

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/366407997>

BIODIVERSITY CONSERVATION OF PLANTS: THE ROLE OF ETHNIC AND INDIGENOUS POPULATIONS

Article in *Annals of Forest Research* · December 2022

CITATION

1

READS

951

6 authors, including:



Isha Gunwal

Swami Shraddhanand College, University of Delhi

14 PUBLICATIONS 40 CITATIONS

SEE PROFILE



Pendyala Chitrlekha

Dyal Singh College

7 PUBLICATIONS 75 CITATIONS

SEE PROFILE



Payal Mago

Shaheed Rajguru College of Applied sciences for women

23 PUBLICATIONS 123 CITATIONS

SEE PROFILE

BIODIVERSITY CONSERVATION OF PLANTS: THE ROLE OF ETHNIC AND INDIGENOUS POPULATIONS

Rashmi Mathur^a, Isha Gunwal^a, P. Chitrlekha^b, Payal Mago^c, Saloni Gulati^b, and RomaKatyal^{b*}

^a Department of Botany, Sri Aurobindo College, University of Delhi, New Delhi, India.

^b Department of Botany, Dyal Singh College, University of Delhi, New Delhi, India.

^c Shaheed Rajguru College of Applied Sciences for Women, University of Delhi, Delhi, India.

*Corresponding author

E-mail: romakatyal@dsc.du.ac.in, ORCID- 0000-0002-8125-172X

Abstract

Biological diversity, also referred to as biodiversity, is the variety of life forms on Earth. Ecosystems with higher biodiversity are considered healthier, and thus the conservation of biodiversity is one of the major goals to ensure food security and long-term economic viability. Biodiversity conservation is the preservation and management of flora, fauna, and habitats, and the indigenous people have made significant contributions to biodiversity conservation. Ethnic groups have a thorough understanding of the species that make up their ecosystem and have extensive knowledge of plants as valuable resources. Therefore, the participation of indigenous populations in biodiversity conservation programs is the key to sustaining life on this planet. Here, we review the role of indigenous people and their practices in biodiversity conservation in India.

Keywords: Biodiversity, Conservation, Environmental movements, Ethnic groups, Indigenous people, Tribals

Introduction

Biodiversity is the diverse range of life forms, including plants, animals, and microorganisms. As per an estimate, there are 8.7 million living species on Earth, with many more yet to be discovered and identified (Mora et al. 2011). Biodiversity is critical because it helps fulfill essential human requirements such as food, clothing, and shelter. Moreover, biodiversity is crucial for other life forms and is the key to sustaining life on earth. The species that participate in biodiversity richness perform unique functions that are different from the other lifeforms. For instance, plant diversity provides life-sustaining oxygen, a steady climate, medications, and other crucial components such as dyes, resins, and recreational opportunities. Although rich biodiversity is essential to human existence, it is under threat because of various anthropogenic activities such as deforestation, urbanization, and mining, among others. As a result, approximately a million species are in danger of becoming extinct.

India is a mega-diverse nation, having rich biodiversity of approximately 11 percent of global biodiversity with a geographical area of only 2.4 percent (Sinha et al. 2010). India possesses different kinds of ecosystems, ranging from the snow-covered Himalayan Mountain ranges in the north to the southern coastal regions, from the thick forest cover in the northeastern areas that

receive heavy rainfall to the desert areas of the northwest (Sinha et al. 2010). According to a botanical survey, India has 47,513 plant species. The Himalayas, the Western Ghats, the Indo-Burma region, and the Nicobar Islands are four biodiversity hotspots in India that contain 147 endemic genera belonging to 47 different higher plant groups (Arisdason, Lakshminarasimhan 2020). There are 45,000 wild plant species, of which 9,500 have ethnobotanical significance. Indigenous people use plants for medicinal and health practices (7,500 species), fiber (525 species), fodder (400 species), preparing and extracting insect and pest repellent (300 species), gum, resins, dyes, and perfume extraction (300 species), and about 700 species are considered important culturally and religiously (Jain 1996).

In addition, India has a vast ethnic population and resources that contribute to the country's biodiversity. There are approximately 300 million tribal people in the world. As reported in the 2011 census, there are 104.2 million tribals in India, representing 8.6 percent of the entire population (Chandramouli 2011). They occupy about 15% of the geographical areas rich in natural resources. The tribal people are an integral component of the social fabric in India and are thought to be India's first inhabitants. There are approximately 645 tribes, each with a unique culture, language, and tradition. Tribal people are connected to nature and have devised ways to live in harmony with nature. The most remarkable aspect of these tribal people is that they dwell in areas abundant in flora and fauna and are thus acquainted with the economically significant plants growing in the area and use them ethically and judiciously. Moreover, these tribal people play a pivotal role in developing and managing the environment since they pass on traditional wisdom essential to eco-restoration from generation to generation. The protection, regeneration, and harvesting methods practiced to manage these forests are the best examples of indigenous ecological knowledge.

Tribal communities and forest interrelationship

To understand the relationship between the tribals and the forests in India, the maps showing the distribution of the tribal population (Figure 1, Tribal Profile at a Glance 2014) and forest cover (Figure 2, ISFR 2021) were compared. Interestingly, this comparison showed that the areas with a higher tribal population also have a higher green cover, indicating a symbiotic relationship between the tribals and the forests (Chandramouli 2011; MOEFCC 2019). Forest ecosystems possess the majority of biological resources, and many have been recognized as hotspots of biodiversity (Raven, Wackernagel 2020). Further, this analysis showed that the tribal concentration and forest cover are high in North-Eastern and Central India. The North-Eastern region is inhabited by a significant number of tribals, and this region is also rich in floristic diversity. The tribals in this region constitute more than 57 % of the entire population (Sharma and Pegu 2011). According to the census of 2011, four states in North-East of India, Mizoram (94.4 %), Nagaland (86.5 %), Meghalaya (86.1 %), and Arunachal Pradesh (68.8 %) have a tribal population as a majority (Census India. 2011). Interestingly, the forest cover in these states (Mizoram 84.53 %, Nagaland 73.90 %, Meghalaya 76 %, Arunachal Pradesh 79.33 %) is also high (ISFR 2021). Further, the population of tribals in the two states of central India, Madhya Pradesh and Chhattisgarh, is 21.1 % and 30.6 %, respectively (Chandramouli 2011) and it is noteworthy

that the forested area in Madhya Pradesh is 25.11 %, and that of Chhattisgarh is 41.09 % (ISFR 2017).

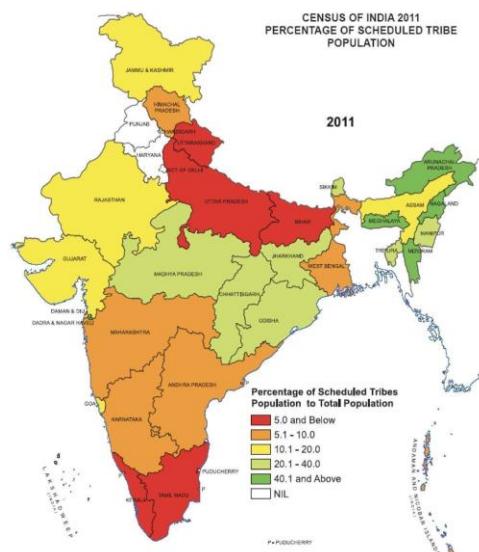


Figure 1: Tribal Population in India

(Figure 1: <https://tribal.nic.in/ST/Tribal%20Profile.pdf>)

(Figure

<https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/jan/doc20221207001.pdf>)



Figure 2: Forest cover of India

Contribution of indigenous people to biodiversity conservation

Indigenous and local communities participate in biodiversity conservation as they are aware of the potential uses and values of hundreds of species (Raj et al. 2018). Tribal people have lived in the forests for generations and have developed an association with them. They believe that forests are a gift from nature, and thus they prevent the degradation of fragile and biologically rich ecosystems in their proximity. They gather forest products for their daily needs and livelihood. The forests are intrinsic to tribal people's lives and economies, which affect their socio-economic and cultural well-being (Gurung 2017).

Cultural norms and rules also help communities manage their natural resources. Several gods are revered in India by people of various religions, and flowers, fruits, seeds, bark, twigs, and leaves of many different plants are offered to gods. Furthermore, many ethnic groups regard the plants grown near religious sites as sacred, and safeguard these plants to use them in various rituals. As a result, many natural vegetation pockets are preserved nearly in pristine form by the tribals in India when environmental degradation and deforestation are occurring at an alarming rate globally (Arora 1991; Chacko 2021). Sustainable development is possible only if accompanied by the conservation of natural resources (Allen, Allen. 1985).

The role of tribal women, in particular, is crucial and important in biodiversity conservation. Although they make up roughly half of the population, women are more significant in a tribal society than in other social groupings because they are responsible for managing the household. Women and children are primarily responsible for gathering edible items from forests like fruits, flowers, berries, tubers, and vegetables. The tribal economy heavily depends on minor forest products, contributing to around 70% of their total income (Menon 2016). Even though indigenous women are actively engaged in biodiversity conservation, their contributions are, by far, not appreciated. If a global society wants to achieve sustainable development, the contributions of women must be recognized (Mago and Gunwal 2019). Gender equality and environmental sustainability are all part of the Millennium Development Goals. Input from women in environmental protection would greatly help communities acquire the sense of responsibility necessary to maintain a fair balance between humanity and the earth's resources.

Indigenous people help with plant protection in their natural habitats.

Plants used as food by indigenous people

Over the years, indigenous people have developed various strategies to meet their needs from natural forest resources. The varied ethnic and indigenous tribes rely on wild plant species for food, medicine, and shelter, which has a significant impact on their sociocultural, and physical well-being (Bhogaonkar et al. 2010). To protect biodiversity, indigenous people follow conservation rules while harvesting edible plants. Tribal communities worldwide have relied on wild edible plant species as an indispensable part of everyday life. There are over 20,000 edible wild plants reported globally, and in India, 1532 wild edible plant species have been recorded. As compared with cultivated plants, wild plants have more minerals (Thakur et al. 2020). These plant varieties have proven beneficial as a steady source of food for everyday consumption. Despite being a relatively new term, "nutraceuticals" have existed in India's tribal communities for a long time (Oak et al. 2015). The tribes have regularly practiced this strategy of integrating food with medicinal and nutritional value into the diet. Different tribes prefer different foods because the wild edible plants vary with the surrounding biodiversity and influence food habits. An ethnobotanical analysis of wild plant species used as food is of significance as it may aid in the identification of alternative food sources to address the demands of an ever-increasing population (Table1).

