



International Journal of Herbal Medicine

Available online at www.florajournal.com



E-ISSN: 2321-2187
P-ISSN: 2394-0514
IJHM 2015; 3(4): 35-40
Received: 19-08-2015
Accepted: 21-09-2015

Patra Biswajit
Ecology and Floristic
Laboratory, P.G. Department of
Botany, Berhampur University,
Berhampur-760007, Odisha,
India.
Email: patrabiswajit090@gmail.com
om
Mobile: 09040374481

Labanyagada: The protected red sandal forest of Gajapati district, Odisha, India

Patra Biswajit

Abstract

The paper reports 94 plant species under 83 genera and 44 families of which 34 are dicot, 7 monocot and 3 pteridophyta. The plant species constitute 34 herbs, 10 shrubs, 9 climbers and 41 tree species. There are no gymnosperm species found in the forest. The forests are dry deciduous type and dominated by Rakta Chandan (*Pterocarpus santalinus* L.). In this forest 737 red sandal trees were present.

Keywords: Red sandal forest, plant species, Labanyagada, Gajapati district, Odisha.

1. Introduction

Floristic lists are the only source of botanical information for a particular area and may serve as a useful starting point for more detailed study. Such lists also used for general comparisons of the vegetation of different localities, or that of the same locality at different times [1]. Taxonomists are mainly interested to record flora of different geographical areas. Studies of forest flora provide useful information on several aspects related to species diversity, other valuable information like dominant families, life form status etc. The knowledge of the floristic study of an area is a prerequisite for any ecological and phyto-geographical studies and conservation management activities [2]. So, knowledge of forest structure and floristics are necessary for the study of forest dynamics, plant animal interactions and nutrient cycling [3]. The flora includes the number of species, while vegetation refers to their distribution and number of individuals and size of each of the relative importance [4]. World is always variable. So, a vast range of floras are available ranging from concise or field floras to research floras [5]. Plants are indispensable sources of medicine. Studies on natural products are aimed to determined medicinal values of plants by exploration of existing scientific knowledge and traditional uses. Floristic study shows the diversity of vegetation of an area and can be affected by many factors like overgrazing, soil deterioration, deforestation and dependence of local people. The identification of local plants along with description of an area is essential as it can provide particular species of the local area, growing season, any new species establishing in the area and the effect of climatic conditions like over grazing and drought on vegetation [4]. The listing of species and their conciseness, is easy to handle and less time consuming that helps in the identification and correct naming of species, important resources for biogeographic study and biodiversity estimates [6]. Very few studies regarding floristic study on red sandal forests are available. So, there is an immediate need to study the red sandalwood forest. Red sandal wood is an endangered timber tree species and placed in the red list of endangered species under IUCN guidelines [7]. Locally, it is known as *Rakta Chandan* and its botanical name is *Pterocarpus santalinus* L. It is a woody plant with red heartwood.

2. Study area and climate

Gajapati is one of the 30 districts of Odisha, which is covered by mountains and hills. Gajapati district is a part of the Eastern Ghats of India. This district is lying between 18.46° to 19.39° N lat. and 83.48° to 84.00° E long [8]. Labanyagada is a village in Gosani tehsil in Gajapati district of Odisha state. It is located 55km towards south from district headquarters Paralakhemundi, 9km from Badagosani, 265km from state capital Bhubaneswar. Gandahati (10km), Ghorani (12km), Gurandi (12km), Bhusukudi (14km), Saradhapur (15km) are the nearby villages to Labanyagada. Paralakhemundi, Palasa, Kasibugga, Ichchapuram, Gunupur are the nearby cities to Labanyagada. Labanyagada is surrounded by Palasa tehsil towards east, Meliaputti tehsil towards west, Vajrapukotturu tehsil towards south. This place is in the border of Gajapati district and Srikakulam district. Srikakulam district Meliaputti is west towards this

Correspondence:
Patra Biswajit
Ecology and Floristic
Laboratory, P.G. Department of
Botany, Berhampur University,
Berhampur-760007, Odisha,
India.
Email: patrabiswajit090@gmail.com
om
Mobile: 09040374481

place (Fig. 1). Odia, Telgu and Saura is the local language. Vishakapatnam railway station is major railway station 183km near to Labanyagada. The total forest of Gajapati district is 2302 sq km, of which 473 sq km is reserve forest. The Labanyagada red sandal forest is 31 Acre. The forests are dry deciduous type and dominated by Rakta Chandan (*Pterocarpus santalinus* L.). In this forest 737 red sandal trees were present. Atmospheric temperature varies from 16 °C to 45 °C. The normal annual rainfall of the district is 1403 mm.

