Diversity, Medicinal Uses and Conservation Status of Medicinal Plants at Mandaragiri, Angul Forest Division, Odisha, India

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Abstract The present paper provides the status of medicinal plant species growing in and around the tribal settlements of Mandaragiri region and emphasizes on their medicinal uses. A total number of eighty two species belonging to seventy four genera and forty families are represented as medicinal value. Species such as *Acacia catechu*, *Acacia nilotica*, *Buchanania lanzan*, *Emblia officinalis*, *Gardenia* sp., *Indigofera cassioides*, *Shorea robusta* and *Woodfordia fruticosa* are rare at Mandaragiri forest. Whereas, plants like *Rauvolfia serpentina*, *Santalum album*, *Streblus asper* and *Spondias pinnata* are endangered species at Mandaragiri forest.

Keywords Medicinal Plants, Rare, Endangered

1. Introduction

Plants are the basis of life on earth, supplying fresh oxygen and play an important role to people's livelihood. Worldwide, 422,000 seed plants are reported and more than 50,000 of them are used for medicinal purposes [1]. Besides, 85% of traditional medicine practices used in primary healthcare is derived from plants. India and China, two of the largest Asian countries, have the richest arrays of registered and relatively well known medicinal plants [2]. India is one of the twelve mega biodiversity countries of the world having rich vegetation with a various medicinal value. About 43% of plants from Indian subcontinent (approximately 7,500 species) are reported to have medicinal value [3]. Indian subcontinent is being inhabited by over 53.8 million tribal people in around 5,000 villages with 427 tribal communities dominated by forest. Among the states of India, Odisha has dense forests with natural plant resources. The tribes residing deep inside the forest are still depending on medicinal plants for their primary health care and treatment of diseases. Odisha state has 62 categories of tribes. These

ethnic communities have good acquired knowledge on medicinal uses of plants in the course of their lifetime. The rural people of the state depend on the traditional ethno-medicine for their day-to-day primary health care. These medicinal plants gain further importance in the regions where modern medical health facilities are either not available or not easily accessible.

The dialectical relationship between indigenous knowledge and practices shapes the ecosystem and affects the constituent plant populations [4]. By incorporating indigenous knowledge and use in the process of scientific research, new hypotheses for the sustainable conservation of the resources can be developed [5]. Indigenous knowledge and use have to be analyzed to develop appropriate management measures that build on both scientific and local knowledge [6]. Due to the changing perception of the local people, and the ever increasing influence of global commercialization and socio-economic transformation, indigenous knowledge on plant resource use is constantly diminishing [7, 8]. In addition to this lack of organized sustainable and scientifically monitored cultivation and harvesting management techniques, lack of awareness of social factors, the number of usefulness of plant resources is decreasing at an alarming rate [8]. The continuous exploitation of several wild medicinal plant species have resulted in population decline of many high value medicinal plants. Furthermore, the indigenous knowledge on the use of lesser known plants declines rapidly [9].

Until today, there are not any studies about the medicinal plants and their uses from the Mandaragiri region inhabitants. The present paper aims to record in detail the status of medicinal plant species growing in and around the tribal settlements of Mandaragiri region and to emphasize on their medicinal uses.

2. Study Area

The Mandaragiri forest lies between $20^{\circ} 47' 15''$ and $20^{\circ} 49' 00''$ north latitude and $85^{\circ} 1' 30''$ and $85^{\circ} 3' 30''$ east longitude in the district of Angul, Odisha, India. The Mandaragiri forest is a unique fragile ecosystem covering 586 hectares of forest land (Figures 1 & 2). The whole mountain was covered with dense forest but due to lack of protection, a rapid, large scale felling of trees occurred since 1970, diminishing the forest cover. In 1995, the people of the surrounding nine villages formed the *Mandaragiri Surakshya Manch* in order to protect the forest. Now the mountain boasts a thick sprawling green and many useful plants. Inhabitants around Mandaragiri hill are attached to it and have a basic natural feeling for its conservation due to different religious beliefs and mythological reasons. The climate of Mandaragiri is warm and humid. Summer months are very hot with maximum day temperatures 45- 47°C in the months of May and June which drops sensibly with the onset of the monsoon. When the monsoon withdraws in October, the daytime temperature remains the same however the nights become cooler. Gradually, both day and night temperatures fall. The coolest month is December when temperature at night varies between 6°C and 11°C. Relative humidity is maximum in October and minimum in April and May.