Table 1: Plants used as food by indigenous people

S. No	Common name (English/Hindi)	Botanical name	Family	Plant part used	Reference
1	Malabar Nut/Vasaka	<i>Adhatoda vasica</i> (L)	Acanthaceae	Vegetables are made from young shoots and leaves	Khuraijamand Huidrom, 2013; Upreti et al 2016

2	Stone apple/Bael	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	The pulp of ripe fruits is consumed	Yesodharan and Sujana 2007; Rathore 2009; Dutta et al. 2014; Anju et al. 2018
3	Elephant-Head Amaranth/Chaulai	<i>Amaranthus tricolor</i> L.	Amaranthaceae	Leaves cooked as vegetable	Shukla et al. 2006; Chauhan et al. 2014
4	Smooth Angelica/Chora	<i>Angelica glauca</i> Edgew	Apiaceae	Dry seeds and roots are used as spices	Uniyal et al. 2002
5	Climbing asparagus/Satawari	<i>Asparagus racemosus</i> Wild.	Liliaceae	Roots are cooked and used to make curry	Yesodharan and Sujana 2007
6	Indian pennywort/Brahmi	<i>Bacopa monnieri</i> (L.) Pennell	Plantaginaceae	Leafy greens are consumed as a vegetable.	Mallick et al. 2020
7	Giant thorny Bamboo/Baans	<i>Bambusa bambos</i> (L.) Voss.	Poaceae	Vegetables are made from young shoots. Seeds are used for making flour	Yesodharan and Sujana 2007
8	Orchid tree/Kachnar	<i>Bauhinia variegata</i> Lam.	Caesalpiniaceae	Vegetables are made from young flowering buds	Alawa and Ray 2016
9	Painted leaf Begonia/Patharchatti	<i>Begonia picta</i> Sm.	Begoniaceae	Leafy greens are consumed as a vegetable	Mallick et al. 2020
10	Silk cotton tree/Semal	<i>Bombax ceiba</i> L.	Bombacaceae	Fruits and flowers are consumed like vegetables; Flowers: Pickled	Alawa and Ray 2016; Upreti et al. 2016
11	Laburnum/Amaltas	<i>Cassia fistula</i> L.	Caesalpiniaceae	Leaves and stems are cooked and eaten	Alawa and Ray 2016

12	Water Yam/Ratalu	<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	The tuber is cooked as vegetables	Yesodharan and Sujana 2007
13	Finger millet/Ragi	<i>Eleusine coracana</i> (L) Gaertn.	Poaceae	Grains are used as staple food	Saradha et al. 2016
14	Culantro/Ban dhania	<i>Eryngium foetidum</i> L.	Apiaceae	The whole plant is used as a spice	Bharali et al. 2017
15	Bur - Flower Tree/Kadamb	<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae	Fruits and flowers are consumed as vegetables	Pandey and Negi 2016
16	Indian Gooseberry/Amla	<i>Phyllanthus emblica</i> L.	Euphorbiaceae	Fruits are eaten	Yesodharan and Sujana 2007
17	Sal tree/Sakhua	<i>Shorea robusta</i> L.	Dipterocarpaceae	Seeds and leaves are eaten	Chauhan et al. 2014
18	Great millet/Jowar	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Grains are used as staple diet	Saradha et al. 2016
19	Fenugreek/Methi	<i>Trigonella foenumgraceum</i> L.	Papilionaceae	Seeds and leaves are eaten	Chauhan et al. 2014
20	Wild Jujube/Suran	<i>Ziziphus rugosa</i> L.	Rhamnaceae	Ripe fruits are eaten	Yesodharan and Sujana 2007; Mallick et al 2020

Plants that indigenous people use in households/day-to-day life

Over the years, forest-dwelling communities have developed specialized skills for utilizing forest resources in their daily lives. Except for a few goods, the tribals rely entirely on the surrounding forest for their existence. The leaves, stems, and wood that are abundantly available throughout the year are used for many household articles like brooms, ropes, mats, baskets, containers for storing grains, etc. In addition, the non-toxic, eco-friendly home decor products made by tribal artisans are sold in the market, contributing to household economies. These are valued because

they are unique, meticulously handcrafted, and safe. The plants commonly used belong to the families Arecaceae, Poaceae, Verbenaceae, and Fabaceae (Table 2).

Some tribes use seeds of some plants for barter in exchange for potatoes and onions in the local markets, indicating that the barter system is still prevalent in the tribal communities. (Lele et al. 2017). The commonly used plant species for barter are *Bridelia retusa* (L.) A. Juss., *Hibiscus cannabinus* L. and *Argemone mexicana* L. (Lele et al. 2017).

Table 2: Plants used by indigenous people in households/day-to-day life

S. No	Common name (English/Hindi)	Botanical name	Family	Uses`	Reference
1	Scholar tree/Saptaparni	<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	Wood is used for house construction.	Chaudhry and Murtem 2017
2	Marigosa/Neem	<i>Azadirachta indica</i> L.	Meliaceae	Mosquitoes are killed by burning dried leaves. Fruits are used to destroy insects in granaries. This tree is protected by the tribes because it provides shade. The twig is used to clean teeth.	Thaplyal et.al. 2012; Mohanty 2011; Sharma et.al. 2014
3	Bamboo/Baans	<i>Bambusa pallida</i> Munro	Poaceae	Used for the house construction	Patel 2005; Sharma and Borthakur 2008
4	Bamboo/Baans	<i>Bambusa stricta</i> (Retz.)	Poaceae	Basketry, bamboo cylinders for concealing money and accessories	Patel 2005; Mohanty et al. 2011
5	Viagra Palm/Tara	<i>Calamus erectus</i> Roxb.	Arecaceae	Culm is used to make ropes.	Chaudhry and Murtem 2017

6	White Jute/Pattashaak	<i>Corchorus capsularis</i> L.	Tiliaceae	Used to make ropes	Mohanty et al. 2011
7	Indian rosewood/Sisam	<i>Dalbergia sissoo</i> Roxb. ex DC	Fabaceae	Used to make doors and furniture.	Mohanty et al. 2011
8	White Teak/Gamhar	<i>Gmelina arborea</i> L.	Verbenaceae	The wood is used to make musical instruments as well as timber.	Chaudhry and Murtem 2017
9	Morning Glory Tree/Behaya	<i>Ipomoea fistulosa</i> Mart. ex Choisy	Convolvulaceae	Used as fencing material	Mohanty et al. 2011
10	Champak/Champa	<i>Michelia champaca</i> (L.) Baill. ex Pierre	Magnoliaceae	House making, wood is used for furniture, household items and constructional works	Chaudhry and Murtem 2017
11	Sweet wild banana/Kopa Kela	<i>Musa balbisiana</i> Colla	Musaceae	Leaf-sheaths used as rope and dried leaves used as the roofing material and rope	Chaudhry and Murtem 2017
12	Date Palm/Khajur	<i>Phoenix acaulis</i> Roxb.	Arecaceae	Making ropes, brooms and mats	Mohanty et al. 2011
13	Golden Palm/Himalayan Pinanga	<i>Pinanga gracilis</i> Blume	Arecaceae	Leaves are used for thatching	Chaudhry and Murtem 2017
14	Bengal Shrub-Mint/Ishwar jata	<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	Lamiaceae	Leaves are used to get rid of bed bug	Lele et al. 2017
15	Heart leaf/Kharinta	<i>Sida cordifolia</i> L.	Malvaceae	Entire plant is used for making broom	Mohanty et al. 2011
16	Teak/Sagwan	<i>Tectona grandis</i> L.	Verbenaceae	Wood is used as timber	Chaudhry and Murtem 2017
17	Vetiver Grass/Khus	<i>Vetiveria zizanioides</i> (L.) Nash	Poaceae	Scented cooling mats	Mohanty et al. 2011

Plants used by indigenous people as medicines

According to the WHO, 80% of people globally depend on herbal medicines (from 21,000 different plant species) for primary health care (Khan 2016). Ethnic tribes use around 7500 species to source their medicines (Gowthami et al. 2021). Among the different medicine practices, indigenous healing methods, in particular, have evolved over one hundred years of beliefs and observations. These practices are culturally recognized and have gained widespread acceptance. In India, traditional medicine accounts for more than 40% of healthcare services, and plants account for over 85% of traditional medicines (Datta et al. 2014). Indigenous communities have the know-how of a variety of forest products. They, in particular, conserve those wild and cultivated plant species that have medicinal value (Table 3). These, in conjunction with the involvement of the general population, would aid in preserving the ecosystem and biodiversity. Natural remedies are made from plant parts or plant extracts. These are commonly used for curing ailments like fever, cold, cough, bronchitis, rheumatoid arthritis, gastrointestinal disorders, skin diseases, jaundice, etc. Snake bites and fractured bones are also treated by plant-based preparations (Table 3). The tribal societies have established treatments for these illnesses using crude drugs from wild plants and plant products. Although the scientific consequences of these age-old remedies are difficult to comprehend, the tribes believe in them and find them helpful.

