

Indigenous Knowledge and Practices on Conservation of Natural Resources by Tribal Communities of Koraput District, Odisha, India

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ABSTRACT

Natural resources provide the life support system for all life forms on the earth. In order to understand the indigenous knowledge and practices on conservation of resources, present study was carried out in villages located in five tribal blocks with 300 local tribal people and three sacred grooves through field studies and structured interviews. It was noted that tribal communities protect 66 plant species distributed among 63 genera and 42 different families because of their medicinal values based on long experience. Further, 54 plant species (25 trees, 20 herbs, 03 shrubs and 6 climber) were conserved as foods resources. Though a number of tribal communities were found to be involved in the conservation process linked to their cultural and religious beliefs, Parija was the most dominant tribe. Further tribal communities were observed to conserve soil, water and vegetation through various means such as stone bunding, stone cum vegetation bunding, Jhola Kunds, terrace farming. The philosophy of environmental sustainability

behind conservation has been discussed.

Keywords : Conservation, Tribes, Sacred grooves natural resource, Sustainability.

INTRODUCTION

Nature is vital for sustaining life on the planet earth that happens to be a treasure house of innumerable resources such as, soil, water, vegetation, wild life, minerals. Evolution of humankind is closely associated with nature and environment. However due to population over growth and increase in demand, these natural resources are under tremendous pressure (Sahoo *et al.* 2016, Singh 2017) that has led to their degradation to a great extent.

The epistemology of early human societies as well as many of the present day tribals and rural communities has developed due to close interaction with their ecosystems. Soe cological knowledge of these societies has facilitated their harmonious living with nature. As such, their traditional ecological /indigenous knowledge has been the principle behind natural source conservation and environmental sustainability.

The largest concentration of tribal communities living in the world after Africa is in India forming about eight percent (Roy 2010) of the country's total population. Odisha with a tribal population of 22 % harbors 62 different tribal communities (Sinha and Lakra 2005) who live mostly in the hills and dense

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forests and depend on forest resources including upland agriculture for their livelihood.

The studies on indigenous practices of conservation of natural resources by tribals of Koraput district by earlier workers (Franco *et. al.* 2009, Bisoian and Panda 2015) are incomplete and scanty. Consequently, many indigenous practices relating to conservation of resources left unnoticed demand their study. Under this background the present study was conceptualized to study and document the indigenous knowledge and innovative practices on conservation of resources from tribal areas of Koraput for their analysis and replication.

MATERIALS AND METHODS

Study site

Koraput, the Southern most district of Odisha state lies between 18° 14' to 19° 14' N latitude and 82° 05' to 83° 25' E longitude with a total geographical area of about 8,807 sq km (amounting to about 5.38% of the state area), Physio-graphically, it is contiguous to the main land of Eastern Ghats high land zone and South-Eastern Ghats zone. It is bounded by Rayagada district of Odisha and Srikakulam district of Andhra Pradesh in the East, by Bastar district of Chhatisgarh in the West, Nabarangpur district of Orissa in the North and Malkangiri district of Orissa and Visakhapatnam district of Andhra Pradesh in the South (Fig. 1). The general topography area is of broken mountains interrupted by large riverbeds and water courses. The altitude varies from 500 M on Western side to 1600 M on the eastern side with mountain peaks and ridges. Deomali, the highest mountainous peak (1672 M) of Orissa found in this district. Sandy and clay type soils predominate in the entire district. The climate in major part of the district is influenced by its varied elevations. It receives about 1500 mm rainfall annually from southwest monsoon between July to September. Generally humidity is very high especially in the monsoon and post monsoon months.

Development of questionnaire and collection of data

The study was participatory in nature. During the

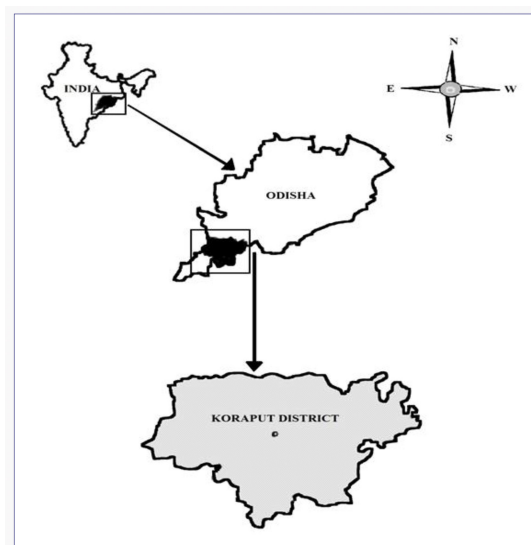


Fig. 1. Location Map of study area (Koraput), Odisha.

study, fast hand informations were collected through field visits to different tribal localities (villages). Open and structured interviews were conducted with the use of questionnaire for collection of data.

The questionnaire was developed in consultation with experts working in the field for collecting qualitative data. It included question items on conservation of water, soil, and plant biodiversity including sacred groves intertwined with the culture/belief of tribal society. The questions also included local name of the plant, plant part(s) used, nature of use and mode of conservation.

Before visiting the field, basic information on the socio-cultural as well as status of different of different tribal groups were gathered from the Council of Analytical and Tribal Studies, Koraput. Field studies were undertaken in different times of the year, between August 2018 to March 2019 to selected tribal villages of Similiguda, Laxmipur, Kundra and Boipariguda blocks of Koraput and the researches discussed with the local community members and collected information about conservation methods followed with the support from community leaders.

Observation and documentation

Five tribal villages from each block were randomly

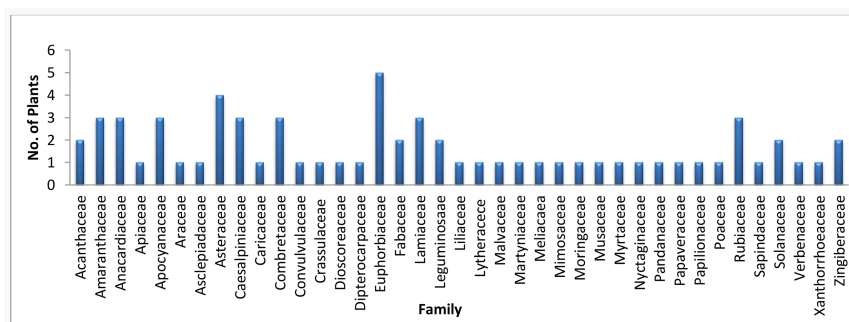


Fig. 2. Conservation of ethno-medicinal plants according to family.

selected and about 300 tribal people constituting about 20% of each tribal group with the age group of 45-60 years were consulted. All the gathered information were cross-checked with people of other nearby locality wherever possible.