3. Materials and Methods

Field study (16 trip) was conducted from time to time during both winter and summer to generate the information's by contacting village medicine men and Kavirajs (Vaidyas). They were interviewed to record different plants used in primary healthcare system for various remedies . The spot

identification of medicinal plants was done with the help of local experts and published floras [10]. Fresh samples of species which could not been identified were brought to the institution and identified in the laboratory. The diversity and place of distribution was recorded. Nativity and endemism were identified based on the distribution of the species.

To establish the uses of the medicinal plants literature was composed from the earlier published books by Kirtikar et al. [11-13]. In the following tabulation, the plant names have been arranged alphabetically accordingly their botanical names.

4. Results

A Total number of 82 species belonging to 74 genera and 40 families were recorded. Fabaceae (9 species); Anacardiaceae (5); Mimosaceae (5); Moraceae (5); Apocynaceae (4); Caesalpiniaceae (4); Combretaceae (4) and Verbenaceae (4) are the dominated families. *Ficus* sp., *Terminalia* sp. and *Acacia* sp. are the dominated genera. Among the medicinal plants *Anogeissus latifolia*, *Gmelina arborea*, *Madhuca longifolia*, *Pterocarpus marsupium*, *Shorea robusta*, and *Terminalia bellirica* are high value species exploited for different purposes. Species such as *Acacia catechu*, *Acacia nilotica*, *Buchanania lanzan*, *Emblia officinalis*, *Gardenia* sp., *Indigofera cassioides*, *Shorea robusta* and *Woodfordia fruticosa* are rare at Mandaragiri forest. Whereas, plants like *Rauvolfia serpentina*, *Santalum album*, *Streblus asper* and *Spondias pinnata* are endangered species at Mandaragiri forest. (Table 1).

Figure 1. Map of Odisha, India showing Mandaragiri forest

Figure 2. Map of the Mandaragiri forest

Table 1. Important ethno-medicinal plants of Mandaragiri forest

Botanical Name	Family	Local Name	Status of Finding	Place of distribution	Parts Used	Medicinal Properties
<i>Abrus precatorius</i> L.	Fabaceae	Kaincha	MQ	V	Rt, Lf, Sd.	Leucoderma, skin diseases asthma and fever.
<i>Acacia nilotica</i> (L.) Willd. ex Delile sp. indica	Mimosaceae	Babul	CF	F H	Bk, gum	Haemostatic, antipyretic, asthma, diarrhea
<i>Acacia catechu</i>	Mimosaceae	Khair	MQ	E	Bk, Hw	Anti-dysenteric, haemostatic, leprosy, leucoderma
<i>Acacia leucophloea</i> (Roxb.) Willd.	Mimosaceae	Gohira	R	F H	Bk	Thermogenic, constipating, antipyretic, used in cough, bronchitis, leprosy, vomiting and ulcers
<i>Achyranthes aspera</i> L.	Amaranthaceae	Apama-ranga	CF	E	Wp	Useful in cough, asthma, bronchitis, colic and cardiac disorder.
<i>Aegle marmelos</i> (L.) Corr. Serr.	Rutaceae	Bela	CF	E	Rt, Lf, Fr	Useful in diarrhea and dysentery, seminal weakness, gastric, diabetes and asthmatic complaints
<i>Ageratum conyzoides</i> L.	Asteraceae	Poksungha	CF	E	Rt, Lf	Used in cough, wound infection and eye lotion.
<i>Albizia lebbek</i>	Mimosaceae	Siris	R	E	Bk, Fl, Sd	Used in catarrh, asthma, leprosy, leucoderma, sprain, wounds and ulcers.
<i>Alstonia scholaris</i> (L.) R.Br	Apocynaceae	Chhatian	R	F H	Bk, Lf	Useful in preparation of cardio-tonic and abdominal disorder, diarrhea, dysentery and cardiopathy.
<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Acanthaceae	Bhuinnimba	CF	E	Wp	Wounds, ulcers, chronic fever, malaria, skin diseases, and intestinal worms.