Table 3: Plants used by indigenous people as medicines

S. No .	Common Name (English/Hindi)	Botanical name	Family	Plant part: disease/treatment	References
1	Okra/Van Bhindi	<i>Abelmoschus esculentus</i> L.	Malvaceae	Seeds Decoction: Asthma	Rai 2017
2	Chaff-flower/Apamarg	<i>Achyranthes aspera</i> L.	Amaranthaceae	Entire plant: cough, piles, worms, indigestion, cureseye disorders Root paste: headache, snakebite	Jain et.al. 2010; Kumar et.al. 2016; Uprety et.al. 2016; Rai 2017
3	Malabar Nut/Vasaka	<i>Adhatoda vasica</i> (L.)Nees	Acanthaceae	Leaves: rheumatism, bronchitis, Flowers: Nose bleeding, Stem paste: Diarrhea,	Jain et.al 2010; Ahirwar and Shakya 2015

4	Stone apple/Bael	<i>Aegle marmelos</i> (L.) Correa	Rutaceae	Fruit pulp: braintonic, increases appetite, treatment for diabetes, ulcer, piles, constipation, diarrhea & dysentery, increases strength, increases skin moisturization, treats scabies, vomiting	Jain et al 2010; Mazid et.al. 2012; Dutta et.al. 2014; Upreti et. al. 2016; Singh et.al. 2019
5	Goat Weed/Jangli pudina	<i>Ageratum conyzoides</i> L.	Asteraceae	Leaves: cuts and wounds Root infusion: appetizer Plant extract: stomach disorder	Jain et.al. 2010
6	Sage Alangium/Aakol	<i>Alangium salvifolium</i> (Lf) W	Cornaceae	Leaves: laxative, loosen the bowels, cures flatulence Paste of Bark: antifertility, abortion	Mazid et. al. 2012; Upreti et.al. 2016
7	Garlic/Lahsun	<i>Allium sativum</i> L.	Liliaceae	Cloves: healing wound, skin troubles and abscess; laxative, aphrodisiac, breathing, heart problems	Jain et. al 2010; Mazid et. al. 2012

8	Aloe vera/Ghritkumari	<i>Aloe barbadensis</i> Miller	Asphodelaceae	Leaves: preventsskin dryness, wound healing, anthelmintic, improves digestion, stomachic, kills intestinal worms, loosens bowels	Ravishankar and Shukla 2007; Mazid et. al.2012
9	Scholar Tree/Saptaparni	<i>Alstonia scholaris</i> (L.)R.Br.	Apocynaceae	Bark: malarial fever, abdominal disorders, intestinal worms,hypertension, skin diseases, leucoderma Leaves: dysentery, spider, snake bites Latex: preventsacidity	Kalaria et.al. 2012; Datta et.al. 2014; Bose et.al. 2015; Upreti et.al. 2016; Bhandary and Jayakary 2020
10	Chaff-flower/Apamarg	<i>Amaranthus aspera</i> L.	Amaranthaceae	Root paste:toothache	Rai 2017
11	Elephant FoodYam/Jimikand	<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson.	Arecaceae	Rhizome: impotence in males	Rai 2017
12	Bitterweed/Kalmedh	<i>Andrographis paniculata</i> (Burm.f.)	Acanthaceae	Plant decoction: malarial fever	Rai 2017
13	Climbing asparagus/Shatavari	<i>Asparagus racemosus</i> wild	Liliaceae	Dried leaves:stomach pain and urinary disorders. Root powder: impotence in males Whole plant paste: for snake bite	Ravishankar and Shukla 2007; Jain et. al. 2010; Kumar et. al. 2016

14	Margos/Neem	<i>Azadirachta indica</i> A.Juss.	Meliaceae	Leaves: antiseptic, bloodpurifier, treats fever and acidity Twigs: cleaning teeth. Leaf & stem extract: snake bite, liver problems Bark: malarial fever	Jain et.al. 2010; Bose et.al. 2015; Upreti et.al. 2016
15	Herb of grace/Bramhi	<i>Bacopa monnieri</i> (L.) Pennell	Scrophulariaceae	Leaf decoction: memory enhancing, antioxidant	Ravishankar and Shukla 2007; Rai 2017
16	Spiny Bamboo/Baans	<i>Bambusa arundinacea</i> (Retz.) Willd.	Poaceae	Leaves, roots, shoots and seeds: fracture healing, anthelmintic, antioxidant, anti-inflammatory. Seeds: enhance fertility. Root paste: snake bite	Kumar et. al. 2016; Singh 2017
17	Spreading Hogweed/Punarnava	<i>Boerhavia diffusa</i> L.	Nyctaginaceae	Roots: Jaundice and asthma.	Ravishankar and Shukla 2007; Ahirwar and Shakya 2015

18	Silk Cotton tree/Semal	<i>Bombax ceiba</i> L.	Bombacaceae	Root, Bark:diarrhea, urinaryinfection, dysentery, appetizer, destroy smallcolonies of spore,treats bacterialskin infections	Mazid et.al.2012; Uprety et.al. 2016
19	Indian frankincense/Salai guggul	<i>Boswellia serrata</i> Roxb.ex Colebr.	Burseraceae	Resin: bronchitis, arthritis, fever, jaundice, asthma, cough, stimulatesliver	Ravishankar and Shukla 2007; Bhogaonkar et.al. 2010; Soumya et.al. 2019; Soni and Bohra. 2021.
20	Lollipop Climber/Shivlingi	<i>Bryonopsis laciniosa</i> L.	Cucurbitaceae	Seed powder: impotence in females	Rai 2017
21	Life-Plant/Amar poi	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Crassulaceae	Leaf paste: burns, bruises,wound, swelling, insectbites, snake bite	Kumar et.al. 2016; Uprety et.al. 2016
22	Flame of the forest/Tesu	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	Gum: diarrhea, anthelmintic, antigout Roots: tuberculosis	Ravishankar and Shukla 2007; Das et.al.2011; Mazid et.al. 2012; Uprety et.al. 2016

23	Pigeon Pea/Arhar	<i>Cajanus cajan</i> (L.) Millsp.	Fabaceae	Leaves: jaundice	Datta et.al. 2014
24	Giant milkweed/Aak	<i>Calotropis gigantea</i> (L.) Aitonf.	Asclepiadaceae	Leaves: rheumatism, paralysis, leprosy, sprain, swelling Latex: tooth ache, joint pain, burns, ring worm, scorpion bite	Parihar and Balekar 2016; Uprety et.al. 2016; Kambhar et.al. 2020
25	Papaya/Papita	<i>Carica papaya</i> L.	Caricaceae	Fruits: anti-fungal, treats jaundice, ringworms, convalescence, cough, digestion	Jain et. al. 2010; Uprety et.al. 2016; Maravi et.al. 2017
26	Karanda/Karonda	<i>Carissa carandas</i> L.	Apocynaceae	Root extract: headache, rheumatism, chest complaints, syphilis, oedema, rabies	Kaunda and Zhang 2017
27	Antbush/Kasunda	<i>Cassia occidentalis</i> (L.)	Fabaceae	Root extract: snake bite Flower and seed paste: infection, inflammation	Datta et. al. 2014; Uprety et. al. 2016
28	Periwinkle/Sadabahar	<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Plant: anti-cancerous Leaf powder: hypertension, diuretic and diabetes	Sajem and Gosai 2010; Uprety et. al. 2016

29	Black oil plant/Malkangni	<i>Celastrus paniculata</i> Willd.	Celastraceae	Plant juice: sore throat, fever Seedoil: arthritis, applied for severestomach ache	Uprety et.al. 2016; Rai 2017
30	Veldt Grape/Harajora	<i>Cissus quadrangularis</i> L.	Vitaceae	Whole plant: inflammation, fractures Root & stem extract: fractured bones, osteoporosis, arthritis	Ravishankar and Shukla 2007; Singh 2017; Rai 2017
31	Bitter apple/BadiIndrayan	<i>Citrullus colocynthis</i> (L.) Schrad	Cucurbitaceae	Seed powder: jaundice, migraine	Rai 2017
32	Ivy Gourd/Kundru	<i>Coccinia grandis</i> (L.) Voig	Cucurbitaceae	Leaves: hypertension	Datta et.al. 2014
33	Indian Myrrh/Guggal	<i>Commiphora wightii</i> (Arn.) Bhandari	Burseraceae	Oleo-gum resin: arthritis, liver toxicity, fracture bones, cardiovascular disease, obesity	Soni 2010; Singh 2017
34	Indian cherry/Lasure	<i>Cordia dichotoma</i> G.Forst.	Boraginaceae	Bark decoction: digestive problems, dysentery, headache, stomach-ache, leprosy, skin diseases, antibacterial, antiviral, antitussive dyspepsia, fever, diarrhea, Jaundice, Mouth and ulcer	Rathore 2009; Jamkhande 2013; Ahuja et. al. 2020

35	Coriander/Dhania	<i>Coriandrum sativum</i> L.	Apiaceae	Plant extract: conjunctivitis, cough, bronchitis, urinary problem Fruits powder: digestion, stomach aches, carminative, flatulence, constipation	Jain et.al. 2010; Upreti et.al. 2016
36	Wax Leaved Climber/karanta	<i>Cryptolepis buechanani</i> Roem. &Schult.	Asclepiadaceae	Root, stem, and leaf paste: fractured bones	Singh 2017
37	Mango ginger/AmaHaldi	<i>Curcma amada</i> Roxb.	Zingiberaceae	Rhizome paste: joint pain	Rai 2017
38	Golden eye-grass/Kali Musli	<i>Curculigo orchioides</i> Gaertn.	Amaryllidaceae	Root powder: impotence infemales Root stock: enhances spermatogenesis	Ravishankar and Shukla 2007; Rai 2017
39	Turmeric/Haldi	<i>Curcuma longa</i> L.	Zingiberaceae	Rhizome paste: rich in antioxidants, treats cough, cuts, wounds, inflammation, snakebite, fractured bones	Scartezzini and Speroni 2000; Datta et.al. 2014; Bose et.al. 2015; Upreti et.al. 2016; Maravi et.al. 2017

40	Giant dodder/Amarbel	<i>Cuscuta reflexa</i> Roxb.	Convolvulaceae	Plant extract: treats dandruff Plant decoction: jaundice Seeds: ulcer and liver diseases	Jain et.al. 2010; Ahirwar and Shakya 2015; Upreti et.al. 2016
41	Cypriol/Gundla	<i>Cyperus scariosus</i> R.Br.	Cyperaceae	Root powder: jaundice	Rai 2017
42	Indian rosewood /Sheesham	<i>Dalbergia sissoo</i> Roxb.	Fabaceae	Leaf juice: gonorrhoea, stomach disorders	Jain et.al. 2010; Datta et. al. 2014
43	Air yam/Zimikand	<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	Rhizome powder: piles	Rai 2017
44	Bombay ebony/Bistendu	<i>Diospyros cordifolia</i> Roxb.	Ebenaceae	Plant extract: liver disorder, Skin diseases, wounds, leprosy, cough, dysentery, eyes infection, stomach pain, ulcers, fever, anthelmintic	Mall 2016
45	False daisy/Bhringraj	<i>Eclipta alba</i> (L.) Hassr.	Asteraceae	Leaf extract: promotes hair growth	Ravishankar and Shukla 2007; Rai 2017
46	Embelia/Vaividang	<i>Embelia ribes</i> Burm.f.	Myrsinaceae	Root extract: bronchitis, stomach worms	Rai 2017
47	Asthma Weed/Badi Dudhi	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Leaf extract: cough, asthma, wounds, menstrual Problems	Jain et.al. 2010; Datta et. al. 2014; Marayi et.al. 2017