Three sacred groves were randomly selected from the study site and were documented in terms of their size and location of the grove, rituals performed in the groves, deity worshiped, rules of access and its biodiversity. GPS reading was taken from the respective study site.

The plant species protected within the grove and specific benefits obtained from those by the local people were also documented. For each sacred grove, information relating to local name of the plant, parts used, nature of use and method of conservation, traditional beliefs associated with plants were recorded. Efforts were made to collect plant specimen as far as possible in flowering/ fruiting conditions and were provisionally identified with support from local community members. In order to make sure, plant specimens were collected and taken to Laboratory in Department of Botany, Regional Institute of Education, Bhubaneswar for further identification following the "Flora of Odisha" (Saxena and Brahman 1996).

RESULTS AND DISCUSSION

Tribal communities residing in the forests do have their socio-cultural life associated with nature and natural resources. From the forest ecosystem they

derive their food, fodder, fuel wood, medicines. However with modernity and degradation of forests, the diversity in plant and animal resources is declining at a fast rate. However, still ethnic groups continue to preserve their age old knowledge and experiences through practice and try to pass those to the next generation.

Conservation of plants through ethno-medicinal practices and food values

Plants identified being used as medicines included a total of 66 species (Table 1) distributed in 66 genera belonging to 42 different families of which Euphorbiaceae, Asteraceae, Anacardiaceae and Amaranthaceae were the important families (Fig. 2). The ethno-medicinal plant species includes 22 trees, 16 shrubs and 26 herbs and 2 climbers/creepers. Various plant parts such as seed, fruit, root, tuber, leaf were used in the treatment of various diseases and infections (Fig. 3). Tribes using plants for various treatments has been listed. *Paraja* was the most important tribe having associated with strong ethno-medicinal knowledge. The pharmaceutical study on the therapeutic uses of different plants may provide a great potential for rediscovering of new drugs and promote awareness among the people to use those on remedy of health care system.

A total of 54 plant species were recorded as food resources used by tribal people of the area studied (Table 2). Among the plant species, there were 25 trees, 20 herbs, 3 shrubs, and 6 climbers/creepers (Fig. 4). Maximum number of wild food

Table 1. List of major ethno-medicinal plants conserved by tribal community.

Sl. No.	Name of the plant	Family	Common name (E/O)	Parts use	Medicinal value	Tribe associated
1.	<i>Achyranthes aspera</i> L.	Amaranthaceae	Prickly Chaff flower/Apamaranga	Leaf	Medicine for vomiting and dysentery	Faaja, Adivasi, Dombo
2.	<i>Aegle marmelas</i> L.	Rutaceae	Wood apple/Bela	Leaf	Medicine for stomach disorder and proenote digestion	Kandha, Paraja
3.	<i>Aerva lantana</i> (L.) Juss	Amaranthaceae	Mountain Knot Grass/Paunsia	Leaf	Medicine for swelling and eye diseases	Bhumia, Adibasiv
4.	<i>Ageratum conyzoides</i> L.	Asteraceae	Goat weed Pokasunga	Leaf	Medicine for scabies and ring worm	Kandha, Paraja, Mali
5.	<i>Aloe vera</i> (L.) Burm f.	Xanthorrhoeaceae	Aloe vera/Ghikuanri	Leaf	Medicine burn injury, dysentery & skin diseases	Paraja, Kandha, Adivasi, Gadaba
6.	<i>Amaranthus tricolor</i> L.	Amaranthaceae	Chinese spinach/Lal Khada	Leaf	The leaf is used as vegetable against anaemia	Dora, Paika, Kandha
7.	<i>Anacardium occidentale</i> L.	Anacardiaceae	Cahsew/Bhalila	Seed	Oil from the seed is applied to spine affected wound followed by heat treatment for easy relief	Paraja, Paika, Adivasi, Rana
8.	<i>Andrographis paniculata</i> (Burm f.) Nees	Acanthaceae	Creat/Bhuimnimba	Leaf whole plant	Medicine for skin diseases, scabies & worm infection	Paraja, Bhumia, Mali, Gadaba
9.	<i>Argemone mexicana</i> L.	Papaveraceae	Mexican Prickly Poppy/Agara	Latex	Latex is massaged on body to get relieve of rheumatic pain	Gouda, Sundi, Bhatra
10.	<i>Asparagus recemosus</i> Willd.	Liliaceae	Satabari	Tuber	Medicine for joint pain	Paraja, Kandha
11.	<i>Azadiracta indica</i> L.	Meliaceae	Neem tree	Leaf	Leaf and bark of the plant used Medicine for skin disease and mouth disorder	Dora, Paraja, Bhumia, Gadaba, Kandha
12.	<i>Bauhinia variegata</i> L.	Caesalpiniaceae	Kachnor/ Kanchan	Flower leaf	Medicine for stomach disorder, disrrhoea and intestinal worm	Gadaba, Kandha
13.	<i>Biden pilosa</i> L.	Asteraceae	Spanish needle	Leaf	Medicine for toothache and leg ulcer	Paraja, Rana, Gouda
14.	<i>Blumea lacera</i> L.	Asteraceae	Kakronda	Leaf	Medicine for scabies and ring worm	Bhumia, Kandha
15.	<i>Buchanania cochinchinensis</i> (Lour.) M.R.Almeida	Anacardiaceae	Chironji Tree/Charkoli	Leaf, Fruit	Leaf is used medicine for wound and fruit is used as medicine for constipation & headache	Bhumia
16.	<i>Calotropis gigantea</i> L.	Asclepiadaceae	Giant milk-weed	Latex	Latex used for cure chronic fever and snake bite	Paraja, Gadaba, Mali
17.	<i>Carica papaya</i> L.	Caricaceae	Papaya/Amrutabhandha	Fruit	For lactation in mother, the fruit is cooked and given in diet	Adivasi, Kandha
18.	<i>Cassia occidentalis</i> L.	Caesalpiniaceae	Coffee senna/ chakunda	Leaf	Leaf pest is instant medicine for wound	Paraja, Dora, Dombo
19.	<i>Centella asiatica</i> L.	Apiaceae	Indian Penny wart/Thalkudi	Leaf	Medicine for stomach disorder and asthma	Kandha, Gadaba, Rana
20.	<i>Citrus aurantifolia</i> Christm.	Rutaceae	Lime/Lembu	Fruit, Leaf	Fruit is Medicine for vomiting and Leaf pest is for headache	Paraja, Bhumia, Kandha, Dombo
21.	<i>Clitoria ternatea</i> L.	Fabaceae	butterfly pea/Aparajita	Root	Medicine for stomach disorder	Gadaba
22.	<i>Colocasia esculenta</i> L.	Araceae	Elephant ear taro/Saru	Tuber	Tuber pest is medicine to cure boils	Adivasi, Bhumia

Table 1. Continued.