<i>Anogeissus latifolia</i> (Roxb.) Wall. ex Bedd.	Combretaceae	Dhaura	R	E	Rt, Bk, Lf, Sd	Haemostatic, useful in skin diseases, diarrhea and dysentery.
<i>Argemone mexicana</i> L.	Papaveraceae	Ganghauda	R	F H	Wp	Antipyretic, sedative, aphrodisiac, used in asthma, skin diseases, wounds and ulcers, latex is used in jaundice and malaria fever.
<i>Asparagus racemosus</i> Willd.	Liliaceae	Satabari	R	E	Rt	Useful in nervous disorder, diarrhea, dysentery, throat infections, tuberculosis and epilepsy, cardiac debility hypertension and abortion.
<i>Azadirachta indica</i> A. Juss.	Meliaceae	Neem	R	E	Bk, Lf, Sd, oil	Useful in the cure of cough, skin diseases, eczema, leucoderma, malaria, bronchitis and diabetes.
<i>Bacopa monnieri</i>	Scrophulariaceae	Brahmi	MQ	V	Wp	Intellect promoting, anticonvulsant, cardio tonic, useful in epilepsy and insanity.
<i>Bambusa arundianacea</i>	Bambusaceae	Kanta baunsa	CF	S	Rt, Lf	Skin diseases, ringworm, diarrhea, gonorrhoea.
<i>Bauhinia variegata</i> L.	Caesalpinaceae	Kanchana	R	E	Rt, Bk.	Useful in skin diseases, leprosy, intestinal worms, wounds and ulcers.
<i>Bombax ceiba</i> L.	Bombacaceae	Semul	R	E	Rt, gum, Bk, Fr.	Paste is good for skin eruptions, fruits useful in ulceration of bladder and kidney.
<i>Buchanania lanzan</i> Spreng.	Anacardiaceae	Char	CF	E	Rt, Fr	Skin diseases, seminal weakness, cardio tonic, nervous debility and cardiac debility.
<i>Calotropis gigantea</i> R.Br.	Asclepiadaceae	Arakha	MQ	F H	Wp	Febrifuge and laxative. Promotes gastric secretions. Useful for asthma, paralysis.
<i>Careya arborea</i> Roxb.	Barriangtoniaceae	Kumbhi	R	E	Bk, Lf, Fr	Thermogenic and antipyretic. Useful for tumours. colic, intestinal worms, epileptic fits and healing of vaginal ruptures.
<i>Cassia fistula</i> L.	Caesalpiniaceae	Sunari	R	E	Wp	Useful in skin diseases, tuberculosis, syphilis, diabetes, leprosy and ring worm.
<i>Cassia tora</i> L.	Caesalpiniaceae	Chakunda	R	F H	Lf, Sd	Thermogenic, laxative, liver tonic, cardio tonic.
<i>Clitoria ternatea</i> L.	Fabaceae	Aparajita	CF	MH	Rt, Lf, Sd	Useful in leprosy and leucoderma treatment
<i>Curcuma aromatica</i> Salisb	Zingiberaceae	Bana haladi	CF	V	Rh	Useful in the treatment of bruises, sprains, bronchitis, cough, leucoderma and skin eruptions.
<i>Cuscuta reflexa</i>	Convolvulaceae	Nirmuli	R	F H	Wp	Useful in jaundice, cough, bronchitis and paralysis.
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Duba ghassa	CF	E	Wp	Haemostatic, useful in the treatment of skin diseases, vomiting, diarrhea, dysentery and abortion.
<i>Dalbergia sissoo</i>	Fabaceae	Sissoo	R	E	Rt, Lf, Bk, Hw	Thermogenic, aphrodisiac and antipyretic. Useful in the treatment of skin diseases, leucoderma, scabies, ulcers, syphilis, gastropathy and ophthalmopathy.
<i>Datura metel</i> L.	Solanaceae	Dudura	CF	FH	Wp	Narcotic, antispasmodic, intoxicant. Useful in asthma, fever, ulcers and skin diseases. Also used to treat dog bite.
<i>Desmodium gangeticum</i> (L.) DC.	Fabaceae	Salapami	CF	E	Rt	Febrifuge, thermogenic, nervine tonic, cardio tonic.
<i>Emblica officinalis</i> Gaertn.	Euphorbiaceae	Anla	CF	E	Rt, Bk, Lf, Fr	Aphrodisiac, antipyretic, digestive. Useful for diabetes, asthma, peptic ulcers, anaemia and emaciation.
<i>Ficus bengalensis</i> L.	Moraceae	Bara	CF	E	Rt, Bk, Lf, Lt	Useful in the treatment of diarrhea, dysentery, diabetes, ulcers, skin diseases, gonorrhoea, rheumatism.
<i>Ficus microcarpa</i> L.f.	Moraceae	Jari	R	HT	Rt, Bk, Lf	Useful in the treatment of wounds, ulcers, diabetes, diarrhea and dysentery.
<i>Ficus racemosa</i> L.	Moraceae	Dimiri	R	HT	Bk, Fr	Useful in ulcers, leucoderma, anaemia, jaundice and dysentery.
<i>Ficus religiosa</i> L.	Moraceae	Aswastha	R	E	Bk, Fr,	Aphrodisiac, antibacterial and purgative.