48	Dwarf morning-glory/Shankpushpi	<i>Evolvulus alsinoides</i> L	Convolvulaceae	Flower powder: leucorrhoea Herbal decoction: memory loss	Rai 2017
49	Banyan tree/Bargad	<i>Ficus benghalensis</i> L.	Moraceae	Fruit: fever Latex: rheumatism, tooth decay, dysentery	Jain et.al. 2010; Upreti et.al. 2016
50	Gloriosa lily/Kalihari	<i>Gloriosa superba</i> L.	Liliaceae	Tuber: spasmolytic, oxytocic Rootpaste: ulcer	Ravishankar and Shukla 2007; Rai 2017
51	Veronica/Veronica/Kukurbicha	<i>Grewia hirsuta</i> Vahl	Malvaceae	Whole Plant: cancer	Rai 2017
52	Indian linden/Dhaman	<i>Grewia tiliifolia</i> Vahl	Malvaceae	Bark: cancer	Rai 2017
53	Indian sarsaparilla/Anantmool	<i>Hemidesmus indicus</i> L.	Apocynaceae	Root decoction: improving appetite	Rai 2017
54	China rose/Gurhal	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Leaves: skin disorders, burning sensations Roots: cough, fever	Datta et.al. 2014
55	Seabuckthorn/Brahmaphal	<i>Hippophae rhamnoides</i> L.	Elaeagnaceae	Fruit: treats disorders of circulatory system, enhances wound healing, treats duodenal ulcer	Ravishankar and Shukla 2007

56	Purging nut/Ratanjot	<i>Jatropha curcas</i> L.	Euphorbiaceae	Latex: toothache, gumache, burns, wounds, eczema Seed oil: Joint Pain Seed: stomach disorders, antidote for poisoning	Jain et.al. 2010; Upreti et.al. 2016; Rai 2017
57	Large-Leaf Leea /Hathpan	<i>Leea macrophylla</i> (Roxb.) ex.Horn.	Vitaceae	Root: ulcer	Rai 2017
58	Soft bolly gum/Maidalakdi	<i>Litsea glutinosa</i> (Lour) Rob.	Lauraceae	Bark: dysentery	Rai 2017
59	Mint/Pudina	<i>Mentha arvensis</i> L.	Lamiaceae	Leaves: rheumatism, antiemetic, indigestion gastritis, jaundice, antibacterial, removes intestinal worms, provides cooling effects	Jain et.al. 2010; Mazid et.al. 2012; Upreti et.al. 2016; Maravi et.al. 2017
60	Touch-me-not/Chuimui	<i>Mimosa pudica</i> L.	Mimosaceae	Root extract: piles, snake bite	Kumar et.al. 2016
61	Night-flowering jasmine/Harsingar	<i>Nyctanthes arbor tristis</i> L.	Oleaceae	Bark paste: treats dislocated bones Leaf decoction: malarial fever	Upreti et.al. 2016; Rai 2017
62	Basil/Ban Tulsi	<i>Ocimum basilicum</i> L.	Lamiaceae	Seed paste: wasp, bee & other insect stings	Datta et. al. 2014

63	Holy basil/Tulsi	<i>Ocimum sanctum</i> L.	Lamiaceae	Leaf extract:gastric disorders, leucoderma, skin disease, hypoglycemia, cough, cold, bronchitis Leaf and rootpaste: snake bite	Ravishankar And Shukla 2007;Jain et.al 2010;Kumar et.al. 2016; Rai 2017
64	Date Palm/Khajur	<i>Phoenix dactylifera</i> L.	Arecaceae	Fruit: digestive tonic improves digestion, treats constipation	Mazid et al. 2012
65	Indian Gooseberry/Amla	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Fruits: stomachache, diabetes,jaundice, fever,diarrhea, cough, dandruff, laxative, improves digestion & curesflatulence	Scartezzini and Speroni 2000; Jain et al 2010; Mazid et al. 2012; Upreti et al. 2016; Maravi et al. 2017
66	Gale of the wind/BhuiAmla	<i>Phyllanthus niruri</i> L.	Phyllanthaceae	Leaf extract:diarrhea Root extract:fever Powdered herb: jaundice	Jain et. al. 2010; Rai 2017
67	Blue Plumbago/NilaChitrak	<i>Plumbago auriculata</i> L.	Plumbaginaceae	Root extract: constipation, acidity, stomachpain	Jain et al. 2010
68	Indian beech/Karanj	<i>Pongamia pinnata</i> (L.)Pierre	Fabaceae	Seed oil: skin diseases, snake bite	Kumar et.al. 2016; Rai 2017

69	Serpentine wood/Sarpagandha	<i>Rauwolfia serpentina</i> (L.) Benth.ex Kurz	Apocynaceae	Root Extract: snake, reptilebites, respiratory problems, mental illness, insomnia Root, stem, leaf: fever, malaria Shoot extract: pneumonia	Dey and De 2011; Upreti et.al. 2016
70	Castor Bean/Arand	<i>Ricinus communis</i> L.	Euphorbiaceae	Leaf paste: jaundice, carminative, urinary disorder, purgative, aphrodisiac Seed Oil: relieve pain, cracked heels	Jain et.al. 2010; Datta et al. 2014; Upreti et.al. 2016
71	Indian madder/Moyen	<i>Rubia cordifolia</i> L.	Rubiaceae	Bark paste: dysentery	Rai 2017
72	Agati/Agasti	<i>Sesbania grandiflora</i> L.	Fabaceae	Leaf extract: jaundice	Datta et.al. 2014; Upreti et.al. 2016
73	Catbriers/Ramdatun	<i>Smilax perfoliata</i> Lour.	Smilacaceae	Stem powder: leucorrhoea	Rai 2017
74	Black nightshade/Bhatkataiya	<i>Solanum nigrum</i> L.	Solanaceae	Aerial parts: sedative Root, leaves, fruits: leucoderma, vomiting, urinary discharge Root decoction: toothache	Jaryan et. al. 2010; Upreti et.al. 2016; Rai 2017
75	Toothache Plant/Akarkara	<i>Spilanthes oleracea</i> L.	Arecaceae	Flower powder: toothache	Rai 2017

76	Arjun tree/Arjun	<i>Terminalia arjuna</i> (Roxb.) Wgt & Arn.	Combretaceae	Bark decoction: stomachic, blood pressure, heart troubles	Jain et.al. 2010; Ahirwar and Shakya 2015; Upreti et.al. 2016; Rai R. 2017
77	Myrobalan/Bahera	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Powdered fruit: antioxidant, migraine indigestion, laxative, constipation, bronchitis, respiratory problems. Bark: anemia, leucoderma	Ravishankar and Shukla 2007; Gupta 2020; Jain et.al. 2010; Upreti et. al. 2016; Rai 2017
78	Portia tree/Paras peepal	<i>Thespesia populnea</i> (L.) Sol.ex Corrêa	Malvaceae	Seed paste: diseases of skin	Rai 2017
79	Guduchi/Giloy	<i>Tinospora cordifolia</i> (Thunb) Miers	Menispermaceae	Root extract: snake bite, fever, cough, jaundice, malaria, typhoid	Jain et.al. 2010; Ahirwar and Shakya 2015; Rai 2017
80	Chinese chaste tree/Nirgundi	<i>Vitex negundo</i> L.	Verbenaceae	Leaf: asthma, sinusitis, tonsillitis, lung disease, enlarged spleen, arthritis, rheumatism, repellent for insects & bedbugs Leaf oil: arthritis	Ravishankar and Shukla 2007; Jaryan et.al. 2010; Rai 2017

81	Winter cherry/Ashwagandha	<i>Withania somnifera</i> (L.)Dun al.	Solanaceae	Root: antioxidants rich, sedative, aphrodisiac, promotes good memory	Scartezzini and Speroni 2000; Ravishankar and Shukla 2007
82	Ginger/Adrak	<i>Zinger officinale</i> Rosc.	Zingiberaceae	Rhizome paste: carminative, appetizer, aphrodisiac, jointpain, cough, fever, diarrhea, asthma, soothes the skin, destroys germs	Ravishankar and Shukla 2007; Mazid et. al. 2012; Uprety et.al. 2016

Plants protected by indigenous people in sacred groves as part of *in-situ* biodiversity conservation

Sacred groves are forest areas left undisturbed and protected by the locals (King et al.1997). Anthropogenic activities in these areas are prohibited, which has helped the groves to develop into old-growth forests. The practice of safeguarding sacred groves is ancient, dating back to a time when tree worship was quite prevalent. This traditional practice in India based on religious faith has significantly contributed to nature conservation. Sacred groves continue to be of spiritual significance to tribals. These plant species have medicinal value and are also essential for their rituals, festivals, and ceremonial practices. Forest areas and sacred groves promote religious beliefs and thus help to conserve biodiversity (Amirthalingam 2016). *In-situ* conservation in the sacred groves is a centuries-old ecological tradition that safeguards the entire ecosystem as well as many species in their native habitats. The richness of plant diversity in the sacred groves also contributes to preserving and maintaining the gene pool (Amirthalingam 2016). The ecological services provided by the sacred groves are vital. They serve as water catchments and prevent soil erosion. The sacred groves with dense vegetation have a high carbon sequestration potential and contribute to lower CO₂ levels in the atmosphere (Rana et al. 2016). Indigenous communities understand the need to protect plants of medicinal and religious significance in the sacred groves (Table 4).

