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Traditional Medicinal Plant Knowledge among Three Indian Tribal Populations in the Vindhyan Highlands: A Strategy for Their Sustainability and Conservation

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ABSTRACT

The ethnomedicines, utilisation of some edible wild plants for food, and related customary wisdom of the Gond, Kharwar, and Baiga tribes people in the Vindhyan mountain ranges of India were all examined in this study. Overall, Threat Impact (OTI) was used to evaluate anthropogenic threats to valuable species. A semi-structured, open-ended a survey was utilised to gather the data. Out of 36 families, 53 species were employed as wild foods, out of the 95 species there were 88 genera and 48 families that were documented for a variety of medical conditions. Most of the medical treatments were made from trees (44.42%), followed by climbers (12.64%) and herbs (29.47%). Elaeodendron glaucum (1.56) and Cissus quadrangularis (0.96), which have high utilisation high relative frequency of citation (RFC) and value (UV), were utilised to treat issues with poisonous bites and musculoskeletal disorders. Calotropis procera and Cassia tora were recommended for the management of eye and ear conditions issues, respectively, based on the strong consensus factor among informants (1.0) obtained. 9.5 and 24.2 percent of species, respectively, had extremely high and high OTIs for the thirteen categories of anthropogenic threats, moving them closer to extinction. Policies pertaining to wild foods and medicinal plants under different hazard categories must be connected to nutritional security and the preservation of highly prized species.

Keywords*: Ethnomedicines, Nutritional, Anthropogenic, Elaeodendron, Medicinal, Musculoskeletal.*

I. INTRODUCTION

Since ancient times, herbal-based traditional medical methods have been practiced extensively in nearly every nation on Earth (Güneş et al., 2017). In order to preserve human health and ensure the preservation of medicinal plants, ethnomedical knowledge is becoming more and

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more popular globally (Bal-ick 1996). The pharmacological properties of different traditional remedies are being evaluated for potency, which could lead to the development of new drugs (Amjad et al., 2017). The number of therapeutic plants has grown steadily during the last few decades, reaching 50,000 species, or 18.9% of all plants on Earth (Baydoun et al. 2015). According to estimates, between 65 and 80 percent of people in underdeveloped nations rely only on wild food and medicine.[4]

Interest in using herbal remedies in medical systems around the world is demonstrated by the significant demand for and exports from therapeutic plants in many parts of the world. With a growth rate of 15–25%, the global herbal trade, currently valued at over US$800 million annually, is predicted to reach US$50 trillion by 2050 (UN Comtrade 2018).Indigenous tribes possess a lengthy history of using forest plants as wild food and medicine. Although they constitute just 4% of the global populace, indigenous people are in charge of 11% of all forest areas worldwide. They support 80% of the world's biodiversity and are found in or close to 85% of the world's protected areas (Sobre-vila 2008). These groups' traditional wisdom can aid in addressing the famine situation, health issues, and conservation of biodiversity (Pardo-de-Santayana and Macía 2015). According to Uprety et al. (2012), millions of people in underdeveloped nations obtain a significant portion of their income from natural sources. Wild plant products are an essential source of income, particularly for the poor who live in isolated places and rely solely on them for food, fuelwood, medicine, and building materials (Maroyi 2017). Tribal people's food security (Ong and Kim 2017; Whitney et al. 2018) and nutritional and dietary diversity (Heywood 2011) depend heavily on wild food plants. Wild food plants are essential to the development of sustainable livelihoods, which is crucial for enhancing people's socioeconomic circumstances.[5]

Additionally, they offer vitamins, alkaloids, phenolics, and vital oils derived from secondary metabolites (FAO 1996; Arora and Pandey 1996).With 8% of the world's biodiversity on 2% of its territory, India is one of the world's 17 mega-diversity hotspots, which are defined by the richness and endemicity of species in various agro-climatic zones (Vijayakumar et al. 2015). The country's cultural and geographic diversity greatly influences the diversity of ethnomedical knowledge among its various communities. Primarily residing in forests, hills, plateaus, and isolated regions, tribal tribes foster ethnic diversity and indigenous knowledge, which contribute significantly to ethnobotanical study. About 15% of the Indian subcontinent is made up of approximately 5000 tribal settlements that rely on forests (D'Rozario et al., 2004). Over

[4] Balick MJ (1996) Transforming ethnobotany for the new millennium.
[5] FSI (2019) State of Forest Report. Ministry of Environment Forest and Climate change, Dehradun, India

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84.3 million tribal people live in India, comprising 550 227 cultural communities (Pushpangadan and Pradeep 2008).