					Sd	Useful in skin infection.
<i>Flacourtia indica</i>	Flacourtiaceae	Kanteikuli	CF	E	Rt, Lf, Fr	Useful in the treatment snake bite, skin diseases. Fruits are appetizer and digestive.
<i>Gardenia gummifera</i> L.f.	Rubiaceae	Ghurudu	EX	HT	Resin	Thermogenic, antispasmodic, cardio-tonic. Useful in intestinal worms.
<i>Gmelina arborea</i> Roxb.	Verbenaceae	Gambhari	R	HT	Wp	Useful in fever, dyspepsia, skin diseases and promoting the growth of hair.
<i>Helicteres isora</i> L.	Sterculiaceae	Mudmudi	CF	E	Rt, Bk, Fr	Lactifuge, demulcent. Useful in colic, scabies, diabetes and gastropathy.
<i>Hemidesmus indicus</i> (L.) R.Br.	Asclepiadaceae	Anantamula	CF	E	Rt, Lf, St	Aphrodisiac, demulcent, febrifuge, Useful in asthma, bronchitis, leucoderma, leprosy, epileptic fits.
<i>Holarrhena antidysenterica</i> Wall ex. A.DC.	Apocynaceae	Kurein	CF	E	Bk, Sd, Lf	Aphrodisiac, digestive and febrifuge. Useful in amoebic dysentery, diarrhea, asthma, skin diseases and chronic bronchitis.
<i>Ichnocarpus frutescens</i> (L.) R.Br.	Apocynaceae	Soyamlai	CF	E	Rt	Seminal weakness, fever, skin diseases and diabetes.
<i>Indigofera cassioides</i> Rottl. ex DC.	Fabaceae	Nil	R	E	Wp	Thermogenic, laxative. Useful for promoting the growth of hair, cardiopathy and neuropathy.
<i>Lannea coromondelica</i> (Houtt.) Merr.	Anacardiaceae	Mai	CF	E	Bk, Lf	Useful in treatment of wounds, bruises, ulcers and sprains.
<i>Lantana camara</i> auct. non L.	Verbenaceae	Lantana (Naga Airi)	CF	FH	Wp	Antispasmodic. Useful in malaria, epilepsy and gastropathy.
<i>Leucas indica</i> (L.) R. Br. ex Vatke	Lamiaceae	Gayasha	R	FH	Lf, Fl	Thermogenic, antipyretic. Leaf juice is used as eye and nasal drop during infection.
<i>Limonia acidissima</i> L.	Rutaceae	Kainthha	MQ	HT	Bk, Fr, gum	Cardio tonic. Useful in gastropathy, diarrhea, vomiting, bronchitis.
<i>Madhuca longifolia</i> (Koenig) Macbride	Sapotaceae	Mohul	R	FH	Bk, Fr, Sd	Useful for epilepsy, sprains and rheumatism.