Table 4: Plants protected by indigenous people in the sacred groves

S.No.	Common name (English/Hindi)	Botanical name	Family	Uses/beliefs	References
1	Billy goat weed/Jangli pudina	<i>Ageratum conyzoides</i> L.	Asteraceae	Medicinal	Jeeva et.al.2006
2	Scholar tree/Saptaparni	<i>Alstonia scholaris</i> (L) R.Br.	Apocynaceae	Medicinal/ ritual	Datta et.al.2014; Sharma et. al. 2014
3	Spiny Bamboo/Baans	<i>Bambusa arundinacea</i> (Retz.) Willd.	Poaceae	Medicinal/Ritual	Kumar and Kumari 2021
4	Malabar Bauhinia/Kachnar	<i>Bauhinia malabarica</i> Roxb.	Fabaceae	Ritual	Chandrakar et.al. 2014
5	Himalayan birch/Bhoj patra	<i>Betula utilis</i> D. Don	Betulaceae	Ritual/sacred	Thaplyal et.al. 2012; Kandari et.al. 2014; Rana et.al. 2016
6	Ngai camphor/Kukronda	<i>Blumea balsamifera</i> (L.) DC.	Compositae	Ritual/medicine	Kandari et.al. 2014; Rana et.al. 2016
7	Indian frankincense/Salai guggul	<i>Boswellia serrata</i> Roxb. exColebr.	Burseraceae	Household/sacred	Bhogaonkar et.al. 2010; Soumya et.al. 2019
8	Flame of forest/Palash	<i>Butea monosperma</i> (Lam.) Taub.	Fabaceae	Medicinal/dye/ Sacred	Das et.al. 2011
9	Giant milkweed/Safed Aak	<i>Calotropis gigantea</i> (L) Dryand.	Apocynaceae	Medicinal/Sacred	Kumar and Kumari 2021

10	Rubber Bush/Aak	<i>Calotropis procera</i> (Willd.) R. Br.	Apocynaceae	Medicinal/Sacred	Chandrakar et.al 2014; Kandari et.al. 2014; Parihar and Balekar 2016
11	Karanda/Karonda	<i>Carissa carandas</i> L.	Apocynaceae	Medicinal	Kaunda and Zhang 2017
12	Cedar/Deodar	<i>Cedrus deodara</i> (Roxb.) G.Don.	Pinaceae	Sacred	Kandari et.al. 2014; Rana et.al. 2016
13	Coconut/Nariyal.	<i>Cocos nucifera</i> L.	Arecaceae	Medicinal/Ritual	Chandrakar et.al. 2014; Sharma et. al. 2014
14	Indian cherry/lasure	<i>Cordia dichotoma</i> G.Forst.	Boraginaceae	Medicinal/Ritual	Rathore 2009; Ahuja et. al. 2020
15	Jimson weed/Datura	<i>Datura stramonium</i> L.	Solanaceae	medicinal/Ritual	Kandari et.al. 2014; Rana et.al. 2016
16	Mottled ebony/Bistendu	<i>Diospyros cordifolia</i> Roxb.	Ebenaceae	Medicinal	Mall 2016
17	Black ebony/Tendu	<i>Diospyros melanoxylon</i> Roxb.	Ebenaceae	Medicinal	Chandrakar et.al. 2014
18	Blue Marbletree/Rudraksha	<i>Elaeocarpus ganitrus</i> Roxb.	Elaeocarpaceae	Ritual/Sacred	Kandari et.al. 2014; Rana et.al. 2016
19	Banyan tree/Bargad	<i>Ficus benghalensis</i> L.	Moraceae	Ritual/sacred	Kandari et. al. 2014; Rana et. al. 2016

20	Sacred Fig tree/Peepal	<i>Ficus religiosa</i> L.	Moraceae	Sacred	Chandrakar et. al. 2014;Kandari et.al. 2014; Sharma et. al. 2014; Rana et. al. 2016
21	Seabuckthorn/Chharma	<i>Hippophae rhamnoides</i> L.	Elaeagnaceae	Sacred	Thaplyal et.al. 2012
22	Indian Buttertreet/Mahua	<i>Madhuca latifolia</i> (Roxb.)A.Chev.	Sapotaceae	Medicinal /Sacred	Chandrakar et. al. 2014
23	Mango/Aam	<i>Mangifera indica</i> L.	Anacardiaceae	Ritual	Kandari et.al. 2014; Sharma et al.2014; Rana et al. 2016
24	Banana/Kela	<i>Musa paradisiaca</i> L.	Musaceae	Ritual	Kandari et.al.2014; Sharma et al.2014; Rana et. al. 2016
25	Holy Basil/Tulsi	<i>Ocimum sanctum</i> L.	Lamiaceae	Medicinal/Sacred	Kandari et.al. 2014; Sharma et.al.2014; Rana et.al. 2016
26	Himalayan longleaf pine/Chir	<i>Pinus roxburghii</i> Sarg.	Pinaceae	Ritual	Kandari et.al. 2014; Rana et.al.2016
27	White leadwort/Chitrak	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Medicinal	Jeeva et.al. 2006; Jaryan et. al. 2010
28	Khejri tree/Khejri	<i>Prosopis cineraria</i> (L.)Druce	Leguminosae	Ritual	Kandari et. al. 2014; Rana et. al. 2016

29	Pomegranate/Anar	<i>Punica granatum</i> L.	Lythraceae	Ritual	Kandari et.al. 2014; Rana et.al. 2016
30	Banj oak/Ban oak	<i>Quercus leucotrichophora</i> A.Camus	Fagaceae	Sacred	Kandari et. al. 2014; Rana et.al. 2016
31	Serpentine wood/Sarpagandha	<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	Apocynaceae	Medicinal	Chandrakar et.al. 2014
32	Castor/Arand	<i>Ricinus communis</i> L.	Euphorbiaceae	Ritual	Jaryan et.al. 2010
33	Sandalwood/Chandan	<i>Santalum album</i> L.	Santalaceae	Ritual	Kandari et.al. 2014; Sharma et. al. 2014; Rana et. al. 2016
34	Brahma Lotus/Brahma Kamal	<i>Saussurea obvallata</i> (DC.)Sch. Bip.	Asteraceae	Sacred	Kandari et.al. 2014; Rana et.al. 2016
35	Sal tree/Sakhua	<i>Shorea robusta</i> Gaertn.f.	Dipterocarpaceae	Ritual/Sacred	Chandrakar et.al. 2014; Das et. al. 2016
36	Prickly ivy/Salsa	<i>Smilax prolifera</i> Roxb.	Liliaceae	Medicinal	Jeeva et.al. 2006
37	Arjuna/Arjun	<i>Terminalia arjuna</i> (Roxb. exDC.) Wight & Arn.	Combretaceae	Medicinal/Ritual	Kandari et. al. 2014; Sharma et. al. 2014; Rana et. al. 2016

38	Myrobalan/Baheda	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Medicinal/Ritual	Chandrakar et. al. 2014
39	Myrobalan/Harad	<i>Terminalia chebula</i> Retz	Combretaceae	Medicinal/Ritual	Jeeva et.al. 2006; Sharma et. al. 2014
40	Winter cherry/Ashwagandha	<i>Withania somnifera</i> L.	Solanaceae	Medicinal/Ritual	Chandrakar et.al. 2014
41	Winged PricklyAsh/Tejphal	<i>Zanthoxylum armatum</i> DC.	Rutaceae	Medicinal/Ritual	Kandari et.al. 2014; Rana et. al. 2016

Plants protected by indigenous people for cultural, religious, and traditional beliefs

India is a country with varied cultural and religious traditions. Plants are extensively used during various religious activities. Rituals and beliefs of the local communities keep the plant diversity preserved. For rituals and ceremonies, wood, root, stem, leaves, flowers, and fruits are used. These are also offered to the deities. The tree worship tradition is followed in several parts of the world by various ethnic societies that facilitate the conservation of multiple plant species (Rana et al. 2016). The customs and festivals of tribals are intricately related to the flora in the surroundings, which is maintained and protected by indigenous people (Table 5).

Table 5: List of plants protected for cultural, traditional, and religious beliefs

S. No	Common name (English/Hindi)	Botanical name	Family	Reasons for conservation of plants	References
1	Black catechu/Supari	<i>Acacia catechu</i> Willd.	Mimosaceae	Worshiped for family welfare	Kumar and Kumari 2021
2	Stone apple/Bael	<i>Aegle marmelo</i> (L.) Correa	Rutaceae	Leaves are offered to Gods during worship	Dutta et.al. 2014; Sharma et.al. 2014; Ahirwar 2015
3	Flame of forest/Palash	<i>Butea monosperma</i> , (Lam.) Taub.	Fabaceae	The leaves and flowers are offered while worshipping. Flowers are also used during the festival of Holi	Rana et.al. 2016; Kumar and Kumari 2021

4	Rubber Bush/Aak	<i>Calotropis procera</i> R. Br.	Asclepiadaceae	Idols of Gods are washed with the plant's latex. Flowers are offered to Gods while praying.	Ahirwar 2015; Rana et.al. 2016; Kumar and Kumari 2021
5	Giant Dodder/Amarbel	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Iron tools are worshiped by some tribes as their sacred objects. They whirl up the plant stems on their implements to honor their Gods.	Ahirwar 2015
6	Bermuda Grass/Doob	<i>Cynodon dactylon</i> Pers.	Poaceae	Offered to different deities during rituals. Grass is used to sprinkle water on holy occasions.	Sharma et. al. 2014; Ahirwar 2015; Rana et.al. 2016; Kumar and Kumari 2021
7	Devil's Trumpet/Datura	<i>Datura metel</i> L.	Solanaceae	Fruits and seeds are offered while praying and are consumed as a grace.	Ahirwar 2015; Kumar and Kumari 2021
8	Hard bamboo/Baans	<i>Dendrocalamus strictus</i> Nees.	Poaceae	Immature culms are considered auspicious at the time of marriage.	Ahirwar 2015

9	Sacred fig tree/Peepal	<i>Ficus religiosa</i> L.	Moraceae	The tree is worshiped to please the planet Saturn. This tree is thought to be the abode of Gods.	Ahirwar 2015; Kumar and Kumari 2021
10	Honey tree/Mahua	<i>Madhuca longifolia</i> (J.Koenig) Macbr	Sapotaceae	A branch is erected in front of the house with a red flag. Believe to ward off evil spirits.	Ahirwar 2015; Rana et.al. 2016; Kumar and Kumari 2021
11	Mango/Aam	<i>Mangifera indica</i> L.	Anacardiaceae	Leaves used on auspicious occasions, rituals, religious ceremonies	Sharma et.al. 2014; Kumar and Kumari 2021
12	Banana/Kela	<i>Musa paradisiaca</i> L.	Musaceae	Leaves used on auspicious occasions	Sharma et.al. 2014; Kumar et al. 2020
13	Holy Basil/Tulsi	<i>Ocimum sanctum</i> L.	Lamiaceae	Regarded as a holy/sacred plant. Grown in the homes of all Hindu tribes	Sharma et.al. 2014; Ahirwar 2015; Kumar and Kumari 2021
14	Wild rice/Dhan	<i>Oryza coarchata</i> Griff.	Poaceae	Grains used in religious ceremonies	Kumar and Kumari 2021
15	Sandalwood/Chandan	<i>Santalum album</i> L.	Santalaceae	This tree is considered sacred and is worshiped in various ceremonies. The wood is also used in a funeral pyre. It is believed that applying sandalwood paste keeps the mind fresh and protects from the evil gaze	Sharma et.al. 2014; Rana et.al. 2016

16	Indian jujube/Ber	<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	Fruits used during festivals and while performing ceremonies	Rana et.al. 2016
----	-------------------	---------------------------------	------------	--	------------------

Environmental movements initiated by tribals

Several studies indicate that indigenous people play a crucial role, sometimes even more than government organizations in conservation. The rate of deforestation in indigenous and tribal lands is considerably lower (Jones 2021). Nonetheless, the impact of these communities on global conservation efforts is unnoticed. A large number of environmental movements have been initiated, in India, by tribals that concern the protection of the environment, livelihoods, distribution of resources, and socio-economic issues. Biodiversity conservation was not the primary objective of these movements, but since these resulted in the protection and restoration of ecosystems, it led to biodiversity conservation. There are numerous examples all across India, proving the efforts of indigenous peoples as environmental saviors. Some of these movements and initiatives are the Bishnoi movement (1700's), Jungle Bachao Andolan (1982), Gandhamardan movement (1980's), Narmada Bachao Andolan (1985), Save-Matanuvans movement (2013), and Thengapalli community practice (1970's).