Tribal people make up 8.6% of the nation's population, according to the 2011 census, with over 33% of the nation's indigenous people residing in the Vindhyan area, which includes the Gujarat, Madhya Pradesh, Uttar Pradesh, Chhattisgarh, and Bihar are the five states. Numerous tribal communities, including the Chero, Agaria, Kol, Panika, Gond, Kharwar, and Baiga, may be found in the Vindhyan highlands. The ecosystem and environment in which these communities obtain their daily dietary supplements from nature are closely related. It's intriguing to see how different communities living in the same area have different ethnomedical practices and expertise. They provide comprehensive information on how culture can alter how people view nature and emphasise the relationship between humans and nature (Pieroni 2017; Shaheen et al. 2017). The use of natural remedies for traditional herbalists such as Rajbaiga, Vaidya, and shamans rely on the treatment of various illnesses by the region's tribal and non-tribal inhabitants. However, because of lopping, overgrazing, burning, and cleansing for agriculture, the valued plant species that these activities are founded on have drastically decreased (Jha and Singh 1990). Anthropogenic activities like as mining, cement factories, and hydropower facilities have caused irreversible modifications to the natural vegetation (Chaturvedi et al. 2012). In addition, illicit tree-cutting, extensive lopping, unregulated non-timber gathering, and the introduction of alien species pose a threat to natural vegetation (Sagar et al., 2003; Sharma and Raghubanshi, 2007). Numerous qualitative studies of tribal groups from various regions of India have been published.

However, there is little information available about the medicinal plants that various tribal communities in the Vindhyan highlands employ (Narayan and Singh 2017; Singh and Dubey 2012; Singh et al. 2012).The usage of wild edible kinds and traditional knowledge of therapeutic plants have not been thoroughly studied by the earlier researchers. Therefore, in order to assess the utilisation of wild edibles as vitamin supplements, culture-based herbal practices, and related information that supplied nature-based nutritional solutions, we took into consideration three different tribal populations in this study: the Baiga, Kharwar, and Gond. The OTI, or total threat effect, on species of medicinal plants was another way we assessed different threat drivers before proposing nature-based management and sustainable conservation strategies.[6]

II. SUPPLIES AND TECHNIQUES

[6] Bultosa G, Molapisi M, Tselaesele N, Kobue-Lekalake R, Haki GD, Makhabu S, Sekwati-Monang B, Seifu E, Nthoiwa GP (2020), Plant-based traditional foods and beverages of Ramotswa Village, Botswana. J Ethnic Foods 7(1):1.

(A) Study Space

Three villages were the sites of the study, namely The Vindhyan highlands, which include Gardarva, Saudih, and Rajkhar, are located in the Sonbhadra district of Uttar Pradesh, India (21° 29'–25° 11' N and 78° 15'–84° 15' E). They range in elevation above mean sea level, between 313 and 483 meters. The region experiences three separate seasons (summer, wet, and winter) under the tropical monsoon. The average yearly precipitation is 28°C, while the average yearly temperature is 1419.2mm. The district of Sonbhadra has 36.79% of its total land covered by forests (6905 km2), with 130 km2 of that area being very dense, 967 km2 being somewhat thick, and 1443.29 km2 being open forest, as per the Forest Survey of India (2019). Four states around the district: Jharkhand in the south, in the south, Chhattisgarh, and Madhya Pradesh in the west Bihar in the northeast and the south-east. The red lateritic soil, known locally as "Murram," has noticeable nodules and is sandy loam in texture. It is also extremely nutrient-deficient. Every year, the region experiences a dry spell lasting seven to eight months. The demand for food cannot be met by rain-fed, nutrient-poor agriculture. Tribal populations suffer from persistent food shortages and nutritional problems as a result of these situations.[7]

(B) The Individuals

The Chero, Panika, Agaria, Baiga, Kharwar Gond, and Kol tribal communities make up the majority of the study area's population. Baiga, Kharwar, and Gond were chosen for in-depth research among these tribes because of their substantial understanding of therapeutic herbs and related customs. These localities were originally of Dravidian stock. Their source of income is based on raising animals and engaging in limited agricultural activities, the gathering of resources derived from forests. Most tribes get their names from their farming practices, employment, culture, and usage of natural resources. Baigas, for instance, are people who work as conventional medical treatment providers. For their livelihood, they are collecting forest products and honey. Godharins are women who do tattooing.

Likewise, Kharwar is also referred to as khairwar, khaira, and khairwa, and they utilise the khair trees for a variety of purposes. They are known as Kharwar because they use khair a lot. The word for mountain in Tamil, Kond or Khond, is where the term "Gand" originates. They typically live on the outskirts of woodlands and gather herbs, fruits, and tubers from them. Although the majority of their income comes from agriculture, the poor also rely on hunting,

[7] Giday M, Asfaw Z, Elmqvist T, Woldu Z (2003) An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia.