Sl. No.	Name of the plants	Family	Common name (F/O)	Parts	Medicinal value	Tribe associated use
23.	<i>Cullen corylifolium</i> (L.) Medik.	Leguminosae	Babchi/Bakuchi	Seed	Medicine for skin diseases & worm infection	Gadaba, Bhumia
24.	<i>Curcuma aromatic</i> Salisb.	Zingiberaceae	Wild turmeric/Ban haladi	Leaf	Instant medicine for wound	Gadaba, Paraja
25.	<i>Cymbopogon flexuosus</i> (Nees ex Steud.) W.Watson	Poaceae	Lemon grass	Leaf, whole plant	Medicinal oil is prepared for joint pain	Bhumia, Kandha, Koya
26.	<i>Datura stramonium</i> L.	Solanaceae	Jimsonweed/Dudura	Flower, leaves.	The flowers and young leaves are rolled and sundried. The smoke of the dried material is taken to cure asthma	Gadaba, Dombo
27.	<i>Dioscorea pentaphylla</i> L.	Dioscoreaceae	Five Leaf Yam/Masia kanda	Tuber	Medicine for swelling and joint pain	Bhumia, Bhatra, Koya
28.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Asthma plant/Chitakutei	Leaf	Medicine for dysentery	Kandha
29.	<i>Euphorbia antiquorum</i> L.	Euphorbiaceae	Triangular Spurge/Siju	Latex	Latex of the plant along with castor oil applied on the body for to relief from pain	Paraja, Paika, Adivasi
30.	<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Sm.	Apocynaceae	Gymnema/Gudamari	Leaf, Bark	Medicine for dandruff & skin diseases	Gadaba, Paraja
31.	<i>Hibiscus rosasinensis</i> L.	Malvaceae	China rose/Mandar	Leaf	Leaf pest is used as medicine for hair disorders	Bhumia, Bhatra
32.	<i>Harpullia arborea</i> (Blanco) Radlk.	Sapindaceae	Tulip-Wood Tree/Patuli	Seed	Medicine for rheumatism	Koya, Durua, Bhumia
33.	<i>Ipomoea mauritiana</i> Jacq	Convolvulaceae	Giant Potato/merdamali	tuber	Medicine for headach	Bhumia, Koya
34.	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	bellyache bush/Baigia	Leaf, seed latex	Medicine for eczema and itches	Kandha, Paraja
35.	<i>Justicia adhatod</i> L.	Acanthaceae	Malbar nut/Basanga	Leaf	Medicine for asthma and vomiting	Bhumia, Bhatra, Koya
36.	<i>Kalanchoe lanceolata</i> L. (DC)	Crassulaceae	Kalanchoe	Leaf	Medicine for diarrhoea	Gadaba, Paraja
37.	<i>Lannea coromandelica</i> Houtt.	Anacardiaceae	Indian Ash tree	Leaf	Medicine for mouth disorder	Mali, Paraja, Paika
38.	<i>Lantana camara</i> L.	Verbenaceae	Wild sage/Nagaari	Leaf, Flower	Medicine for joint pain	Gadaba, Bhumia
39.	<i>Lawsonia inermis</i> L.	Lythraceae	Henna	Root	Medicine for jaundice and abdominal pain	Durua, Bhatra
40.	<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Thummi (Gayasa)	Leaf	Leaf pest taken orally to cure fever/malaria	Paraja, Adivasi
41.	<i>Martynia annua</i> L.	Martyniaceae	Tiger's Claw/Baghanakhi	Leaf	Medicine for face swelling and throat infection	Gadaba, Mali Adivasi
42.	<i>Mimosa pudica</i> L.	Mimosaceae	touch me not/Lajakuli	Root	Root is used as medicine for tooth pain and snake bite	Paraja, Gadaba, Durua
43.	<i>Mirabilis jalapa</i> L.	Nyctaginaceae	Four o'clock plant	Tuber	Grounded tuber is taken as medicine for fever and stomach pain	Gadaba
44.	<i>Moringa Oleifera</i> Lam.	Moringaceae	Drum stick/Sajana	Leaf	The leaf juice is taken to cure cold	Gadaba, Gouda, Dombo
45.	<i>Murraya koenigii</i> L.	Rutaceae	Curry Leaf Tree/Brusanga	Leaf	Medicine for dysentery	Kandha, Dombo
46.	<i>Musa paradisiacal</i> L.	Musaceae	Banana/Kadali	Root	Root pest is applied on forehead to relief headache	Paraja, Adivasi, Paika

Table 1. Continued.