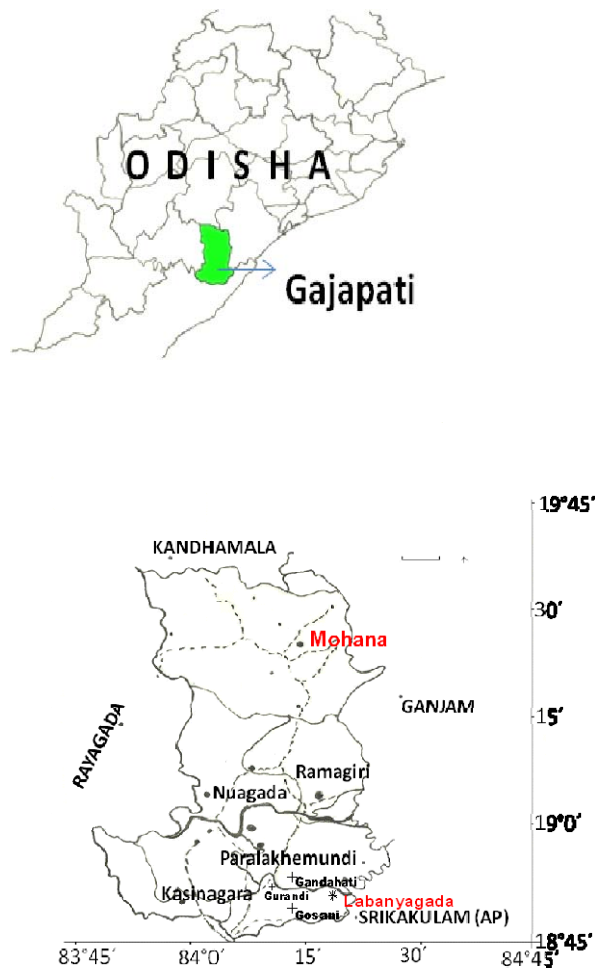


Fig 1: Map showing the Labanyagada of Gajapati district, Odisha.

3. Method

During 2014, field trips were conducted to Labanyagada village of Gajapati district, Odisha and floristic data were recorded. Information on plants was collected from forest personnel (foresters and forest watcher) and other tribal and village peoples of Labanyagada forest. Plant specimens collected with the help of the local people during the survey were processed, dried and herbarium specimens were prepared. The identification of the plant species was done by the help of local flora [9], and the specimens were deposited in the Herbarium of the Department of Botany, Berhampur University (BOTB), Berhampur, Odisha. The plants are enumerated alphabetically as per their botanical name along with family and odia name (Od.). The small description of the plant species were prepared with the help of flora [9] and the interview information collected during study.

4. Observation

The Labanyagada reserve forest of Gajapati district are rich in red sandal trees and 94 other plant species are reported in this study. These plant species constitute 76 dicot, 15 monocot and 3 pteridophyta species. These plants belong to 44 families, of which 34 are dicot, 7 monocot and 3 pteridophyta. These plant species comes under 83 genera. Out of the 94 plant species 34 are herbs, 10 shrubs, 9 climbers and 41 tree species (Fig. 2). The most dominant plant species of these forest are Fabaceae (8 species), Euphorbiaceae (6 species), Poaceae (5 species) followed by Rubiaceae, Rutaceae, Asteraceae, Acanthaceae and Apocynaceae (each 4 species) and Mimosaceae and Verbenaceae (each 3 species) (Fig. 3). There are no gymnosperm species found in the forest. The contribution of total dominant species was 48% and angiospermic species was 49% where as total dominant genera was 47% and angiospermic genera was 49 %.

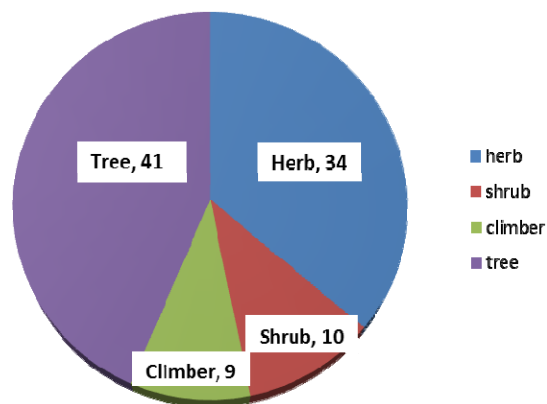


Fig 2: Phytodiversity of Labanyagada forest.

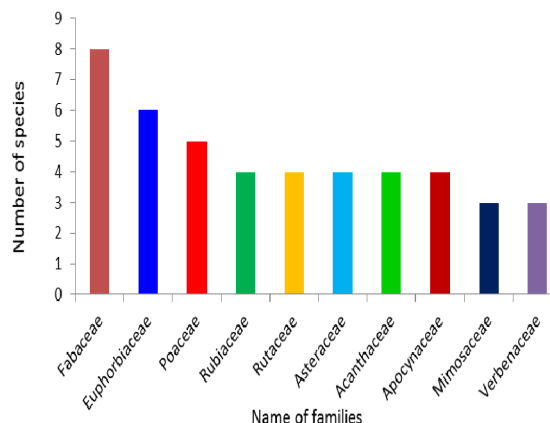


Fig 3: Number of species under ten dominant families of flora of Labanyagada.