- **The Bishnoi movement** was an organized and coordinated eco-conservation movement. 363 Bishnois sacrificed their lives while protecting the trees being cut down by the king's soldiers for a new palace. The Bishnoi community strictly forbids the harming of trees and animals and is often called the protector of wildlife and the environment. The Bishnoi community stood firm against cutting trees and continued to oppose deforestation. This movement developed the strategy for protecting trees by hugging or embracing them. The Chipko movement of the 1970s, the nonviolent resistance by the Himalayan villagers to prevent logging, had its roots in the Bishnoi resistance in 1730. The Bishnoi movement is considered as one of the many grassroot environmental movements in the country (Alam and Halder 2018).

- **Jungle Bachao Andolan** was initiated in 1982. The protest started by the tribals of Singhbhum district in Bihar when the government decided to substitute the sal forests with the commercially viable teak. This movement was popularly referred to as “Greed Game Political Populism”. Subsequently, the movement spread to Orissa and Jharkhand, as Jharkhand Jungle Bachao Andolan, which emerged as an initiative to launch a campaign to safeguard the tribals’ forest rights in Jharkhand. The tribals understood that they could protect their forests only by recognizing their rights over forests.
Suryamani Bhagat, an indigenous forest activist, is working to protect valuable forests with the help of other women in the village of Kotari, in Jharkhand. She started with 15 tribal women as part of the Jharkhand Save the Forest Movement to oppose attempts by government officials to plant highly-priced teak that had no consumption value for the locals who rely on the forest (Anantharaman 2016; Menon 2016).
- **Gandhamardan movement** The Gandhamardan hills are known as Ayurveda Paradise due to the unique biodiversity of medicinal plants, orchids, and other species. Many medicinal plant species that were plentiful, such as *Clerodendrum indicum*, *Rauvolfia serpentina*, and *Plumbago zeylanica* have become uncommon. The hills that provide a livelihood to the tribal people and are essential for balancing the ecology of the region, witnessed one of India's most vocal people's struggles to conserve forests and livelihood. The hills are rich in bauxite. The movement took place to protect Gandhamardan Hill from the mining operations of the Balco (Bharat Aluminum Company) in the 1980s by the tribals whose survival was directly threatened by the mining of bauxite deposits. BALCO's project threatened to deforest and desertify hills where the inhabitants believe in religious traditions. The project endangered the daily existence of thousands of self-sufficient farmers who faced eviction from the soil they had tilled for generations. Local communities in the Gandhamardan hills started a movement to preserve the region's rich biodiversity. Tribals opposed the modern concept of development, which involves relocating local people while also allowing mining. A five-year sustained campaign by the local people saw Balco shut down its operation to mine 213 million tonnes of bauxite. It was an achievement for the forest-dependent people of western Orissa and the region's ecology. These communities have succeeded in safeguarding forests and resources from corporate interests. The campaign inspired several struggles across Odisha (Down to earth 2001).
- **Narmada Bachao Andolan (NBA)** is a tribal, environmentalist, and human rights activist - led social movement that emerged to oppose several large dam projects across the river Narmada for their huge ecological and social impact. The Sardar Sarovar Dam is one of the largest dams on the Narmada River. It provides water for agriculture and electricity to Gujarat, Maharashtra, and Madhya Pradesh. According to an environment impact assessment report, conducted by the Wildlife Institute of India, Dehradun, on the Narmada Sagar Project, several species with considerable ethnobotanical value in the area were

apprehended to face extinction because of the submergence of the area due to the construction of the dam (Jain 1994). Tribal groups and villagers that were displaced by the reservoir's inundation opposed the project. Several mass protests resulted in a movement against the project to prevent the destruction of local ecosystems and the eviction of about a million people (Jain 1994; Mallick 2021).

- **Save-Matanuvans movement** was a conservation movement started by NGOs, villagers, and tribals to protect their diminishing “sacred” forest area known locally as the Matanuvans. The tribal villages in the Jhabua district of Madhya Pradesh have Matanuvans, where the villagers worship their tribal gods to seek protection from evil forces. Earlier, the natives guarded these forests and prohibited anyone from felling trees. However, due to globalization and external interference, the tribals lost control over the management of forest resources. Consequently, these forested areas started diminishing due to encroachment, urbanization, and irresponsible felling of trees. It deprived the natives of forest resources that were important for their livelihoods. Seeing the slow death of the Matanuvans, NGOs, tribals, and local people restored the forests by planting saplings in over a hundred villages in the district. With the save-Matanuvans movement gaining momentum, an increasing number of indigenous people began venturing into the forests to pray and save the trees (Singh and Mitra 2017).
- **Community practice of 'Thengapalli'** For the past decades' tribal women have been voluntarily safeguarding and protecting the forests in Odisha. Women patrol the forest in small groups of four to six, armed with a stick, to drive the timber thieves away. The practice is known as Thengapalli. It is a term that combines the words thenga, which means stick, and palli, which means turn. The practice began in the early 1970s in Odisha's Nayagarh district but gained popularity in the 1990s when women joined men in protecting forests. In 300 villages in the district Nayagarh, women are responsible for keeping a watch over forests. In the Gunduribadi village, the forest protection committee led by women participated in the restoration of around 500 acres of forest land (Down to earth 2015; IANS 2021; Nitnaware 2021).
- **Mayilamma**, an Indian social activist from a tribal community in Plachimada in Palakkad, Kerala, is the most well-known face of the local community's fight for water conservation. She played a critical role in the campaign holding Coca-Cola responsible for water scarcity and pollution in Plachimada in Palakkad, Kerala (Menon 2016). She launched a satyagraha against the soft drink giant on April 22, 2002. The community compelled the company to shut down its bottling plant in March 2004 under her leadership, for which she received the Sthree Shakthi Award.

The practice of shifting agriculture by the tribals

Ethnic people look after their forest and environment because their livelihood and survival depend on it. They have managed their agricultural lands for generations and are excellent conservationists. Slash and burn or shifting cultivation is a primitive agricultural practice extensively followed by the tribals (Das and Das 2014; Swami 2018; Gabay 2020). The cultivated plants in the area are harvested and then cut down and burned, leaving the ashes to enrich the soil. To restore the fertility of the land, it is left fallow for many years after farming (Swami 2018). Soil organic matter is naturally replenished during the fallow period, thus improving soil structure and preventing soil erosion. The farmers relocate to a new area to cultivate. However, the tribals do not clear the forests entirely but keep several beneficial agricultural species. Valuable plants invade abandoned regions. A variety of food crops like bananas, rice, maize, cotton, millet, and cassava are grown on the land for subsistence purposes. Shifting cultivation is eco-friendly because it is organic farming and is an effective and sustainable system that has fulfilled the needs of the tribes for generations. Rather than destroying biodiversity, tribal people are being recognized for their contributions to preserving the diversity of forest areas and their environment. This shows that the tribals have a reciprocal relationship with the environment.

However, recent insights suggest that shifting agriculture causes immense harm to the forest ecosystem. Traditional farming practices have resulted in shrinking green cover in the area. It was envisaged that shifting cultivation was harmful to environmental health and was one of the primary reasons for deforestation and soil erosion (Pendharkar 2018). The fallow periods of 10-15 years have been cut down to just five years. Due to increasing urbanization and shorter fallow periods, natural vegetation regeneration is hampered, causing irreversible damage to the forest. However, some ecologists highlight that shifting agriculture should not be taken as destroying forests. The peculiar nature of this practice allows the use of land for agriculture, followed by the land being held fallow for sufficient time to regain forest cover. It is a sustainable mode of practicing agriculture in forest land where continued cultivation of the same field, without adding fertilizers, would be detrimental to the fertility of the soil. In such conditions, it may be preferable to cultivate the land for a short period and then leave and move on to another field before the soil is depleted of nutrients completely (Malik 2003).

Conclusion

Tribal people play a significant role in biodiversity protection as they understand that it is essential to save the environment from destruction to effectively manage natural resources for livelihood and economic equity. Indigenous and local knowledge is—and will be—a vital part of protecting the earth's biodiversity and the overall health of ecosystems. However, indigenous knowledge is getting lost due to diminishing forest cover and wresting control over forests from the indigenous tribal people. In the current scenario, the long-term management and conservation of valuable plant species are imperative. The government must acknowledge and support indigenous-led efforts like biodiversity conservation and forest management. Community engagement and increased awareness about the judicious harvesting of plants among the indigenous people must be given

priority. Indigenous people must be encouraged to be more actively involved in biodiversity conservation projects and programs. The government needs to promote funding to train the indigenous people. Cooperation and knowledge sharing among tribals, social activists, and government officials will result in better biodiversity conservation. It is important to amend the socioeconomic conditions of indigenous people living around the area to limit human activities and prevent the depletion of natural resources. It would promote the sustainable development of local geographies and ecosystems and enhance the quality of life, thereby empowering local communities, generating skills, and cultivating the spirit of entrepreneurship.

Declaration of competing interests

The authors declare no known competing financial interests and personal relationships that could have appeared to influence the work reported in this article.

Acknowledgments

The authors are grateful to Dr. Ravi Gupta, Assistant Professor, College of General Education, Kookmin University, Seoul, South Korea, for his valuable suggestions that immensely helped in the preparation of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References:

- Ahirwar RK. 2015. Indigenous Knowledge of Traditional Magico Religious Beliefs Plants of District Anuppur, Madhya Pradesh, India. *American Journal of Ethnomedicine* 2 (2).
- Ahirwar RK, Shakya VS. 2015. An Investigation of Some Ethnobotanical Plants Used by Tribes of District Shahdol, Madhya Pradesh, Central India. *International Journal of Advanced Research in Biological Sciences* 2(8):29–34.
- Ahuja SC, Ahuja S, Ahuja U. 2020. Nutraceutical Wild Fruits of India-Lasora (*Cordia*)-History, Origin, and Folklore. *Scholars Academic Journal of Biosciences* 8(7):187-209.
- Alam K, Halder UK. 2018. A pioneer of environmental movements in India: the Bishnoi movement. *Journal of Education & Development* 8(15):283-287.
- Alawa KS, Ray S. 2016. Ethnobotany: Some wild Vegetable Plants used by Tribals of Dhar District, Madhya Pradesh. *Indian Journal of Applied & Pure Biology*. 31(1):65-69.