 [ISSN 2581-5369]

fishing, forestry, and regional businesses for financial stability.[8]

(C) Information Gathering

The ethnomedical practices of three selected villages that are dominated by tribal people were surveyed between October 2015 and September 2017. The goals Participants were given an explanation of the study, and their ethical approval was acquired for its publication and documentation. 75 people in all—48 (64%) men and 27 (36%) women—were chosen at random using convenience sampling, which is based on accessibility or availability. The informants' ages ranged from 35 to 50 and 51 to 75 years old, with a 42–63 age range on average. A semi-structured, open-ended questionnaire was used to gather data from a few important participants on an individual basis (Martin 2014). We asked informants what the plants' local names were plant parts utilised in medicine and nutrition, preparation techniques, application methods, dosage administrations, and illnesses these plants treat. Furthermore, to gather further data on the community-level applicability of ethnomedicinal plants, focus groups and data cross-checking were also carried out with these communities (Mussarat et al. 2014). Field studies were conducted in several growing seasons of the sampling sites to determine the anthropogenic hazard to medicinal plants.

Every location near a forest where these species of therapeutic plants were identified was taken into account for the threat assessment. The three main elements of rarity, trends, and threats were used to analyse state of a species' or vegetative system's conservation. The operational human-caused hazards (both At regular intervals of 10 to 15 days, visits to research locations in various seasons were conducted to evaluate the impacts on several species of medicinal plants, both direct and indirect and habitats. Through observation and documentation of the number of medicinal plants and ecosystems that were reasonably impacted by current events, the risks to various medicinal plant species were discovered (Salafsky et al. 2008).[9]

(D) Plant Recognition

The information was gathered more than six field trips, local experts were able to identify therapeutic plants in their natural habitat. GRIN-Taxonomy (https:// npgsweb.ars-grin. gov), Tropicos (https:// www.tropi cos. org), The Plant List (http:// www.theplantlist. org), the International Plant Names Index (http:// www.ipni. org), and reference books (Khare 2008; Joshi 2019) were used to produce the final list. The voucher specimens were placed in the

[8] Kang J, Kang Y, Ji X, Guo Q, Jacques G, Pietras M, Łuczaj Ł (2016) Wild food plants and fungi used in the mycophilous Tibetan community of Zhagana (Tewo County, Gansu, China).
[9] Pingali P (2015) Agricultural policy and nutrition outcomes–getting beyond the preoccupation with staple grains. Food Secur7(3):583–59.

Banaras Hindu University, Varanasi, India's Department of Environment and Sustainable Development.

III. ANALYSIS OF DATA

The significance of reported plant species referenced by informants was evaluated by analysing the gathered field data employing quantitative metrics like relative frequency of citation (RFC) and use value (UV). Using plants in a group, the Informant Consensus Factor (ICF) establishes the consensus for the treatment of a disease.[10]

(A) Understanding Medicinal Herbs

In the research region, There are 88 species and 48 families of 95 therapeutic plants were discovered. Nine plant species were farmed, while the remaining four species represented both forms. Eighty-two plant species, or the bulk, were gathered in their natural state. In terms of species, the most common family was Fabaceae (16), followed by Rubiaceae and Malvaceae (6 each), Apocynaceae (5 each), Com-bretaceae, Convolvulaceae, and Solanaceae (4 each). Similarly, Bhatia et al. (2014) revealed that 27 cultivated medicinal plant species outnumbered 119 wild species in the Udhampur District of Jammu & Kashmir.

When it came to tribal use, Baiga used the most medicinal herbs (33 species), followed by Kharwar (26 species) and Gond (41). The distribution of medicinal plants by family shows that the Baiga ate the most of the Fabaceae family (8 species), while the Gond tribe devoured Each of the Rubiaceae and Malvaceae families has three species families. Three communities each had 36 families, each of which included a single species, either separately or together. The local community of Shigar Valley (7 species) in the Karakoram range (Abbas et al., 2017) and Hawassa Zuria District (11 species) in Southern Ethiopia (Tefera and Kim, 2019) also reported the greatest number of Fabaceae species.