4.1 Enumeration

Acacia pennata (L.) Willd. (Mimosaceae) Od. Dantari
 Large woody climber. Bark–light coloured. Branches usually more. Branchlets grey. Flowers cream, pedicelled, brown or purple, glabrous. Fairly common in mixed forest. Fl: May – Aug. Fr: Oct.–Dec. [9].
Adiantum incisum Forssk. (Adiantaceae)
 Herb. Small tufted fern with many rhizomes. Fronds linear or linear–oblong, 15–30 cm long, deep brown stipe, Sori at the ends of the segments never forming a continuous line. Common in forest. Fertile: Jul.– Dec. [9].

Aegle marmelos (L.) Corr. (Rutaceae) Od. Bela

Small or medium sized tree. Spines 1–2, axillary, strong. Petiole 2.5–6.5cm, leaflet ovate, ovate–lanceolate or elliptic, terminal one larger. Flowers white or greenish white. Berry globose or ovoid, woody. Seeds embedded in a clear mucilage and yellow, sweet aromatic pulp. Common in open forest. Fl: Mar.–Apr. Fr: ripening after one year^[8,9].

Aerva lanata (L.) Juss. ex Schultes (Amaranthaceae) Od. Pounsia

Perennial herb. Leaves obovate, rounded, white tomentose beneath or hairy or lanata both side. Spikes 0.6–1.2 cm. Common weed. Fl: and Fr: Aug.–Jan.^[9].

Ageratum conyzoides L. (Asteraceae) Od. Pokasunga, Dengsingi

Hairy herb. Leaves petioled, ovate. Heads white or blue–purple. Fairly common weed. Fl: and Fr: all the year round^[9].

Alangium salvifolium (L.f.) Wangerin (Alangiaceae) Od. Ankula, Dhala ankula

Small bushy tree. Bark light coloured. Leaves oblong, gland pits or tufts of hairs in the nerve axils. Flowers white, fragrant. Fruits sub-globose, black, succulent with bony endocarp. Common in waste ground and mixed forest. Fl: Mar.–Apr. Fr: Jun.–Jul.^[9].

Andrographis paniculata (Burm.f.) Wall. ex Nees (Acanthaceae) Od. Bhui–nimba, Chirata, Bhuin kara

Erect, glabrous herb. Stem square, margined on the angled. Leaves sessile, lanceolate, long, acute. Flowers pedicelled, white–purple. Seeds subquadrate, rugose. Common in forest, waysides. Fl: and Fr: Sep.–May^[8,9].

Annona reticulata L. (Annonaceae) Od. Ramphala, Barhial

Tree. Leaves oblong–lanceolate, upper surface glabrous, the lower with a few scattered hairs. Flowers 2–4, on lateral pedicels. Woody fruit. Seed smooth and blackish. Cultivated and natural forest. Fl: Jun. Fr: Dec.–Jan.^[9].

Aristida setacea Retz. (Poaceae) Od. Khadikaghasa, Ghora–lenji

Herb. Stoutier grass, simple. Culms erect. Leaves overtopping the inflorescence, sometimes flat, upto 3 mm wide. Sheaths at base of the culm. Common in open lands. Fl: and Fr: Aug.–Feb.^[9].

Azadirachta indica A. Juss. (Meliaceae) Od. Nimba, Neem

Tree. Leaves imparipinnate, 20–38 cm. Leaflets sub-opposite, 5–9 pairs. Flowers white, fragrant. Fruit a 1–seeded drupe, endocarp woody. Commonly planted and natural forest. Fl: Feb.–May Fr: Jun.–Jul.^[8,9].

Barleria prionitis L. (Acanthaceae) Od. Dasakaranta

Herb. Leaves elliptic, ovate, spine tipped. Flowers yellow. Frequent in open place. Fl: and Fr: Oct.–Feb.^[9].

Bombax ceiba L. (Bombacaceae) Od. Simuli, Semulo, Bura

Tree with spiny trunk and branches. Leaves 5–7 foliolate. Flowers bright red. Receptacle glandular. Capsule oblong to ovoid. Seeds more or less pyriform. Commonly planted and natural forest. Fl: Jan.–Mar. Fr: Mar.–May^[9].

Bridelia retusa (L.) A. Juss. (Euphorbiaceae) Od. Kasi

Tree, usually with long conical thorns on the trunk when young. Bark grey, flaky. Leaves oblong. Flowers small, green. Drupe black when fully mature, globose. Common in forest. Fl: Aug.–Oct. Fr: Sept.–Jan.^[9].

Cajanus scarabaeoides (L.) Thouars (Fabaceae) Od. Banaharada, Kanduli, Duma hirma

Herb. Leaflets elliptic, lateral leaflets somewhat smaller and oblique. Flowers yellow and tinged with reddish–brown. Seeds grey–brown. Common in open forest. Fl: and Fr: Aug.–Jan.^[9].

Canthium parvifolium Lam. (Rubiaceae) Od. Tothudi, Kanta

Tree. Bark grey. Spine 1cm long. Leaves ovate, rounded. Flowers small, green. Fruit yellow, apical areole surrounded

by the 4 short linear sepals. Near rocky hills. Fl: Apr.–May Fr: Nov.–Dec.^[9].

Capparis zeylanica L. (Capparaceae) Od. Asadhua, Sabbi

Climber with brown–red to grayish stellate–tomentose. Leaves ovate, base rounded. Flowers white or pink. Fruit globose. Seeds many. Common in forest. Fl: Feb.–Apr. Fr: Sept.–Oct.^[9].