Sl.	Name of the plant	Family	Common name (E/O)	Parts use	Medicinal value	Tribe associated
47.	<i>Ocimum sanctum</i> L.	Lamiaceae	Sacred basil	Leaf	Medicine for cold	Paraja, Bhumia Gadaba, Kandha
48.	<i>Paederia foetida</i> L.	Rubiaceae	Skunkvine/ Pasaruni	Leaf	Medicine for dyscentry, stomachach & worm infection	Bhumia, Durua
49.	<i>Pandanus foetidus</i> Roxb.	Pandanaceae	Screw pine/Kia	Root	Medicine for skin diseases	Paraja, Rana
50.	<i>Phyllanthus emblica</i> L.	Euphorbiaceae	Amla/Aanla	Seed	Medicine for indigestion	Paraja, Bhumia, Mali
51.	<i>Plumeria rubra</i>	Apocyanaceae	Temple tree/Katha Champa	Bark, Flower	Medicine for cold and cough	Gadaba, Bhumia, Paraja
52.	<i>Pongamia pinnata</i> L.	Fabaceae	Indian beach Karanja	Seed	Oil is prepared from seeds apply in hair for strongness and also in skin for prevent- ing skin disease and mosquito bite	Paraja, Gadaba Bhumia, Knadha, Dombo etc
53.	<i>Psidium guajava</i> L.	Myrtaceae	Guava/Pijuli	Fruit	Tender fruit are taken orally for dysentery/blood dysentery	Gadaba
54.	<i>Rauvolfia serpentine</i> L.	Apocynaceae	Serpentine root/Patala garuda	Root	Medicine for bowel pain	Paraja, Kandha Dombo, Gadaba, Bhumia etc.
55.	<i>Ricinus communis</i> L.	Euphorbiaceae	Castor /Jada	Seed	The oil extracted from seeds is locally applied in hand, legs and head to get relieved from pain.	Gadaba, Paraja
56.	<i>Sesbania grandiflora</i> (L.) Pers.	Papilionaceae	Hummingbird tree/Agasti	Fruit, Leaf	Fruit paste is used to cure fever. Cooked leaf is taken as a vegetable against night blindness	Paraja
57.	<i>Shorea robusta</i> Roth.	Dipterocarpaceae	Sal tree/Sala	Seed	Medicine for cold	Bhumia, Koya, Bhatra
58.	<i>Solanum nigrum</i> L.	Solanaceae	Black nightshad/B heji baigana	Seed, Leaf	Seeds used for teeth pain and leaf for asthma	Gadaba, Paraja
59.	<i>Tamarindus indica</i> L.	Caesalpiniaceae	Tamarind plant /Tentuli	Seed Tester	Medicine for digestion	Paraja, Mali
60.	<i>Tectona grandis</i> L.f.	Lamiaceae	Teak/Saguan	Seed	Medicine for diarrhoea & Dysentery	Bhumia, Durua, Bhatra
61.	<i>Terminalia arjuna</i> Roxb.	Combretaceae	Arjuna tree	Bark	Bark of the tree is roasted in warm water for drinking which cures stomach disease	Kandha, Dombo
62.	<i>Terminalia belirica</i> Gaertn.	Combretaceae	Belericmyrobalan/B ahara	Fruit	Medicine for jaundice	Paraja, Gadaba Bhumia
63.	<i>Terminalia chebula</i> Retz.	Combretaceae	Chebolicmyrobalan/H	Fruit	Medicine for stomach disease	Paraja, Gadaba, Bhumia, Kandha, Adivasi
64.	<i>Tridax procumbens</i> L.	Asteraceae	Coat button/ Bisalyakarani	Leaf	Leaf juice is used as instant medicine for wound	Gadaba, Paraja. Dombo, Dora
65.	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Zinger/Aada	Tuber	Medicine for cold, cough & indigestion	Paraja, Bhumia, Gadaba, Knadha, Mali etc.
66.	<i>Xylocarpus xylocarpa</i> (Roxb.) Taub.	Leguminosae	Burma Ironwood/ Tangia chinha	Bark	Bark of the plant is boiled and applied on wound occurred by iron weapons	Paraja, Rana Adivasi

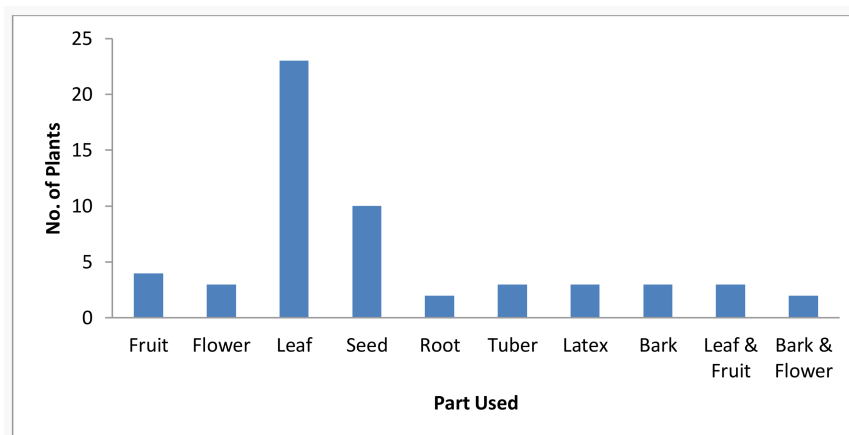


Fig. 3. Plant part used/conserved for ethno-medicinal practices.

plants recorded belonged to families, Amaranthaceae, Moraceae and Dioscoreaceae (Fig. 5). Leaf, fruit, tuber and shoots were commonly used as sources of food which mode of consumption has been reflected in Table 2. Most of these plant parts are consumed regularly whereas others like bamboo seeds only during emergency situation or difficult period such as famine. However, over use of certain plant species is leading to their extinction. By the by traditional knowledge of food preparation(s) of various recipes is also getting eroded over time with modernity. Many of these plants growing in wild are often rich in nutrients and minerals and meet their mineral deficiency,

the cause behind hidden hunger (Neudeck *et al.* 2012, Mallick *et al.* 2017).

Conservation of plant biodiversity through sacred groves

Sacred groves are the tracts of virgin forests left untouched by the local inhabitants over generations. They harbour rich biodiversity and are protected by the local people due to their cultural and religious beliefs and taboos that deities reside in those. Sacred groves are the good source for a variety of medicinal plants, fruits, fodder, fuel wood, spices (Panda *et al.*

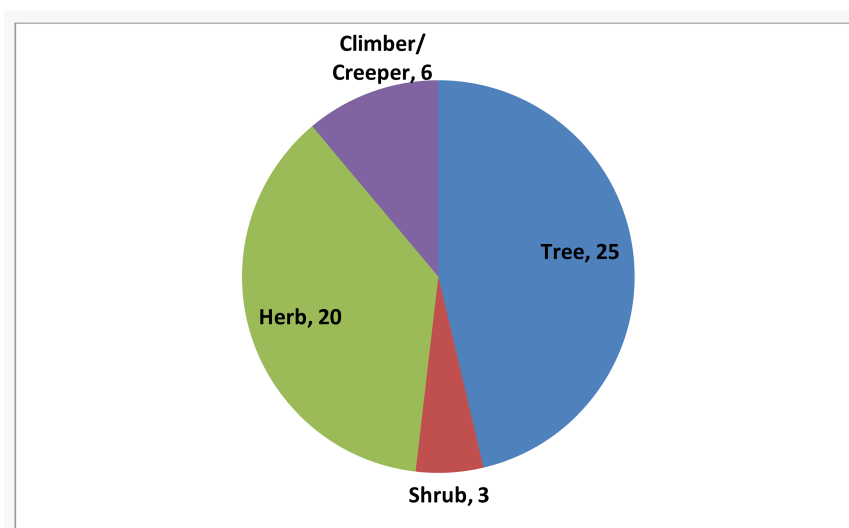


Fig. 4. Conservation of wild food plants by tribal communities.

Table 2. List of major food plants conserved by tribal communities.