(B) Life forms, sections of medicinal plants, and their uses

According to a life form analysis, trees made up the biggest percentage of plants (44.22%), followed by shrubs (11.57%), climbers (12.64%), and herbs (29.47%). According to their total collection of 21, 33, and 26 species, the Gond tribe used the most trees (55.56%), Kharwar (50.01%), and the Baiga (51.62%) came next tribes. According to the findings of Maroyi (2011) in Zimba-bwe and Urso et al. (2016) in mopane woodlands of southern Angola, where tree species are used as the principal life forms, this result suggests that tree species are commonly

[10] Sharma N, Kala CP (2017) Harvesting and management of medicinal and aromatic plants in the Himalaya. J Appl Res Med Arom Plants 8:1–9.

 [ISSN 2581-5369]

used among tribal communities because of the richness of the surrounding environment. Of the entire sample, the most important plant element for making medicine was the leaf (27.20%), which was afterward, the root (18.38%), bark (17.64%), fruit (11.02%), and overall plant (5.14%). Baiga had the highest percentage of leaves (25.73%) among the three tribes, followed by roots (22.86%) and bark (17.14%). The While leaf (33.35%), root (16.67%), and bark (12.52%) were the most commonly used plant parts in Gond, leaf and bark (22.23% each) and root (14.82%) were similarly more common in Kharwar.

According to our findings, the majority of tribal people around the world primarily use leaves for herbal remedies (Alalwan et al., 2019; Biswakarma et al., 2017; Silambarasan and Ayyanar, 2015). The accessibility and ease of availability of leaves in vast quantities throughout the year may be the reason for their abundant use. According to Ahmad et al. (2014) and Cakilcioglu and Turkoglu (2010), leaves are the primary source of photosynthetic organs and other metabolic activities that produce a variety of secondary metabolites. Nevertheless, eating leaves is sustainable and good for the ecosystem (Giday et al. 2003).Oral application accounted for 61.63% of the remedy application route, with topical chewing (2.5%), brushing (1.25%), and chewing (31.44%). In terms of tribal use, oral remedies were consumed in large quantities of their total collection in Kharwar (74.20%), Gond (81.49%), and Baiga (58.99%). The second most crucial application pathway in the communities under study is topical.

According to previous ethnobotanical reports, oral is another important route of administration (Abbas et al., 2017; Kadir et al., 2014; Teklehaymanot, 2017).This study found that three tribes used very primitive methods for processing and preparing herbal treatments. Dried herb decoction, juice, powder, and roasting with milk, honey, or water were among the preparations for oral use. Plant extracts, paste, and poultice were among the remedies used externally.[11]

The extract was ingested by eye drop, nose, ear, and mouth with milk, water, or honey. Topical medications for wounds were ground, and a paste was created by combining the powder with water. For some illnesses, the infusion was administered twice or three times a day after the cures were cooked overnight. Chewing, body washing, binding wounded areas, brushing, and massaging were some of the preparations used to treat certain ailments. Similar preparation and processing techniques were also documented in the Tharu tribal group in Uttar Pradesh, India (Kumar et al. 2013) and the Chitral District of Khyber Pakhtunkhwa province (Sher et al. 2016).

[11] Ramnath M (2002) Gonds, Linnaeus and botanical techniques: Plants and conservation in tropical forests. Nat Res Forum 26(4):314–314.

 [ISSN 2581-5369]

(C) The Ethnomedical Applications of Plants

The 95 plant species that were gathered were documented to treat 14 different disease categories, including gastrointestinal, musculoskeletal, feverish, painful, venereal, reproductive, dental, respiratory, ethno-veterinary, skin, eye, ear, malaria, and circulatory issues. Compared to Kharwar and Gond, Baiga used the most medicinal plants in the entire collection. All three tribes used five distinct plant species, but how these plants were used to cure various illnesses differed from one society to the next. Similar to this, certain plant species had numerous uses, such as Holarrhena antidysenterica, Adina cordifolia, and Cissus quadrangularis, whilst others, such as Boswellia serrata, Aegle marmelos, and Asparagus recemosus, were thought to be helpful in treating a single condition. Hibiscus sabdariffa, Martynia annua, Cyperus longus, Dolichos biorus, Catunaregum spinosa, Cordia macleodii, and Operculina turpethum, and Oroxylum indicum are eight new medicinal plants that were investigated from the study region.

Baiga employed four species in these eight plants, whereas Kharwar and Gond each used one, while two species were shared by both Gond and Kharwar. To treat typhoid, the Baiga community made a powder from the origins of C. longus and O. turpethum. In the Baiga and Kharwar communities, jaundice is treated with the fruit juice of O. indicum with C. macleodii bark decoction, and a poultice made from C. spinosa seeds. However, in Kharwar and Gond, M. annua's seed and leaf, as well as the bloom of H. sab-dariffa, were used to treat skin conditions and poisonous bites. Furthermore, only among the Gond culture was the juice of D. bifurus seeds used to treat renal stones.