Careya arborea Roxb. (Lecythidaceae) Od. Kumbhi

Tree. Bark dark brown. Leaves obovate. Flowers white and pink. Common in forests. Fl: Apr.–May Fr: July–Aug.^[9].

Carissa carandas L. (Apocynaceae) Od. Karanda koli, Anku Koli

Shrub. Leaves elliptic, oblong, rounded at both end. Flowers white. Fruit small, rounded. Found in dry forest, wild and cultivated. Fl: Mar.–Apr. Fr: Jul.–Oct.^[9].

Carissa spinarum L. (Apocynaceae) Od. Dudha koli, Khir koli, Anku koli

Shrub. Sub-erect branches. Spine straight, forked. Leaves ovate, oblong, sub-orbicular. Flowers in close terminal, many flowered cymes. Berry globose. Found in open forest. Fl: Mar.–Apr. Fr: Oct.–Dec.^[9].

Caryota urens L. (Arecaceae) Od. Salapa, Jivalaggu

Tree. Stout. Leaves very large, bipinnate. Flowers ternate. Fruit globose, reddish, acrid. Frequent in the hills in deep ravines. Fl: Apr.–Aug.^[8,9].

Casearia elliptica Willd. (Flacourtiaceae) Od. Khakada

Tree. Leaves oblong. Flowers greenish. Capsule yellow when ripe. Seeds with scarlet aril. Found in lower elevations. Fl: Feb.–May Fr: Apr.–May^[9].

Casearia graveolens Dalz. (Flacourtiaceae) Od. Giridi, Kakoli

Tree. Leaves elliptic, round. Flowers green. Capsule yellow, smooth, shining, oblong. Seeds ovoid, compressed, with a scarlet aril. Found in valleys and natural forest. Fl: Feb.–Mar. Fr: Apr.–Jul.^[9].

Cassia fistula L. (Caesalpinaceae) Od. Sunari, Argavada

Tree. Bark smooth and whitish. Petiol and rachis glandular. Leaflet 4–8 pairs. Flowers light yellow, 3.7–6.2 cm across, in long pendulous racemes. Pods short–stipitate, long cylindrical, drooping, black when mature. Seeds many. Common in forests. Fl: Apr.–Jun. Fr: Mar.^[8,9].

Cassia tora L. (Caesalpinaceae) Od. Chakunda

Herb. Petiole eglandular. Flowers yellow. Seeds many, brown in colour. Common weed. Fl: Sept.–Nov. Fr: Nov.–Dec.^[8,9].

Cheilosoria tenuifolia (Burm. f.) Trivis (Cheilanthaceae) Od. Dodhari

Herb. Fern with shortly creeping scaly caudex. Common in forest. Fertile: Sept.–Nov.^[9].

Chloroxylon swietiana DC. (Rutaceae) Od. Bheru

Tree. Leaves paripinnate, grayish or green. Leaflets 10–20 pairs. Flowers white. Capsule oblong–ovoid. Seeds oblong. Frequent in open forest. Fl: Mar.–Apr. Fr: May–Jun.^[9].

Chromolaena odorata (L.) R. M. King & H. Rob (Asteraceae) Od. Badapokasunga

Shrub. Leaves petiolate. Flowers many, whitish. Introduced and naturalized in forest, way side. Fl: and Fr: Oct.–Dec.^[8,9].

Cipadessa baccifera (Roth) Miq (Meliaceae) Od. Rambelli, Pitamari

Shrub. Leaves 12 cm long. Leaflet opposite. Flowers white and small. Fruit globose, orange–red or black. Common in open mixed forest. Fl: Mar.–Jun. Fr: May–Nov.^[8,9].

Clerodendrum infortunatum L. (Verbenaceae) Od. Genguti, Madhabi

Shrub. Leaves ovate, thin hair both side. Flowers white with pink centre and pink spotted. Drupe bluish–black. Common in forest. Fl: Jan.–Mar. Fr: Apr.–Jul.^[9].

Curculigo orchoides Gaertn. (Amaryllidaceae) Od. Talamuli

Herb. Leaves linear-oblong. Scape very short and hidden among the bases of the leaves underground. Flowers few, opening in succession of 2–3 together. Perianth yellow. Found in forests, moist and shady places. Fl: Apr.–Sep.^[8,9]

Cyanthillium cinereum (L.) H. Rob. (Asteraceae) Od. Badi-Pokasunga

Herb. Stems ribbed, hairy. Leaves variable, linear to elliptic. Common weed. Fl: and Fr: Most of the year^[9].

Cynodon dactylon (L.) Pers. (Poaceae) Od. Duba

Herb. Creeping grass by scaly rhizomes or by strong stolons forming matted tufts. Leaves conspicuously distichous on the prostrate stems usually very short, spreading. Found everywhere and cultivated land. Fl: and Fr: Most part of the year^[8,9].

Desmodium heterophyllum (Willd.) DC. (Fabaceae) Od. Kuradiagacha

Herb, spreading over ground. Branchlets with spreading hairs. 3–foliate. Leaflets elliptic, obovate. Flowers both 1–3 together axillary and 2–6 in small lax racemes. Found in forest^[9].