<i>Mangifera indica</i> L.	Anacardiaceae	Amba	R	FH	Rt, Bk, Sd	Useful for syphilis, wounds, ulcers, and rheumatism.
<i>Melia composite</i> Willd.	Meliaceae	Mohalimba	R	S	Wp	Asthma, diabetes, fevers, after delivery, hysteria, cardiac diseases and typhoid fever.
<i>Mimosa pudica</i> L.	Mimosaceae	Lajkuli	CF	E	Rt, Lf	Antispasmodic, Febrifuge, Useful in leucoderma, jaundice, asthma, small pox and uterus infection.
<i>Morinda tinctoria</i> Roxb. non Noronha	Rubiaceae	Anchhu	CF	E	Rt, Lf	Useful in gastric disorder and diarrhea.
<i>Mucuna pruriens</i> (L.) DC	Fabaceae	Baidanka	CF	E	Rt, Lf, Sd	Thermogenic, stimulant, purgative. Leaves are aphrodisiac. They are useful in gonorrhoea and sterility.
<i>Nyctanthes arbortristis</i> L.	Oleaceae	Gangasiuli	CF	E	Lf, Fl, Sd	Thermogenic, antibacterial and febrifuge. Useful in malaria, chronic fever and grayness of hair and baldness.
<i>Ocimum americanum</i> L.	Lamiaceae	Banatulasi	CF	E	Lf, Sd	Useful in parasite infection and poisonous bites, malarial fever.
<i>Ougeinia oojenensis</i> Roxb.	Fabaceae	Bandhan	EN	V	Bk	Stimulant and rejuvenating. Useful in diabetes, gonorrhoea and anaemia.
<i>Pergularia daemia</i> (Forsk.) Chiov.	Asclepiadaceae	Uturudi	R	F H	Wp	Useful in uterine and menstrual disorder.
<i>Phoenix sylvestris</i> (L.) Roxb.	Arecaceae	Banakhajuri	CF	FH	Fr	Cardio tonic and aphrodisiac. Useful in seminal weakness and general debility.
<i>Pterocarpus marsupium</i> Roxb.	Fabaceae	Piasal	R	V	Hw, gum	Rejuvenating and union promoter. Useful in fractures, bruises, skin diseases, leucoderma, diabetes. gum is used as liver tonic.
<i>Rauvolfia serpentina</i> (L.) Benth.ex Kurz.	Apocynaceae	Patal garuda	EN	V	Rt, Lf	Useful for hypertension, insomnia, epilepsy.
<i>Santalum album</i> L.	Santalaceae	Chandan	EN	F H	Hw, Rt	Intellect promoting, cardio-tonic. haemostatic, aphrodisiac. Useful in