- Allen RP, Allen CP. 1985. What's Wildlife Worth?: Tourism Recreation Research. 10(2):57.
- Amirthalingam M. 2016. Sacred Groves of India – An Overview. International Journal of Current Research in Biosciences and Plant Biology. 3(4):64-74.
- Anantharaman L. 2016. Available at <https://www.thehindu.com/features/metroplus/Seeing-the-forests-and-the-trees/article14382543.ece> [Date Accessed: 3 September 2022]
- Anju K, Jegadeeshwari LA, Lakshmi VD, Gandhi NN, 2018. A review of Indian tribal plants and their biogenic properties. Asian J Pharmaceutical and Clinical Research. 11(4):43-49.
- Arisdason W, Lakshminarasimhan P. 2020. Status of Plant Diversity in India: an overview http://www.bsienvi.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx#:~:text=Besides%20147%20genera%20are%20endemic,widely%20distributed%20throughout%20the%20country [Date Accessed: 1 Sept 2022]
- Arora RK. 1991. Plant diversity in the Indian gene centre. In: Paroda RS, Arora RK, editors. Plant Genetic resources Conservation and Management IBPGR, Regional Office for South and Southeast Asia, New Delhi.
- Bhandary M, Jayakary. 2020. *Alstonia scholaris* in the ethnomedicinal and religious tradition of Coastal Karnataka, India. Biodiversitas. 21(4):1569-1577.
- Bharali P, Sharma M, Sharma CL, Singh B. 2017. Ethnobotanical survey of spices and condiments used by some tribes of Arunachal Pradesh. Journal of medicinal plant studies. 5(1): 101-109.
- Bhogaonkar PY, Marathe VR, Kshirsagar PP. 2010. Documentation of Wild Edible Plants of Melghat Forest, Dist. Amravati, Maharashtra State, India, Ethnobotanical Leaflets: 2010(7) Article 5:751-758.
- Bose D, Roy GJ, Mahapatra S, Datta T, Mahapatra S, Biswas H. 2015. Medicinal plants used by tribals in Jalpaiguri district, West Bengal, India Journal of Medicinal Plants Studies. 3(3): 15-21.
- Census India. 2011. Available at <https://tribal.nic.in/ST/Statistics8518.pdf>. [Date Accessed: 17 May 2022]
- Chacko S. 2021. Forests under indigenous people more protected, says new report. Down To Earth. Available at <https://www.downtoearth.org.in/news/environment/forests-under-indigenous-people-more-protected-says-new-report-76193>. [Date Accessed: 31 August 2022]

Chandrakar K, Verma DK, Sharma D, Yadav KC. 2014 A Study on the Role of Sacred Groves in Conserving the Genetic Diversity of the Rare, Endangered and Threatened Species of Flora & Fauna of Chhattisgarh State (India). International Journal of Scientific and Research Publications,4(1):1-5.

Chandramouli C. 2011 Census India. 2011. Scheduled Tribes in India. Available at https://tribal.nic.in/downloads/Statistics/3-STinindiaascensus2011_compressed.pdf. [Date Accessed: 1 September 2022]

Chaudhry P, Murtem G. 2017. An Ethno botanical note of the plant species used by local tribes for dwelling purposes in the Eastern Himalaya of India and some forest management related pressing issues. Ecological Questions 27(3): 53–64.

Chauhan D, Shrivastava AK, Patra S. 2014. Diversity of leafy vegetables used by tribal peoples of Chhattisgarh, India. Int.J.Curr.Microbiol.App.Sci 3(4):611-622.

Das S, Das M. 2014. Shifting Cultivation in Tripura – A Critical Analysis. Journal of Agriculture and Life Sciences 1(1):48-54.

Das P, Imam I, Mallick K, Mazumder A, Ghosh J, Mitra B. 2016. Present status of sacred groves in Southern and South-Western parts of the Purulia district of West Bengal, India: An inventory from eight administrative blocks. International Journal of Entomology Research. 1(3):18-25.

Das MA, Mazumder PM, Das S, Das S. 2011. *Butea monosperma* (LAM.) Kuntze – A comprehensive review International Research Journal of Plant Science. 2(7):215--219.

Datta T, Patra AK, Dastidar S. 2014. Medicinal plants used by tribal population of Coochbehar district, West Bengal, India-an ethnobotanical survey. Asian Pac J Trop Biomed. 4(Suppl 1): S478–S482.

Dey A, De JN. 2011. Ethnobotanical aspects of *Rauvolfia serpentina* (L). Benth. ex Kurz. in India, Nepal and Bangladesh. Journal of Medicinal Plants Research. 5(2):144-150.

Down to Earth 1994 The drowning of biodiversity
Available at <https://www.downtoearth.org.in/news/the-drowning-of-biodiversity-32572>
[Date Accessed: 6 September 2022]

Down to Earth 2001. Available at: <https://www.downtoearth.org.in/coverage/gandhamardan-revisited-16391> [Date Accessed: 7 September 2022]

Down to Earth 2015. Available at <https://www.downtoearth.org.in/coverage/a-journey-called-change-49624> [Date Accessed: 7 September 2022]

Dutta A, Lal N, Naaz, M, Ghosh, A, Verma, R. 2014. Ethnological and Ethno-medicinal Importance of *Aegle marmelos* (L.) Corr (Bael) Among Indigenous People of India. American Journal of Ethnomedicine. 1(5):290-312.

Gabay A. 2020. Why do indigenous communities persist with practicing shifting cultivation? <https://india.mongabay.com/2020/06/why-do-indigenous-communities-persist-with-practising-shifting-cultivation/>

Gowthami R, Sharma N, Pandey R, Agrawal A. 2021. Status and consolidated list of threatened medicinal plants of India. Genet Resour Crop Evol 68, 2235–2263.

Gupta A, Kumar R, Bhattacharyya P, Bishayee A, Pandey AK. 2020. *Terminalia bellirica* (Gaertn.) Roxb. (Bahera) in health and disease: A systematic and comprehensive review. Phytomedicine. 77(7):153278.

Gurung TR. 2017. Community-Based Non-Wood Forest Products Enterprise: A Sustainable Business Model. SAARC Agriculture Centre. Centre on Integrated Rural Development for Asia and the Pacific.

IANS 2021. Odisha Day: Odisha Women Lead Forest Conservation Movement With Undying Resolve As Green Warriors

<https://weather.com/en-IN/india/environment/news/2021-04-01-odisha-women-lead-forest-conservation-movement-with-undying> [Date Accessed: 3 September 2022]

ISFR 2017. Forest Survey of India (FSI), Ministry of Environment, Forest & Climate Change, Government of India. Available at <https://fsi.nic.in/isfr2017/isfr-forest-cover-2017.pdf> [Date Accessed: 3 September 2022]

ISFR 2021. Forest Survey of India (FSI), Ministry of Environment, Forest & Climate Change, Government of India.

Available at

<https://static.pib.gov.in/WriteReadData/specificdocs/documents/2022/jan/doc20221207001.pdf>
[Date Accessed: 3 September 2022]

Jain DL, Baheti AM, Jain SR, Khandelwal, KR. 2010. Use of medicinal plants among tribes in Satpura region of Dhule and Jalgaon districts and Maharashtra - An ethnobotanical survey. Indian Journal of Traditional Knowledge. 9(1):152-157.

- Jain SK .1996. Ethnobiology in Human welfare. Available at https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004221610299468katiyar_bot_Plan t_Resources_of_Ethnic_Tribes.pdf [Date Accessed: 4 September 2022]
- Jamkhande PG, Barde SR, Patwekar SL, Tidke PS. 2013. Plant profile, phytochemistry and pharmacology of *Cordia dichotoma* (Indian cherry): A review; Asian Pac J Trop Biomed. 3(12):1009–1012.
- Jaryan V, Uniyal SK, Gopichand, Singh RD, Lal B, Kumar A, Sharma V. 2010 Role of traditional conservation practice: highlighting the importance of Shivbari sacred grove in biodiversity conservation. Environmentalist 30:101–110.
- Jeeva S, Mishra BP, Venugopal N, Kharlukhi L, and Laloo RC. 2006. Traditional knowledge and biodiversity conservation in the sacred groves of Meghalaya. *Indian Journal of traditional knowledge*, 5(4):563-568.
- Jones B. 2021. Indigenous people are the world’s biggest conservationists, but they rarely get credit for it. <https://www.vox.com/22518592/indigenous-people-serve-nature-icca>
- Kalaria P, Gheewala P, Chakraborty M, Kamath J. 2012. A Phytopharmacological review of *Alstonia scholaris*: a panoramic herbal medicine. International Journal of Research in Ayurveda and Pharmacy. 3 (3):367-371.
- Kambhar SV, Patil RR Dandinnavar S, Hirekudi S. 2020. Ethnobotanical Survey of Medicinal plants in Raibag, Belagavi, Karnataka. International Journal of Botany Studies. 5(6):83-86.
- Kandari LS, Bisht VK, Bhardwaj M, Thakur AK. 2014. Conservation and management of sacredgroves, myths and beliefs of tribal communities: a case study from north-India. Environmental Systems Research. 3(16):1-10.
- Kanethi P, Alapati P and Sulthana SK. 2018. Traditional medicinal practices for mosquito repellency by tribes of west central India: An overview. Journal of Pharmacognosy and Phytochemistry. 7(2):2755-2759.
- Kaunda JS, Zhang YJ. 2017. The Genus *Carissa*: An Ethnopharmacological, Phytochemical and Pharmacological Review. Natural Products and Bioprospecting. 7:181–199.
- Khan MA. 2016 Introduction and Importance of Medicinal Plants and Herbs. Available at https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl [Date Accessed: 3 September 2022]

Khuraijam JS, Huidrom D. 2013. Ethnobotanical uses of medicinal plant, *Justicia adhatoda* L. by Meitei community of Manipur, India. Journal of Coastal Life Medicine. 1(4):322-325.

King EDIO, Viji C, Narasimhan D. 1997. Sacred groves: traditional ecological heritage. International Journal of Ecology and Environmental Sciences. 23:463-470.