Sl. No.	Name of the plant	Family	Common name	Habit	Part consumed	Mode of consumption	Tribe associated
1.	<i>Acalypha indica</i> L.	Euphorbiaceae	Indian Copperleaf/ Mukta jhuri	H	Leaf	Leaves are fried with oil, then eaten	Paraja, Bhumia
2.	<i>Achyranthes aspera</i> L.	Amaranthaceae	Prickly Chaff Flower/ Apamaranga	H	Leaf	Young leaves and shoots are collected, roasted and eaten	Gadaba, Paraja, Durua
3.	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	Bael apple/ Bela	T	Fruit	Ripe fruits is eaten raw or by cooking and often used to prepare juice/drink	Paraja, Kandha, Adivasi, Gadaba
4.	<i>Aerva lantana</i> (L.) Juss	Amaranthaceae	Mountain Knot Grass/ Paunsia	H	Leaf	Leaves are collected, fried and eaten	Kandha, Paraja, Mali
5.	<i>Alangium salviifolium</i> (L.f.) Wangerin	Alangiaceae	Ankula	T	Fruit	Arils of ripe fruits are eaten raw	Bhumia, Adivasi
6.	<i>Allmania nodiflora</i> R.Br.	Amaranthaceae	Node Flower Allmania/ Chadheimundia saga	H	Leaf	Leaves and young shoot are roasted with mustard oil and then eaten.	Dora, Paika, Kandha
7.	<i>Alternanthera ficoidea</i> (L.) Sm.	Amaranthaceae	Sanguinarea/ Bana madaranga	H	Leaf	Young leaves and shoots are collected, fried then eaten	Paraja, Paika, Adivasi, Rana
8.	<i>Alternanthera sessilis</i> L. R. Br.	Amaranthaceae	Sessile Joyweed/ Madaranga	H	Leaf	Leaves and young shoot are roasted with mustard oil and then eaten	Paraja, Bhumia, Mali, Gadaba
9.	<i>Arisaema tortuosum</i> (Wall.) Schott	Araceae/	Whipcord Cobra Lily/ Bana nada	H	Leaf, Shoot	Young shoot/Fruit stalk is fried to prepare curry and eaten	Paraja, Kandha, Bhumia, Gadaba
10.	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Jack fruit/Panasa	T	Fruit	Ripe fruits are sweet, eaten raw and the unripe fruits are used as vegetables	Gouda, Sundi, Bhatra
11.	<i>Bambusa bambos</i> (L.) Voss	Poaceae	Kanta baunsa/ Indian Throny Bamboo	T	Young shoot	Young shoots (Karada) are cut into small pieces, cooked with salt and chilly and then eaten.	Gadaba, Kandha
12.	<i>Bauhinia purpurea</i> L.	Caesalpiniaceae	Geranium tree/ Kuilar	T	Leaf, Young shoot	Young shoots along with leaces are collected, cooked as curry or fried and taken.	Paraja, Rana, Gouda
13.	<i>Bauhinia vahlii</i> L.	Caesalpiniaceae	Siali	C	Seed, Leaf	Seeds are eaten after boiling or cooked as vegetable and Young leaves are collected, cooked as curry and taken	Bhumia, Kandha
14.	<i>Bauhinia variegata</i> L.	Caesalpiniaceae	Kachnor/ Kanchan	T	Leaf	Leaves are collected, cooked as curry and taken	Bhumia
15.	<i>Buchanania lanzan</i> L.	Anacardiaceae	Charkoli	T	Fruit	Ripe fruits are consumed as berries	Paraja, Gadaba, Mali
16.	<i>Celosia argentea</i> L.	Amaranthaceae	Silver Cockscomb/ Ghurudi sag	H	Leaf	Young leaves and shoots are collected, roasted then eaten	Adivasi, Kandha
17.	<i>Centella asiatica</i> L.	Apiaceae	Indian pennywort/ Thalkudi	H	Leaf	Leaves and young shoots are collected, roasted then eaten	Paraja, Dora, Dombo
18.	<i>Chenopodium album</i> L.	Chenopodiaceae	White goosefoot/ Bathua saga	H	Leaf	Leaves and young shoots are cooked along with other vegetable adding salt and chilly to it.	Kandha, Gadaba, Rana
19.	<i>Cleome gynandra</i> L.	Cleomaceae	Spider flower/ Araka saga	H	Leaf	Leaves and young shoots are collected, roasted then eaten	Paraja, Bhumia, Kandha, Dombo
20.	<i>Cleome viscosa</i> L.	Cleomaceae	Asian spider flower/ Bana sorisa	H	Leaf	Leaves and young shoots are collected, fried/ roasted then eaten	Gadaba

Table 2. Continued.

Sl. No.	Name of the plant	Family	Common name	Habit	Part consumed	Mode of consumption	Tribe associated
21.	<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	Lvy gourd/ Kainchikakudi	C	Fruit	Fruits are consumes raw or cooked	Adivasi, Bhumia
22.	<i>Colocasia esculenta</i> (L.) Schott	Araceae	Elephant ear taro/ Saro	H	Leaf	Leaves are collected, fried with oil then eaten	Gadaba, Bhumia
23.	<i>Commelina attenuate</i> K.D.Koenig ex Vahl	Commelinaceae	Asian spider flower/ Chhena saga	H	Leaf	Leaves and young shoots are collected, fried/ roasted then eaten	Gadaba, Paraja
24.	<i>Commelina benghalensis</i> L.	Commelinaceae	Day flower/ Kansiri	H	Leaf	Leaves and young shoots are collected, fried/ roasted then eaten	Bhumia, Kandha Koya
25.	<i>Cordia dichotoma</i> G.Forst	Boraginaceae	Guakoli	T	Fruit	ripe fruits are commonly eaten as berries	Gadaba, Dombo
26.	<i>Dioscorea alata</i> L.	Dioscoreaceae	Asiatic yam/ Khambalu	C	Tuber	Tuber Consumed after boiling or cooked with other vegetables	Bhumia, Bhatra, Koya
27.	<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	Air yam/ Pita kanda	C	Tuber	Tubers are kept in water for a long time then boiled/cooked and eaten	Kandha
28.	<i>Dioscorea pentaphyla</i> L.	Dioscoreaceae	Five Leaf Yam/ Masia kanda	C	Tuber	Tubers are eaten by cooking as vegetable	Paraja, Paika, Adivasi
29.	<i>Dioscorea tomentosa</i> L.	Dioscoreaceae	Taraga kanda	C	Tuber	Tubers are boiled, then cooked and eaten	Gadaba, Paraja
30.	<i>Diospyros malabarica</i> (Desr.) Kostel	Ebenaceae	Gaun persimmon/ Mankada kendu	T	Fruit	Ripe fruits, though emit a bad smell, are occasionally eaten by tribals during food shortage.	Bhumia, Bhatra
31.	<i>Diospyros melanoxylon</i> Roxb.	Ebenaceae	Coromandel Ebony persimmon /Kendu	T	Fruit	Ripe fruits are sweet in taste and eaten as raw	Koya, Durua, Bhumia
32.	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Asteraceae	Purple Sow Thistle/ Musakani sag	H	Leaf	Tender leaves and young shoots are collected, cooked then eaten	Bhumia, Koya
33.	<i>Ficus benghalensis</i> L.	Moraceae	Banyan/ Bara	T	Fruit	Ripe fruits are consumed during food scarcity	Kandha, Paraja
34.	<i>Ficus hispida</i> L.	Moraceae	Dimiri	T	Fruit	Ripe fruits are consumed as raw	Bhumia, Bhatra,
35.	<i>Ficus recemosa</i> L.	Moraceae	Clister fig tree/ Goolar	T	Fruits	Ripe fruits are eaten as raw	Gadaba, Paraja
36.	<i>Grewia asiatica</i> L.	Tiliaceae	Pharsakoli	T	Fruit	Ripe fruits are eaten as berries	Mali, Paraja, Paika
37.	<i>Hibiscus sabdariffa</i> L.	Malvaceae	Roselle/ Kanuria/Khatapalanga	H	Leaf	The leaves are very sour in taste. So, leaves are collected, cooked with water and other vegetables to prepare sour water 'sambar'	Gadaba, Bhumia
38.	<i>Wrightia antidysenterica</i> (L.) R.Br.	Apocyanaceae	Kuruchi	T	Flower	Flower is eaten after frying or roasting	Kandha, Bhumia
39.	<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Common Leucas/ Gayisa	H	Laef	Leaves are eaten after frying or roasting	Durua, Bhatra
40.	<i>Limonia acidissima</i> Groff	Rutaceae	Wood Apple/ Kaintha	T	Fruit	The pulp of ripe fruits are sour in taste and used to prepare chutney and often eaten as raw	Paraja, Adivasi
41.	<i>Madhuca longifolia</i> (J.Koenig ex L.) J.F. Macbr.	Sapotaceae	Indian Butter Tree/ Mahula	T	Flower	Flowers eaten raw, after frying/ baking, used for preparation of liquor	Gadaba, Mali, Adivasi
42.	<i>Manilkara hexandra</i> (Roxb.) Dubard	Sapotaceae	milk tree/ Khirakoli	T	Fruit	Ripe fruits are eaten fresh as berries	Paraja, Gadaba, Durua