						psychopathy, cardiac debility, gastric irritability and hyper acidity.
<i>Schleichera oleosa</i> (Lour.) Oken	Sapindaceae	Kusum	CF	E	Bk , oil	Bark used for malaria, ripening boils, seed oil used for burns and ulcers.
<i>Semecarpus anacardium</i> L.f.	Anacardiaceae	Bhalia	R	E	Fr	Digestive, purgative, liver tonic stimulant, antiseptic, uterine stimulant. Useful in cancer, diabetes and tumor.
<i>Sesbania grandiflora</i> (L.) Poiret	Fabaceae	Agasti	R	S	Rt, Bk, Lf, Fl, Fr	Febrifuge. Useful for nasal infection.
<i>Shorea robusta</i> Gaertn.f.	Dipterocarpaceae	Sal	R	FH	Bk, Fr	Useful in bacterial infection, tuberculosis, ulcers, Seminal weakness and burning of eyes.
<i>Solanum surattense</i> Burm. f.	Solanoceae	Ankaranti	CF	FH	Wp	Digestive, febrifuge, stimulant, skin diseases. hypertension, cough, asthma, epilepsy, cardiac disorder.
<i>Spondias pinnata</i> (L.f.) Kurz	Anacardiaceae	Ambada	EN	Above FH	Rt, Bk, Fr, Sd	Thermogenic, appetizer and aphrodisiac. Useful in muscular rheumatism.
<i>Streblus asper</i> Lour.	Moraceae	Sahada	EN	E	Rt, Bk, Lf , latex	Useful in cough, ulcers, bronchitis, throat infection.
<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Jamu	R	E	Bk, Lf , Fr	Useful in diabetes and strengthening the teeth, gums, ring worms.
<i>Tamarindus indica</i> L.	Caesalpiniaceae	Tentuli	R	E	Rt, Fr , Sd	Thermogenic, anti-fungal, jaundice, scabies, ringworm, small pox and diabetes.
<i>Tectona grandis</i> L.f.	Verbenaceae	Saguan	MQ	FH	Wp	Useful in hyper acidity, diabetes, leprosy, skin diseases.
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Bahada	CF	E	Bk , Fr	Useful in anaemia, leucoderma, narcotic, digestive, antipyretic.
<i>Terminalia chebula</i> Retz.	Combretaceae	Harida	CF	E	Fr	Purgative, Digestive, Cardio tonic. Useful in throat infection .
<i>Terminalia tomentosa</i> Wight & Arn.	Combretaceae	Asan	CF	E	Bk	Cardio tonic. Useful in throat infection wounds, ulcers, diarrhea and dysentery.
<i>Tragia involucrate</i> L.	Euphorbiaceae	Bichhuati	CF	E	Rt , Lf	Venereal diseases, diabetes and blood purifier.
<i>Trichosanthes anguina</i>	Cucurbitaceae	Mohakal	R	E	Rt , Fr	Useful in asthma, ophthalmia epilepsy and leprosy.
<i>Vitex negundo</i> L.	Verbenaceae	Begunia	R	F H	Wp	Antiseptic, antipyretic, ophthalmic, general debility, sprains and cardiac disorder.
<i>Vitis quadrangularis</i> Wall. ex Lawson	Vitaceae	Hadabh-anga	MQ	E	Wp	Used in treatment of fractures, swellings, powdered roots and stem paste are used in specifically for bone fractures.
<i>Woodfordia fruticosa</i> (L.) Kurz.	Lythraceae	Dhatki	CF	E	Fl	Stimulant, antibacterial corrective of urinary pigments, and diabetes.
<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	Barakoli	CF	E	Wp	Aphrodisiac and invigorating. Useful in the treatment of boils, wounds, syphilis, ulcers, typhoid fever..