Desmodium oojeinensis (Roxb.) H. Ohashi (Fabaceae) Od. Bandhan

Tree. Bark dark brown, deeply cracked. Leaves pinnately 3–foliolate. Flowers small with white or pink. Occasional in mixed and deciduous forest. Fl: Feb.–Mar. Fr: Mar.–Apr.^[9]

Desmodium triflorum (L.) DC. (Fabaceae) Od. Kuradhia

Herb. Leaves very small with 3–foliate. Flowers purple, pink or white. Common in cultivated land. Fl: and Fr: Most part of the year^[9].

Dioscorea bulbifera L. (Dioscoreaceae) Od. Pitakanda, Pita alu

Climber. Leaves alternate, rarely opposite. Flowers green. Capsule oblong. Common in forest. Fl: Aug.– Sep. Fr: Nov.–Dec.^[8,9].

Dioscorea oppositifolia L. (Dioscoreaceae) Od. Pithalakanda
Climber. Leaves all opposite, oblong. Flowers sweet-scented, yellow-green. Capsule glabrous, facing forward, with depressed base and apex. Frequent in forest. Fl: Aug.–Sep. Fr: Nov.^[9].

Diospyros melanoxylon Roxb. (Ebenaceae) Od. Kendu

Tree. Bark black. Leaves mostly sub-opposite, broadly ovate. Fruit globose, smooth, yellow when ripe. Found in open forest. Fl: Apr.–May Fr: Jun.^[8,9]

Dolichos trilobus L. (Fabaceae)

Herb. Leaves 3–foliate. Leaflets simple and 3 lobed. Flowers bluish-purple. Pods pale, flat, curved. Frequent in hill forest. Fl: Sep.–Oct. Fr: Nov.–Dec.^[9]

Elephantopus scaber L. (Asteraceae) Od. Totachera, Mayur chulia

Herb. Stems slender, branched, hairy. Clusters of partial heads with conspicuous leaf bracts. Common in forest. Fl: and Fr: Aug.– Dec.^[8,9].

Eranthemum purpurascens Wight ex Nees (Acanthaceae) Od. Pachaitala

Herb. Leaves large, elliptic. Flowers blue-purple. Capsule 1.2–1.8 cm long. Common in forest. Fl: and Fr: Sep.–Jan.^[9]

Evolvulus alsinoides (L.) L. (Convolvulaceae) Od. Bichamalia
Herb. Leaves sub-sessile, shortly petioled. Flowers blue, bluish-white. Capsule globose, thin. Found in hill side forest. Fl: and Fr: Jul.–Feb.^[9].

Ficus bengalensis L. (Moraceae) Od. Bara

Tree. Leaves ovate to elliptic. Fruits red, figs sessile, scarlet when ripe. Common in forest. Fl: Apr.–Jun. Fr: Dec.–Feb.^[9]

Firmiana simplex (L.) W. Wight (Sterculiaceae) Od. Genduli, Kudalo

Tree. Leaves orbicular-cordate, 5–lobed. Flowers reddish-brown. Seeds dark, oblong. Found in deciduous forest. Fl:

Dec.–Jan. Fr: Apr.–Aug.^[9]

Glochidion zeylanicum (Gaertn.) A. Juss. (Euphorbiaceae) Od. Kalachua

Tree. Bark dark. Leaves oblong, curved. Male flowers yellowish-green, female flowers reddish. Capsule depressed globose. Found in forest. Fl: Feb.–May Fr: May–Oct.^[9]

Gloriosa superba L. (Liliaceae) Od. Panchoangulia, Agnisikha

Herb. Leaves linear to ovate-lanceolate, finely parallel nerved each side of the midrib, base rounded. Flowers 8–15 cm across, lower half yellow, upper half red, finally whole turning more or less red. Fruit oblong. Seeds orange-red. Common in open forest. Fl: Sep.–Nov. Fr: Nov.–Dec.^[9]

Glycosmis pentaphylla (Retz.) DC. (Rutaceae) Od. Chauli
Shrub. Leaves pinnately 1–5 foliolate, oblong. Flowers white, small. Berry pinkish, glassy, depressed globose. 1 seeded. Common in scrub and open forest. Fl: Oct.–Dec. Fr: Nov.–Apr.^[8,9]

Gymnema sylvestre (Retz.) R. Br. ex Schult. (Asclepiadaceae) Od. Gudamari, Mera-singi

Climber. Leaves ovate, broadly elliptic, hairy above. Flowers minute, yellow, hairy peduncled. Seeds long. Frequent in forest. Fl: Aug.–Oct. Fr: Jan.–Mar.^[8,9]

Haldinia cordifolia (Roxb.) Ridsd. (Rubiaceae) Od. Halanda, Kuruma

Tree. Bark smooth, light coloured. Leaves broadly ovate, hairy. Flowers yellow. Fruiting heads dry. Common in deciduous forests. Fl: Jun.–Jul. Fr: Nov.–Mar.^[9]