Kumar N, Godara SK, Ram S, Pathania R, Bhorla R. 2020. Role of ethnic and indigenous people of north western himalayan region of himachal pradesh in the conservation of phyto- diversity through religious and magico-religious beliefs. International journal of creative research thoughts. 8(7):1846-1855.

Kumar S, Kumari S. 2021. Ethnobotanical plants are used in socio- religious and cultural ceremonies of tribes of Sahibganj district, Jharkhand. International Journal of Creative Research Thoughts. 9(8):377-383.

Kumar SS, Padhan B, Palita SK, Panda D. 2016. Plants used against snakebite by tribal people of Koraput district of Odisha, India. Journal of Medicinal Plants Studies. 4(6):38-42.

Lele Y, Thorve B, Tomar S, Parasnis A. 2017. traditional uses of the wild plants, by the tribal communities of jawhar, palghar, maharashtra, india. International Journal of Botany and Research(IJBR) 7(6):19-22.

Mago P, Gunwal I. 2019. Role of Women in Environment Conservation. Available at SSRN: <https://ssrn.com/abstract=3368066> or <http://dx.doi.org/10.2139/ssrn.3368066>

Malik B. 2003. The 'Problem' of Shifting Cultivation in the Garo Hills of North-East India, 1860–1970. Conservation & Society. 1(2):287-315.

Mall TP. 2016. *Diospyros cordifolia* Roxb. An underexploited potent ethnomedicinal feed- A review World journal of pharmaceutical research. 5(8):472-477.

Mallick SN. 2020. Ethnobotanical study of wild edible food plants used by the tribals and rural populations of Odisha, India for food and livelihood security. Plant Archives. 20(1):661-669.

Mallick K. Narmada Bachao, 2021. Available <https://www.cambridge.org/core/books/abs/environmental-movements-of-india/narmada-bachao-andolan-nba-save-the-narmada/86B51F094B8028AF70A69A5347DBED39> [Date Accessed: 22 April 2022]

Maravi MK, Ahirwar BP, Chaudhry S. 2017. Ethno Medicinal Plants Use by Two Sympatric Tribes of Central India. International Journal of Advanced Herbal Science and Technology. 3(1): 37-48.

https://www.researchgate.net/publication/313190212_Ethno_Medicinal_Plants_Use_by_Two_Sympatric_Tribes_of_Central_India

Mazid M, Khan TA, Mohammad F. 2012. Medicinal Plants of Rural India: A Review of Use by Indian Folks. Indo Global Journal of Pharmaceutical Sciences. 2(3):286-304.

Menon KPS. 2016. Role of Tribal Women in Sustainable Development. Indian journal of applied research. 6(5):272-274.

MOEFCC, Ministry of Environment, Forest & Climate Change, Government of India. 2019 India's State of Forest Report; Forest Survey of India. Available at <http://www.indiaenvironmentportal.org.in/files/file/isfr-fsi-vol1.pdf> [Date Accessed: 6 September 2022]

Mohanty N, Das PK, Panda T. 2011. Use of plant diversity in household and rituals by tribal people of Dhenkanal district, Odisha, India Journal of Applied Pharmaceutical Science 1(4): 79-82.

Mora C, Tittensor DP, Adl S. Simpson AGB, Worm B. 2011. How many species are there on Earth and in the ocean? PLOS Biol. 9(8).

Nitnaware H 2021. How Tribal Women Have Been Protecting 1/3 of Odisha's Forests, All By Themselves. Available at <https://www.thebetterindia.com/255198/odisha-women-tribal-system-kodarapalli-thengapalli-forest-protection-environment-natural-resources-over-exploitation-guard-conservation-him16/> [Date Accessed: 23 August 2022]

Oak G, Kurve P, Kurve S Pejaver M, 2015. Ethno-botanical studies of edible plants used by tribal women of Thane District. Journal of Medicinal Plants Studies. 3(2):90-94.

Pandey A, Negi PS. 2016. Traditional uses, phytochemistry, and pharmacological properties of *Neolamarckia cadamba*: A review. Journal of ethnopharmacology. 181:118-135.

Parihar G, Balekar N. 2016. *Calotropis procera*: A phytochemical and pharmacological review. Thai Journal of Pharmaceutical Sciences. 40 (3):115-131.

Patel AB. 2005. Traditional bamboo used by tribes of Gujarat. Indian Journal of Traditional Knowledge. 4(2):179-184.

Pendharkar V. 2018. Traditional knowledge of a northeast community holds answers to the misunderstood practice of shifting cultivation. Available at <https://india.mongabay.com/2018/07/traditional-knowledge-of-a-northeast-community-holds-answers-to-the-misunderstood-practice-of-shifting-cultivation/>

Rai R. 2017. Promising medicinal plants, their parts, and formulations are prevalent in folk medicine among ethnic communities in Madhya Pradesh, India. *Pharmacy & Pharmacology International Journal*. 5(3):99-106.

Raj AJ, Biswakarma S, Pala NA, Shukla G, Vineeta, Kumar M, Chakravarty S and Bussmann RW. 2018. Indigenous uses of ethnomedicinal plants among forest-dependent communities of Northern Bengal, India. *J Ethnobiology Ethnomedicine* 14, 8
<https://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-018-0208-9>

Rana S, Sharma DK, Paliwal PP. 2016. Ritual Plants Used by Indigenous and Ethnic Societies of District Banswara (South Rajasthan). *India American Journal of Ethnomedicine*. 3:26-34.

Rathore M. 2009. Nutrient content of important fruit trees from arid zone of Rajasthan. *Journal of Horticulture and Forestry* 1(7):103-108.

Raven P, Wackernagel M. 2020. Maintaining biodiversity will define our long-term success. *Plant Diversity*, 42(4):211-220.

Sajem AL, Gosai K. 2010. Ethnobotanical investigations among the Lushai tribes in North Cachar Hills district of Assam, Northeast India. *Indian Journal of Traditional Knowledge*. 9(1): 108-113.

Saradha M, Samyudurai P, Jeevith S, Panneerselvam K. 2016. Traditional knowledge of cultivated cereals for their food security in irular tribe of Palamalai hills, a part of Western Ghats of Coimbatore, Tamil Nadu, India. *International Journal of Bioresource Science*. 3(1): 65-68 .

Scartezzini P, Speroni E. 2000. Review on some plants of Indian traditional medicine with antioxidant activity. *J Ethnopharmacol*. 71 (1-2):23-43.

Sharma TP, Borthakur SK. 2008. Ethnobotanical observations on Bamboos among Adi tribes in Arunachal Pradesh. *Indian Journal of Traditional Knowledge*. 7(4):594-597.

Sharma UK, Pegu S. 2011. Ethnobotany of religious and supernatural beliefs of the Missing Tribes of Assam, with special reference to the 'Dobur Uie'. *Journal of Ethnobiology and Ethnomedicine* 7(16).

Sharma M, Sharma CL, Debbarma J. 2014. Ethnobotanical studies of some plants used by the Tripuri tribe of Tripura, NE India, with special reference to magico religious beliefs. International Journal of Plant, Animal, and Environmental Studies. 4 (3):518-528.

Shukla S, Bhargava A, Chatterjee A. Srivastava J, Singh N, Singh SP. 2006. "Mineral profile and variability in vegetable amaranth (*Amaranthus tricolor*)," Plant Foods for Human Nutrition. 61(1):23–28.

Singh CB, Mitra PP. 2017. Save-Matanuvans movement turns Madhya Pradesh's tribal heartland green: Matanuvan Movement. Available at <https://www.hindustantimes.com/bhopal/save-matanuvans-movement-turns-madhya-pradesh-s-tribal-heartland-green/story-z2oRwBt2wUDZJ2Ti7LJWvO.html> [Date Accessed: 23 August 2022]

Singh R, Singh A, Babu Neelesh , and Navneet. 2019. Ethno-medicinal and Pharmacological activities of *Aegle marmelos* (Linn.) Corr: A review. The Pharma Innovation Journal. 8(6):176-181.

Singh V. 2017 Medicinal plants and bone healing National Journal of Maxillofacial Surgery. 8(1):4–11.

Sinha RK, Dubey M, Tripathi RD, Kumar A, Tripathi P, Dwivedi S. 2010. India is a Megadiversity Nation. International Society of Environmental Botanists, Environews. 16 (4).

Soni A, Bohra NK. 2021. *Boswellia serrata* - Propagation and uses - A Review. International Journal of Advanced Research in Biological Sciences I. 8(5):35-46.

Soni V. 2010. Conservation of *Commiphora wightii*, an endangered medicinal shrub, through propagation and planting, and education awareness programs in the Aravali Hills of Rajasthan, India. Conservation Evidence. 7:27-31.

Soumya KV, M. Shackleton C, R. Setty S. 2019. Harvesting and Local Knowledge of a Cultural Non-Timber Forest Product (NTFP): Gum-Resin from *Boswellia serrata* Roxb. in Three Protected Areas of the Western Ghats, India. Forests 10(10):907.

Swami S. 2018. Shifting cultivation: A tribal way of life in northeast India and alternative approaches for increasing productivity. The Pharma Innovation Journal. 7(3):380-385.

Thakur A, Singh S, Puri S. 2020. Exploration of Wild Edible Plants Used as Food by Gaddis-A Tribal Community of the Western Himalaya. The Scientific World Journal. 2020.

Thaplyal V, Sharma S, Bhatt AB, 2012. Sacred groves as ethnobotanical gene pools in tribal areas of the western Himalayas in India: case study of Kinnaur district in Himachal Pradesh. *Indian Forester* 138(1):70-83.

Tribal Profile at a Glance May 2014. Available at <https://tribal.nic.in/ST/Tribal%20Profile.pdf>
[Date Accessed: 4 September 2022]

Uniyal SK, Awasthi A, Rawat GS. 2002. Traditional and ethnobotanical uses of plants in Bhagirathi valley (western Himalaya). *Indian Journal of Traditional Knowledge*. 1(1):7–19.

Upreti Y, Poudel RC, Gurung J, Chettri N, Chaudhary RP. 2016. Traditional use and management of NTFPs in Kangchenjunga Landscape: implications for conservation and livelihoods. *Journal of Ethnobiology and Ethnomedicine*.12(19).

Venkateswarlu K. 2012. *Vitex negundo*: Medicinal Values, Biological Activities, Toxicity Studies, Phytopharmacological Actions. *International Journal of Pharmaceutical and Phytopharmacological Research*. 2(2):126-133.

Yesodharan K, Sujana KA. 2007. Wild edible plants traditionally used by the tribes in the Parambikulam wildlife sanctuary, Kerala, India. *Indian Journal of Natural Products and Resources* 6(1):74-80.