes and mangroves. The large leaves and bright orange-yellow flowers are edible and having ornamental value. It is a good fodder and green manure, grown deliberately in paddy and sugarcane fields to incorporate into soil and practiced as rotation crops to improve soil fertility in coastal areas. The productivity of the plant can be improved on a large scale with little care or investment and it survives well on saline and waterlogged soils. Besides several medicinal uses, the plant is also a source of fiber for paper pulp. It yields gum, galactomannan, which is water soluble, produces a smooth, transparent, coherent and elastic film useful for sizing textiles, paper industry and for stabilizing the mud used in oil drilling. It is also useful as stabilizer and thickener in food products such as ice cream, bakery mixes and salad dressings.

*Tamarindus indica* Linn. (Caesalpiniaceae; Tamirand)
The tree usually found in hind dunes shows stunted growth. The cotyledon of roasted seeds is eaten by the native people. The fruit pulp is used in most of the food preparations and in juices as souring agent. Its pulp with pepper and jaggery forms a nice traditional drink during summer festivals. The pulp along with salt is used for cleaning brass and copper utensils. Seeds are used in folk games. Leaves and tender twigs are edible as vegetable, roasted dehulled seed powder serve as food during scarcity of food in Gujarat.

Leaves yield a yellow dye and wood is useful to prepare domestic articles and to generate charcoal.
An under shrub produce attractive pink flowers in racemes. It is grown in the fields beyond hind dunes as green manure; seeds serve as vegetable in Gujarat desert.

The CSDs are susceptible for a variety of disturbances like tidal action, wind blow, erosion and sand accretion. Numerous human activities have also contributed directly or indirectly to extensive loss of CSD habitats. The CSDs are under great threat from human recreational and commercial activities (tourism, road traffic, disposal of wastes, agriculture, plantation, removal of organic debris). Loss of natural or traditionally managed pastures on the CSDs have serious repercussions on their stability and human life which directly or indirectly dependent on such resources. Traditional knowledge should be valued as it has been inherited by long term experience. In addition, traditional knowledge advocates indirectly restoration of useful plants in the vicinity for ready access and in turn facilitates ecosystem restoration. The CSD legumes fix atmospheric nitrogen, add organic matter to the dunes and some are mat forming creepers and stabilize the dunes effectively. Below ground diversity of microorganisms have a major contribution in the maintenance of plant biodiversity and in ecosystem functioning. Microbes associated with CSD plant species (fungi, mycorrhizas, rhizobia, endophytes) are of special interest as they involve in biogeochemical cycles and facilitate ecosystem restoration. Several CSD legumes have their own value in rotation crops in agricultural fields, cover crops in plantations, nitrogen fixers, green manure and mulch plants. Many serve as fodder and feedstock for the livestock of coastal dwellers.

One of the major influences of human interference of CSDs is the construction of seawall. Addition of granite boulders along the sand dunes has serious repercussions as it prevents the addition of organic matter to the dunes and some are mat forming creepers and stabilize the dunes effectively. Below ground diversity of microorganisms have a major contribution in the maintenance of plant biodiversity and in ecosystem functioning. Microbes associated with CSD plant species (fungi, mycorrhizas, rhizobia, endophytes) are of special interest as they involve in biogeochemical cycles and facilitate ecosystem restoration. Several CSD legumes have their own value in rotation crops in agricultural fields, cover crops in plantations, nitrogen fixers, green manure and mulch plants. Many serve as fodder and feedstock for the livestock of coastal dwellers.

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