Helicteris isora L. (Sterculiaceae) Od. Modimodica, Anti

Shrub. Hairy branches. Leaves orbicular, obovate. Flowers brick-red. Seeds angular. Wildly distributed in the forest. Fl: Apr.–Dec. Fr: Oct.–Jan.^[8,9]

Hemidesmus indicus (L.) R. Br. (Asclepiadaceae) Od. Sugandhi

Climber. Leaves in distant pairs, linear, oblong. Flowers green outside and purplish-brown within. Follicles spreading in fruit, cylindric, gradually narrowed towards tip. Common in forest. Fl: Aug.–Oct. Fr: Dec.–Feb.^[8,9]

Holarrhena pubescens (Buch.–Ham.) Wall. ex G. Don (Apocynaceae) Od. Kurei

Tree. Bark thick, smooth. Leaves elliptic, ovate. Flowers white. Follicles slender. Seeds linear-oblong. Common in forest and waste land. Fl: May–Jul. Fr: Oct.–Feb.^[8,9]

Ichnocarpus frutiscens (L.) R. Br. (Apocynaceae) Od. Shyamalata, Dudhilata

Climber. Leaves lanceolate-oblong. Flowers small and white. Follicle linear, slightly flattened, brown. Seeds brown and linear. Common in forest. Fl: Sep.–Dec. Fr: Jan.–Apr.^[8,9]

Iseilema laxum Hack. (Poaceae) Od. Motha-ghaso

Herb. Leaves larger, acute, few long hairs. Common in moist place.^[9]

Jasminum arborescens Roxb. (Oleaceae) Od. Banamalli

Herb. Leaves lanceolate. Flowers white. Common in forest. Fl: Mar.–May Fr: Jun.–Jul.^[9]

Jatropha gossypifolia L. (Euphorbiaceae) Od. Lanka Kala, Baigoba

Tree. Leaves sub-orbicular. Flowers red with yellow centre. Capsule 1 cm long. Very common in waste ground, scrub forest. Fl: and Fr: Jul.–Oct.^[9]

Justicia japonica Thunb. (Acanthaceae)

Herb. Stems angular and grooved, hairy. Leaves elliptic, oblong. Hairy spikes. Flowers small, pink. Capsule elliptic-oblong, hairy tip. Seeds suborbicular. Common in forest. Fl: and Fr: Sept.–Jan.^[9]

Kydia calycina Roxb. (Malvaceae) Od. Kapasia, Banakapasia

Tree. Leaves sub-orbicular, rounded. Flowers white. Hairy capsule. Seeds brown. Common in mixed forest. Fl: Sept.–

Nov. Fr: Nov.–Dec. ^[9].

Lantana camara L. (Verbenaceae) Od. Nagaeri

Shrub. Leaves ovate or ovate-oblong. Flowers white-pink, orange-yellow. Drupe black, globose. Common in scrub forest. Fl: and Fr: all the year round ^[9].

Leucas decemdentata (Willd.) Sm. (Labiatae) Od. Gayasa

Herb. Leaves petioled, ovate, white tomentose beneath. Whorls many flowered. Common in hilly forest. Fl: and Fr: Sept.–Jun. ^[9].

Lygodium flexuosum (L.) Sw. (Lygodiaceae) Od. Kala Mahajala (Fern)

Herb. Primary pinnae abbreviated to a small knob with hairy apex and bearing a pair of 1–2 pinnate secondary pinnae on growing fronds. Common in forests. Fertile: Aug.–Feb. ^[9].

Madhuca longifolia (Koenig) Macbr. var. *latifolia* (Roxb.) A. Chev (Sapotaceae) Od. Mahula, Mohua

Tree. Bark brown. Leaves elliptic, elliptic-oblong. Flowers cream, fleshy, on rusty tomentose pedicels. Berry ovoid. Seed ellipsoid, pale brown. Testa soft, with milky juice. Common in forests and village sides. Fl: Feb.–Apr. Fr: May.–Jul. ^[8, 9].

Manilkara hexandra (Roxb.) Dubard (Sapotaceae) Od. Khirkoli

Tree. Bark rough, grey. Leaves elliptic, oblong. Flowers small, white. Berry oblong-ellipsoid. Common in open forest. Fl: Nov.–Jan. Fr: Mar.–Jun. ^[9].

Milusa tomentosa (Roxb.) Sinc. (Annonaceae) Od. Gandhapalasa

Tree. Bark brown. Leaves ovate-oblong. Flowers axillary or in short lateral cymes. Fruits black, fleshy, 2 seeded. Found in hilly forest. Fl: May–Jun. Fr: Jun.–Jul. ^[9].

Mimosa pudica L. (Mimosaceae) Od. Lajakuli

Herb. Stems glabrescent. Leaves spreading, long petioled. Leaflet linear. Flowers white-pink. Common weed. Fl: and Fr: Aug.–May ^[8, 9].

Morinda pubescens Sm. (Rubiaceae) Od. Achu

Tree. Bark brown or grey. Leaves ovate, obovate. Flowers white. Fruits whitish-green. Common in forest. Fl: Apr.–Jul. Fr: Nov.–Apr. ^[9].