Table 2. Continued.

Sl. No.	Name of the plant	Family	Common name	Habit	Part consumed	Mode of consumption	Tribe associated
43.	<i>Mitracarpus hirtus</i> (L.) DC.	Rubiaceae	tropical girdlepod/ Ganthia sag	H	Leaf	Leaves are boiled with water and then eaten	Gadaba
44.	<i>Moringa oleifera</i> Lam.	Moraginaceae	Drum stick/ Sajana	T	Leaf, Fruit	Leaves are eaten after frying and also added to curries and fruit is also commonly used as vegetable to prepare curries or can be eaten by frying	Gadaba, Gouda Dombo
45.	<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	Date palm/ Khajuri	T	Fruit	Ripe fruits are sweet, eaten raw and can be preserved to prepare jellies/jams	Kandha, Dombo
46.	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Indian Gooseberry/ Amla	T	Fruit	Fruit is eaten raw as berries and used to prepare pickles/ jellies	Paraja, Adivasi, Paika
47.	<i>Sesbania grandiflora</i> (L.) Pers.	Papilionaceae	hummingbird tree/Agasti	T	Flower	Flower is eaten by frying with other vegetable	Paraja, Dombo
48.	<i>Solanum torvum</i> Sw.	Solanaceae	Dengabheji	S	Tender fruits	Young fruits fried with ghee or oil is eaten as a vegetable	Paraja, Bhumia, Gadaba, Kandha
49.	<i>Syzygium cumini</i> (L.) Skeets	Myrtaceae	Java plum/ Jamu	T	Fruit	Ripe fruits are widely eaten as berries	Bhumia, Durua
50.	<i>Talinum portulacifolium</i> (Forssk.) Asch. ex Schweinf.	Talinaceae	Ceylon Spinach/Matipoi	H	Leaf	Leaves are collected fried with other vegetable then eaten	Paraja, Gadaba,
51.	<i>Tamarindus indica</i> L.	Fabaceae	Tamarind/Tentuli	T	Fruit, Leaf	Fruit and seed are used to prepare sour curries	All Tribe
52.	<i>Terminalia belirica</i> Gaertn.	Combretaceae	Belericmyrobalan/B ahara	T	Seed	Seeds are fried with vegetables or boiled for consumption	Bhumia, Durua, Adivasi
53.	<i>Trapa natans</i> var <i>bispinosa</i> (Roxb.) Makino	Lythraceae	Water Chestnut/ Pani singada	H	Fruit	The nuts are eaten raw when fresh or consumed after cooking or boiling.	Paraja, Rana
54.	<i>Ziziphus oenoplia</i> (L.) Mill.	Rhamnaceae	Jackal jujube/ Kanteikoli	S	Fruit	Ripe fruits are eaten raw mostly by the children as it is sweet and acidic in taste	Paraja, Bhumia, Mali

2014, Bisoi and Panda 2015).

The traditional system of conservation such as sacred sites have gained much importance today. In India there are about 13,720 sacred groves of which 2,163 are seen in Odisha (Amirthalingam 2016, Gadgil 2018). Of the 322 sacred groves in Koraput district, 3 sacred groves has been documented in the present study (Table 3). The sacred groves are very rich in plant and animals (bird, insects, frogs, snakes and other small animals) resources. These sacred groves have been conserved over generations together. Besides serving as reservoir of food, medicines, many plant species are worshiped for religious purposes. Further sacred groves also provide invisible ecosys-

tem services such as pollination, nutrient recycling, biocontrol of pests, seed dispersal (Khan *et al.* 2008).