Note: CF= commonly found, R=Rare, MQ= Medium quantity, EN = Endangered, EX= Extinct, S=Slope areas, MH=Middle of Hills, V=Valley, HT=Hill Top, FH=Foot Hill, E=Every where, Fl-flower; Fr-fruit; Lf-leaf; Bk-bark; Rt-root; Rh-rhizome; St-stem; Sd-seeds; Wp-whole plant

Local users rely on subsistence agriculture; with plants performing vital roles as crops, fodders, fruits and vegetables, fuel wood, building materials and medicines. Moreover, some plant species have religious value; some are used for construction as timber, while many of them are used for edible purpose. Local users use plant parts such as bark, root, leaf, seed, flower, fruit or entire plant for medicinal purpose to cure their different nature of ailments. People rely on plant-based medicines for primary health care against stomachache, diarrhea, bacillary dysentery, colic dysentery, constipation, digestion problem, gastric, stomach pain, rheumatic problems, respiratory problems such as cough,

cold, bronchitis, asthma, tuberculosis, fever, skin diseases and bone fracture.

5. Discussion

Plants are of utmost interest to the human race and our ancestors lived on nuts, roots, succulent stems, fruits and other parts of plants. Today, our existence can still not be imagined without plants. The Mandaragiri forest support a number of plant species, most of which have useful values. Local people are based on agriculture supported by animal

husbandry and dependent upon the forest resources around them for a number of daily requirements such as fodder, fuel wood, medicine, food, and fiber, raw material for handicrafts, house construction and agricultural tools. Most of the identified plants reported here have multiple local uses. Some commercially important plant species such as *Anogeissus latifolia*, *Gmelina arborea*, *Madhuca longifolia*, *Pterocarpus marsupium*, *Shorea robusta*, *Terminalia arjuna* and *Terminalia bellirica* have also medicinal value. Some wild food plants viz *Buchanania*, *Flacourtia*, *Spondias* etc. have medicinal properties and in other parts of the country are well known for their edible.

Aegle marmelos, *Ocimum americanum*, *Achyranthes aspera*, *Calotropis gigantea*, *Ficus bengalensis*, *Emblica officinalis*. *Semecarpus anacardium* and *Mangifera indica* are regarded for religious purpose along with their medicinal value and other domestic uses, and found to be well conserved by the tribal people.

Considering that the demand for medicinal plants is increasing, their survival in their natural habitat is under growing threat. This is due to over-harvesting, rapid degradation and loss of natural habitats. Thirty five medicinal plant species are critically threatened in Odisha state. Species such as *Acacia catechu*, *Acacia nilotica*, *Buchanania lanzan*, *Emblica officinalis*, *Gardenia* sp., *Indigofera cassioides*, *Shorea robusta* and *Woodfordia fruticosa* are rare, while, plants like *Rauvolfia serpentina*, *Santalum album*, *Streblus asper* and *Spondias pinnata* are endangered species at Mandaragiri forest.

Today, it is estimated that about 1,000 species of medicinal plants are facing threat to their existence, and some of them have become extinct in the wild. The Mandragiri forest constitutes a vast treasure of diverse medicinal plants. Many of the identified medicinal species and many more are yet to be identified may exist from Mandragiri. Therefore, steps must be taken for their identification and conservation both by *ex-situ* and *in-situ* means. In order to protect the biological diversity following measures are advised for conservation purpose viz. (i) *In-situ* conservation of wild population in forests and other *in-situ* habitats like sacred grooves and community forests; (ii) Establishment of herbal gardens to conserve representative populations of medicinal plants (iii) Establishment of several home gardens to conserve intra-specific diversity of plants useful for human and livestock health; (iv) Large scale organic cultivation of selected cultivars of medicinal plants. Many authors have advocated the involvement of local people in the protection of natural resources, such as forests and wildlife. So, involvement of local peoples can also play a major role in the conservation with following ways- (i) Generate and share information regarding species of medicinal and economic importance and conservation concern; (ii) Promote awareness of the concerns and policies tribes and other groups that safeguard traditional knowledge of native medicinal plants as these pertain to confidentiality of information; (iii) Encourage active participation by tribes and other holders of traditional ecological knowledge

pertaining to native medicinal plants; and (iv) Conserve indigenous plants and plant communities used in traditional medicines, ceremony, ethnobotany and the natural products industry.

6. Conclusion

The present study indicates that Mandaragiri forest harbors a high diversity of useful plants. The inhabitants are dependent on folk medicine due to poverty and the traditional belief of its effectiveness. Documentation of availability of medicinal plants has provided useful information. Further ethno-medicinal studies are required from this area, as tribes have a strong belief in the efficacy and success of herbal medicine and traditional healing practices among them. Therefore, it is essential to conserve such a wealth of information hidden among the local people.

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