Nyctanthes arbor-tristis L. (Nyctaginaceae) Od. Gangasiuli

Tree. Leaves ovate, entire or coarsely toothed. Flowers white. Capsule elliptic, obovoid. Seeds orbicular. Frequent in open forest. Fl: Sep.–Oct. Fr: Dec.–Jan. ^[8, 9].

Oplismenus burmannii (Retz.) P. Beauv. (Poaceae) Od. Kaugodia

Herb. Leaves lanceolate to ovate-lanceolate, with fine hair both side. Common in hill sides in forest. Fl: and Fr: Oct.–Nov. ^[9].

Oplismenus compositus (L.) P. Beauv. (Poaceae) Od. Kauguria, Mohara

Herb. Culms creeping and rooting below. Leaves lanceolate, linear. Glumes silky or hispidulous, lower red, smooth. Common in damp forest. Fl: and Fr: Oct.–Dec. ^[9].

Pavetta crassicaulis Bremek. (Rubiaceae) Od. Pengu, Kukurachhelia

Tree. Leaves petiolate, obovate. Flowers white. Fruit green, turning black when ripe. Common in scrub forest. Fl: Jun.–Aug. Fr: Oct.–Dec. ^[9].

Phoenix acaulis Buch.– Ham. ex Roxb. (Arecaceae) Od. Bana-khajuri

Shrub. Leaves 1.8 cm long, leaflet stiff, finely acuminate, lowest reduced to strong spines. Flowers 15–25 cm long, white. Drupe oblong-ellipsoid, orange-red, finally black. Common in drier forests. Fr: Apr. Fr: May–Jun. ^[9].

Phyllanthus fraternus Webster (Euphorbiaceae) Od. Badiamla

Herb. Main stem naked below. Leaves elliptic-oblong, dark green above paler beneath. Flowers white. Capsule rounded.

Common weed. Widely distributed in Indian forest. Fl: and Fr: Apr.–Jan. ^[8, 9].

Phyllanthus emblica L. (Euphorbiaceae) Od. Amla

Tree. Bark light grey. Leaves linear or linear-oblong. Flowers yellowish. Drupe globose, succulent. Common in forest. Fl: Feb.–May Fr: Oct.–Apr. ^[8, 9].

Pongamia pinnata (L.) Pierre (Fabaceae) Od. Karanja

Tree. Bark smooth, grey. Leaves 20 cm long, ovate or oblong. Flowers purplish-white or pinkish-white. Pods woody. Seeds reddish brown. Common in coastal forest. Fl: May–Jun. Fr: Dec.–Jan. ^[8, 9].

Pterocarpus marsupium Roxb. (Fabaceae) Od. Bija, Piasal

Tree. Bark thick, grey, wood very hard, yellowish brown with darker streaks. Leaflets 5–7, oblong or elliptic. Pods suborbicular. Seeds reniform. Common in deciduous forest. Fl: Apr.–Jul. Fr: Aug.–Oct. ^[8, 9].

Pterocarpus santalinus L. (Fabaceae) Od. Raktachandan, Lal Chandan

Tree. Bark bluish-brown. Wood extremely hard. Leaflets 3, ovate, orbicular. Pods suborbicular, narrowly winged around, smooth grey silky. Found in Labanyagada forest, Gajapati district. Fl: and Fr: Oct.–Dec. ^[9].

Pterospermum canescens Roxb. (Sterculiaceae) Od. Muchukunda, Bailo

Tree. Leaves oblong, obovate. Flowers white. Capsule oblong-terete. Seeds compressed with large terminal wing. Found in Labanyagada forest, Gajapati district. Fl: Mar.–May Fr: May–Dec. ^[9].

Sapindus trifoliata L. (Sapindaceae) Od. Mukttamanja

Tree. Leaflets 2–3 pairs, elliptic-lanceolate, shining above. Fruits of 3 drupels ferruginous. Found in south forest. Fl: and Fr: Apr.–May ^[9].

Sebastiania chamaelea (L.) Muell.–Arg. (Euphorbiaceae)

Herb. Angled stems. Leaves linear. Flowers yellow. Capsule 3-lobed. Weed in cultivated ground. Fl: and Fr: Most part of the year ^[9].

Semecarpus anacardium L. f. (Anacardiaceae) Od. Bhalia, Kalabhalia

Tree. Leaves obovate or oblong. Flowers dull greenish-yellow. Drupe oblong, black when ripe. Common in forest. Fl: Jun.–Sep. Fr: Nov.–Dec. ^[8, 9].

Sida cordata (Burm. f.) Borssum (Malvaceae) Od. Bajramuli

Herb. Leaves ovate to suborbicular. Few flowered racemes by development of an accessory bud. Seeds ovoid. Common weed. Fl: and Fr: Throughout the year ^[8, 9].

Smilax zeylanica L. (Smilacaceae) Od. Muturi, Ramdantari

Climber. Leaves ovate-oblong, elliptic, orbicular, long, rounded with thickened tips. Berry globose. Seeds biconvex. Common in forest. Fl: Apr.–Jul. Fr: Oct.–Jan. ^[9].