The present study on three selected sacred groves (Plate 1a and b) of Koraput district revealed that 64 plant species are conserved distributed in 53 genera belonging to 44 different families. The conserved sacred plant species included 25 trees, 16 shrubs, 13 herbs and 10 climbers/creepers protected by the local tribal communities in the name of their deity: *Azadiracta indica*, *Ficus racemosa*, *Ficus religiosa*, *Bombax ceiba*, *Mangifera indica*, *Diospyros malabarica*, *Pocarpus marsupium*, *Syzygium cumini*, *Melia azedarac*, *Pterocarpus marsupium*, *Terminalia belirica* and *Phyllanthus emblica* are the major plant

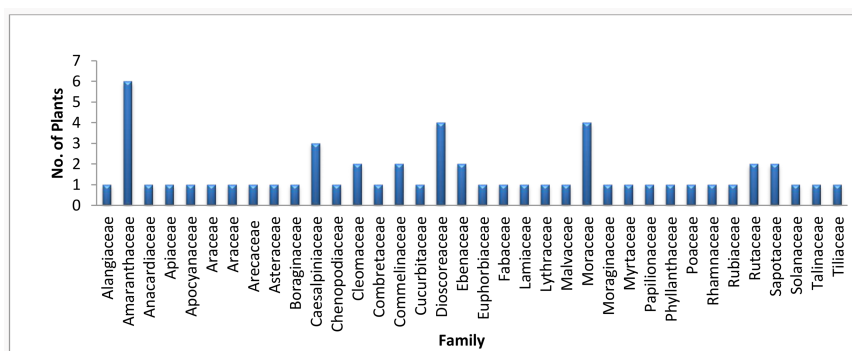


Figure 5. Conservation of food plants according to family.

species found to be conserved within the groves. List of some important plant species conserved in sacred grove are presented in Table 4. Singh *et al.* (2006) has observed life long experience and indigenous strategies for conservation of Paisang tree by Monpa tribe in eastern Himalayan region.

Conservation practices associated with water, soil and farming system

Stone bunding

It is observed that water moving down the hill in high

speed, removes the upper soil reducing its fertility. Hence, small embankments are constructed by tribal people along the field boundary and sometimes across the slopes to check both soil erosion and siltation. Besides preventing soil erosion, it acts as a barrier to prevent animals entering into the field. This is practiced by all types of farmers on individual basis and at some places, tribal farmers construct suitable outlet to remove excess water after rainfall. They used stone sizes of 15-20 cm to construct the bunds. Often stone available inside the field are removed and used in stone bunds, which indirectly improves the soil physical condition. Besides preventing soil erosion,

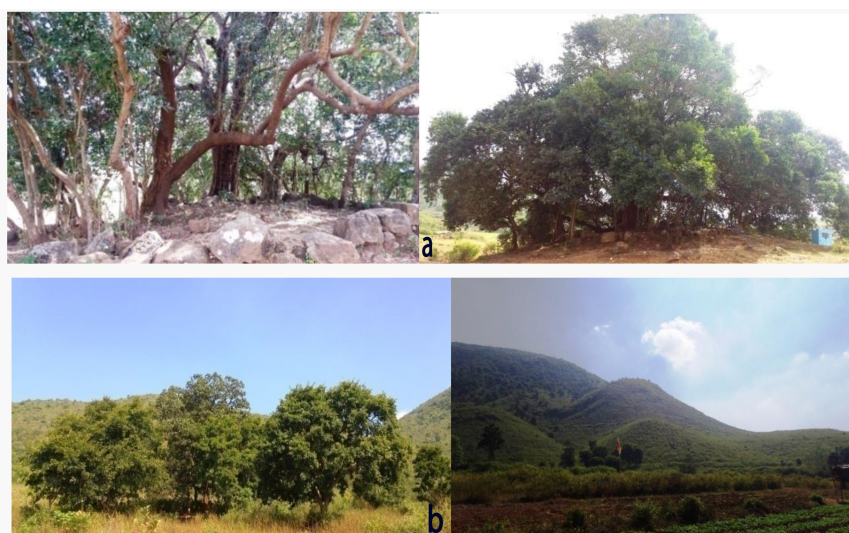


Plate 1. Conservation of plants through sacred groves (a) Mutyulama Sacred Grove, Tikiria road, (b) Gunthaguda Sacred Grove.



Plate 2. Conservation of water, soil and farming system through stone bunding (2a and b), Stone- vegetation bunding (2c) and reuse of water in tribal village (2d).

the stone built embankments (Plate 2a) hold the water for longer period on the upper side. Interestingly, when rainfall is discontinued, the low lands remain wet because of seepage.

Stone-cum-vegetation bunding

In many villages, the tribal farmers were found constructing stone-cum-vegetation bunds that help in demarcating the boundary, protecting the crop from the cattle grazing and minimize runoff and soil erosion. Vegetation/grasses on the bund not only reduce the maintenance cost of the bund but also stones are left unwashed during heavy downpour. The stored water also used for bathing purpose besides culturing small fishes. Often a special compact bunding is done with

a poisonous plant *Ipomoea carnea* (Morning Glory), that checks soil erosion as barrier and protect the crop from animal grazing. (Plate 2b).

Conservation through ‘Jhola kundi’

In many villages tribals were found to construct Jhola kundi a low cost water harvesting structure of circular shape, dug manually having a depth about 2 to 4 m and diameter of 3 m . It is constructed in Jhola land for storage of water which is utilized for purpose of cultivation . These lands are at 1 to 1.5 m lower elevation than the adjoining field. The soil removed from the Jhola kundi is deposited around the structure for making a bund that stops the entry of surface run off water to the Jhola kundi and thereby,



Plate 3a. Jhola Kund for water conservation.



Plate 3b. Terrace farming.

Table 3. Selected sacred groves of Koraput for the study with location, area and the community associated with the grove.

Sl. No.	Name of the Grove	Deity	Area (ha)	Location	Tribal community associated
1.	Mutyulama Sacred Grove, Tikiria	Maa Mutyulama	0.18	18049°27.08''N to 82042°58.68''E	Paraja, Mali, Paika
2.	Gunthaguda Sacred Grove	Jaker mahaprabhau	0.20	18050°08.60''N to 82043°15.76''E	Paraja, Kandha, Gouda
3.	Kokriguda Sacred Grove	Pat debata	0.12	180 40'33.58''N to 820 53'18.35'' E	Paraja, Dombo, Adivasi

prevents siltation. The water that percolates in to the soil keeps the surrounding field moist.

Reuse of water for agriculture

In Kokriguda village of Kunduli block, the tribal people were noticed to drain the used water to agricultural

land for irrigation purpose through a narrow canal in the middle of the village. This reflects not only sustainable utilization of water but also the innovative idea of the tribal communities (Plate 2c, 3a).

Terrace farming

Terrace farming was found to be well adopted by

Table 4. List of major plants species worshiped and conserved in Sacred Groves. T: Tree, S: Shrub, H: Herb, C: Climber/Creeper.