Streblus aspera Lour. (Moraceae) Od. Sahada

Tree. Bark rough, light grey. Leaves shortly petioled, ovate, acute, stiff, scabrid on both sides. Flowers 6–8. Fruits yellow, globose. Common in open forest. Fl: Mar.–Apr. Fr: May–Jun. ^[9].

Strychnos nuxvomica L. (Strychnaceae) Od. Kochila

Tree. Bark smooth, grey. Leaves ovate, suborbicular, rounded. Flowers white or greenish-white. Berry bright orange, globose. Seeds several, discoid, grey. Common in coastal forest. Fl: Mar.–Apr. Fr: Dec.–Jan. ^[9].

Strychnos potatorum L. f. (Strychnaceae) Od. Kataka

Tree. Bark blackish, cracked. Leaves elliptic, ovate. Flowers white, fragrant. Berry globose. Seed 1, large. Found in mixed forest. Fl: May Fr: Oct.–Dec. ^[9].

Tectona grandis L. f. (Verbenaceae) Od. Saguan

Tree. Bark light brown. Leaves large, obovate. Flowers white, short pedicelled. Drupe subglobose. Widely planted in

southern part of the state. Fl: Jul.–Aug. Fr: Nov.–Jan. ^[9]

Terminalia bellerica (Gaertn.) Roxb. (Combretaceae) Od. Bahada

Tree. Bark dark grey. Leaves alternate, obovate, rounded. Flowers greenish–white or greenish–yellow. Drupe subglobose or pyriform. Common in sal and mixed forest. Fl: Mar.–May Fr: Oct.–Dec. ^[8, 9]

Toddalia asiatica (L.) Lam. (Rutaceae) Od. Tundapoda

Shrub. Leaves 3–foliolate, ovate–oblong or lanceolate. Flowers white or yellowish, small. Berry orange, globose. Common in hilly forest. Fl: and Fr: Aug.–Apr. ^[9]

Triumfetta pentandra A. Rich. (Tiliaceae) Od. Bachua

Herb. Simple hairs. Leaves ovate, orbicular. Flowers yellow, small. Capsule ovoid. Common weed. Found in hilly forest. Fl: Aug.–Sep. Fr: Oct.–Nov. ^[9]

Urginea indica (Roxb.) Kunth (Liliaceae) Od. Banapiaja, Ban uli, Kendai

Herb. Bulb globose–ovoid, grey, fleshy scales. Leaves linear, flat, acute. Very lax–flowered. Capsule ovoid–oblong. Frequent in open forest. Fl: Mar.–May Fr: May–Jul. ^[9]

Vanda tassellata (Roxb.) Hook. ex G. Don (Orchidaceae) Od. Rasna, Malang, Banki

Herb. Leaves linear–oblong. Flowers greenish–yellow. Capsule oblong. Common epiphyte. Found in forest. Fl: Mar.–Aug. Fr: May–Mar. ^[8, 9]

Vanda testacea (Lindl.) Reichb. f. (Orchidaceae) Od. Bana Malanga

Herb. Leaves linear. Peduncle few flowered. Flowers yellow with pink, bluish lip. Capsule oblong–elliptic. Common epiphyte. Frequent in sandalwood forest. Fl: Apr. Fr: May–Dec. ^[9]

Xylia xylocarpa (Roxb.) Taub. (Mimosaceae) Od. Tangal, Tangini, Bana Khira, Kat sialhi

Tree. Leaves 2–pinnate. Petiole 3 cm long with a gland at the tip. Flowers yellowish–white. Seeds brown. Frequent in forest. Fl: Apr.–May Fr: Nov.–Apr. ^[9]

Ziziphus oenopia (L.) Mill. (Rhamnaceae) Od. Kanteikoli

Climber. Trunk armed with large conical spine–tipped woody bosses. Leaves ovate, lanceolate. Drupe black, globose. Common in dry forest. Fl: Jun.–Sep. Fr: Oct.–Jan. ^[8, 9]

5. Discussion

The newspapers flash headlines of red sandalwood smuggling almost every month. Smugglers transported red woods illegally out of Odisha. By bringing awareness and controlling the smuggling this valuable plant can be saved. Forest department of Odisha engaging the local tribal people for watching and observing the trees at night with open lamp. As these plants are sensitive to fire, appropriate precautions should be taken to protect it from hazard.

Since, sandal trees have been successfully established in Nepal in very limited period and a new sandal forest was created by plantations only ^[10]. So, on the basis of plantation methods and use of modern techniques another red sandal forests can be created artificially at the start of the monsoon season.

6. Conclusion

The present study suggests that red sandal wood forests degraded by cutting of trees for timber and cattle grazing can be restored by providing protection, which helps in the regeneration process. Conservation of this forests will definitely help for improve the condition of the environment and the economic status of the local people. The information provided in this paper shall help the scientists, research scholars and herbalists for further critical studies and development of eco-friendly medicine for better health.

7. Acknowledgements

The author is thankful to the Head, Department of Botany, Berhampur University, Berhampur, Ganjam, Odisha for laboratory and herbarium facilities and thanks to the Forest Department, Government of Odisha for permission and facilities.

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