Sl. No.	Name of the plant	Family	English name	Local name	Habit	Importance
1.	<i>Asparagus racemosus</i> Willd.	Liliaceae		Satavari	H	Medicinal
2.	<i>Bauhinia vahlii</i> Wight & Arn.	Caesalpiniaceae	Camel's foot climber	Siali/Khali patra	C	Used for making plates and sells to market
3.	<i>Bombax ceiba</i> L.	Bombacaceae	Red Silk Cotton tree	Simili	T	Religious
4.	<i>Caesalpinia pulcherrima</i> L.	Caesalpiniaceae	Peacock flower	Radhachuda	S	Ornamental
5.	<i>Cascabela thevetia</i> (L.) Lippold	Apocynaceae	Yellow oleander	Kaniar	T	Flower used for worshiping the deity
6.	<i>Cassia fistula</i> L.	Caesalpiniaceae	Indian Laburnam	Sunari	T	Economical
7.	<i>Cassia tora</i> L.	Caesalpiniaceae		Sana chakunda	S	Food
8.	<i>Ficus benghalensis</i> L.	Moraceae	Banyan Tree	Bar	T	Religious, Food
9.	<i>Ficus religiosa</i>	Moraceae	Peepal Tree	Aswattha	T	Religious
10.	<i>Jasminum arborescens</i> Roxb	Oleaceae	Tree jasmine	Niali	S	Ornamental
11.	<i>Melia azedarach</i> L.	Meliaceae	Persian Lilac/Bead tree	Mahanimba	T	Worship by the people
12.	<i>Murraya koenigii</i> L.	Rutaceae	Curry leaf tree	Bhursunga/merisinga	S	Medicinal
13.	<i>Naringi crenulata</i> Roxb	Rutaceae		Ranveli	S	
14.	<i>Pongamia pinnata</i> L.	Fabaceae	Indian beach	Karanja	T	Oil is prepared from the seed which is apply in hair for strongness and also in skin for preventing skin diseases
15.	<i>Pterocarpus marsupium</i> Roxb.	Fabaceae	Gum-kino tree/Indian kino tree	Bija/Piasala	T	Religious
16.	<i>Schleichera oleosa</i> Lour.	Sapindaceae		Kusum	T	Medicinal oil
17.	<i>Terminalia alata</i> Willd.	Combretaceae	Sain	Sahaja	T	Economical
18.	<i>Terminalia belirica</i> Gaertn.	Combretaceae	Beleric Myrobalan	Bahada/ Bhida	T	Medicine for jaundice
19.	<i>Tridax procumbens</i> L.	Asteraceae	Coat button	Bisalyakarani	H	Medicine for wound
20.	<i>Ziziphus oenoplia</i> (L.) Mill.	Rhamnaceae	Jackal jujube	Kanteikoli/	S	Food

different tribal communities of Koraput district. This method of farming uses “steps” that are built one above the other at about 45° inclination on mountain or hill slopes. On each level/step, various crops are planted. During raining, instead of washing away all of the nutrients from the soil, the nutrients are carried down to the next lower level. Further these steps prevent a free and fast flow of water that would have removed plants with it destroying the entire ecosystem on the hillside. This system also allowed farmers to build aqueducts, that carries water to next level.

By building these terraces, tribal people have helped water to flow down and gets accumulated in each terrace. Besides rice in wet season, vegetables such as beans, ladies finger, cabbage were found-growing due to availability of moisture in the next *rabi* season (Plate 2d, 3b). Further, tribal farmers were found to have knowledge about the use of biocompost for organic farming.

The study indicates that the tribal communities have wisdom and high social values towards the natural resources particularly soil, water and vegetation. This supports the earlier observation (Singh *et al.* 2006, Malathi and Kalab 2012) that community knowledge and indigenous practices of tribals plays an important role in food security, resource management and environmental and biodiversity conservation. They continue to conserve those resources over generations through cost effective traditional way of livelihood security (Naik and Vishnuvardhan 2014). Tribal community accept plant species those are useful to them socio-economically and reject species (Franco *et al.* 2009) having simple commercial importance. Instead of top down, bottom up approach may be followed for selection of plant species in plantation cum conservation programs in tribal localities. The present study in the long run would likely to be useful for conservation purposes besides restoring traditional knowledge that are getting eroded over time. Further the experiences could be replicated for conservation purpose elsewhere as those are based on age old experiences reflecting the spirit of sustainability (WCED 1987).

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REFERENCES

- Amirthalingam M (2016) Sacred Groves of India – An overview. *Int J Curr Res in Biosci. and Pl Biol* 4: 64–74.
- Bisoi SS, Panda D (2015) Ethno-medicinal plants present in sacred groves of Koraput district of Odisha, India. *Acta Biomedica Scientia* 2 :39–42.
- Gadgil M (2018) The Sacred Groove. *Sci Am* 319 : 42-48.
- Franco FM, Narasimhan D, Stanley W (2009) Relationship between four tribal communities and their natural resources in the Koraput Region. *Ethnobot. Res and Appl*. 6: 481–485.
- Khan M, Khumbongmayum AD, Tripathi RS (2008) The Sacred Groves and their significance in conserving biodiversity : An overview. *Int J Ecol and Environm Sci* 34: 277–291.
- Malathi N, Kalab (2012) Traditional practices of tribes for the conservation of natural resources. *Int J Curr Sci* 2 : 308–310.
- Mallick SN, Naik SK, Panda PC (2017) Diversity of wild edible food plants and their contribution to livelihood of tribal people in Nabarangpur district, Odisha. *Pl Sci Res* 39 : 64–65.
- Naik NR, Vishnuvardhan Z (2014) Conservation soil and agriculture in tribal community in Nalamala forest. *Int J Sci and Res* 3: 874–876.
- Neudeck L, Avelino L, Bareetseng P, Ngwenya BN, Teketay D, Motsholapheko MR (2012) The contribution of edible wild plants to food security, dietary diversity and income of households in Shorobe village, Northern Botswana. *Ethnobot Res and Appl* 10 : 449–62.
- Panda D, Bisoi SS, Palita SK (2014) Floral diversity conservation through sacred groves of Koraput, Odisha, India. *Int Res J Environm Sci* 3 : 80-86.
- Roy BC (2010) Tribals of Orissa : The changing Socio-Economic profile. Gyan Publishing House, New Delhi, pp147.
- Sahoo HK, Mishra RC, Mukherjee AK (2016) Wild edible fruits traditionally used by tribes of Similipal Biosphere Reserve, Odisha, India. *e-Planet* 14 : 45–56.
- Saxena HO, Brahman (1996) The Flora of Orissa. Vol. (I-IV). Regional Research Laboratory. Orissa Forest Development Corporation, Bhubaneswar.
- Singh BP (2017) Biodiversity, tribal knowledge and life in India. *Environ and Social Psychol*. 2: 1-10.
- Singh RK, Singh D., Sureja AK (2006) Community knowledge and biodiversity conservation by Monpa tribe. *Ind J Traditional Knowledge* 59 : 523–528.
- Sinha R., Lakra V. (2005) Wild tribal food plants of Orissa *Ind J Traditional Knowledge* 4 : 246–252.
- WCED (1987) World Commission on Environment and Development. Our Common Future.