(D) Applications of wild food plants

For the three tribes to meet their dietary needs, 53 plant species in all, belonging to 36 families, were used as food components. 25 species were employed as fruits, followed by 21 species for vegetable-tables, 3 species for beverages, and a pair of species for each fruit and vegetable as well as fruit and drinks. Regarding the Tribes used these species for food, and the Gonds ate the fewest fruits (2 species), while Baiga devoured the most (8 kinds). Gond mentioned seven species in the vegetable category, while Baiga and Kharwar each mentioned five. However, all three tribes shared a number of common vegetable, fruit, and beverage species, including Tinospora cordifolia, Shorea robusta, and Coccinia grandis. There were several ways to eat wild edible plants, and the three tribes prepared different meals using different cultural techniques.

YouFruits, seeds, flowers, leaves, and shoots were the most commonly consumed plant parts. In all three cultures, one species (S. robusta) was utilised roasted, whereas the other 22 wild

fruit species were typically consumed as raw snacks. However, Emblica ocinalis fruits were preserved in vinegar making them available all year round in the populations of Baiga, Kharwar, and Gond, and two species, including Madhuca longifolia, were eaten after being air dried food. Because they serve as famine food during the dry season, wild fruits are also common among tribal populations in Nepal (Uprety et al. 2012) and northwest Pakistan (Ahmad and Pieroni 2016).Certain uses in the vegetable category, like the zingiber rhizome, were unique to a particular plant portion was added as a flavouring paste, and in the Kharwar community, leaves were cooked as vegetables. The Gond and Baiga communities used the leaves of Cassia tora and Oxalis cornicu-lata as vegetables.

As with Tibetan tribes in China (Boesi 2014; Kang et al. 2016) and Lao people in Laos (Kosaka et al. 2013), cooking was the most popular way for these communities to use wild vegetables. Wild veggies (such as Tribulus terrestris, Rumex dentatus, Oxalis corniculata, C. tora, Asphodelus tenuifolius, and Basella alba were collected naturally from the village area, surrounding ponds, and woodlands. According to earlier reports, tribal members walked up to 10–15 kilometres inside the dense forest to gather nutrient-rich plant species for daily food and cow grazing in Northwestern Patago-nia's Mapuche group (Ladio and Lozada 2000) and Chinese ethnic people (Boesi 2014; Ju et al. 2013). In addition to increasing the amount of food consumed, edible plants also significantly improve the nutritional status of ethnic groups (Deshmukh and Waghmode 2011; Reddy et al. 2007; Sundriyal and Sundriyal 2001).[12]

Due to their antioxidant capacity, these food products have the ability to boost immunity and are a good source of fibre, carbs, vitamins, minerals, alkaloids, and phenolics (Arora and Pandey 1996; Bultosa et al. 2020). Only three kinds several untamed food plants were identified and employed as immune boosters in the beverage category. For example, the In Baiga, woodfordia fru-ticosa blossoms and Hyptis suaveolens leaves are used to make herbal tea and drinks, respectively and have a pleasant and fragrant flavour In contrast, the leaves of Boiling T. cordifolia and eaten as a wholesome beverage in each of the three cultures. In contrast to central and southern China, Tibet, and the current study, where few beverage species have been documented (Boesi 2014; Bultosa et al. 2020; Ghorbani et al. 2012; Pushpangadan et al. 2012), traditional use of beverage species is typically reported from eastern Europe (Sõukand et al. 2017).

[12] Sahoo T, Acharya L, Panda PC (2020) Structure and composition of tree species in tropical moist deciduous forests of Eastern Ghats of Odisha, India, in response to human-induced disturbances.

 [ISSN 2581-5369]

(E) Utilising Wild Edible Plants for Subsistence

The tribal people rely heavily on wild edible plants for their livelihood. As fruits, leaves, seeds, and immature shoots, 13 species were collected by tribal people for local market sales. Crucial fruits of the season for the tribe's revenue creation were B. lanzan and E. officinalis. Due to consumer preference for these two animals as a plentiful supply of nutrients, locals gathered them from their natural habitat and sold them in marketplaces.

During the fruiting seasons, the local market had the most easily accessible fruits. A. marmelos, D. melanoxylon, and S. heyneanum were present during the April–June season, but the fruits of T. bellirica and B. lanzan are found during the March–April season period. Gathering and selling wild edible species is what these three tribes do. Tribal people spent three to four hours a day gathering wild edibles, travelling an average of 15 km across woodlands.

They occasionally sell these species locally middlemen or shops, but they also sell their products in local markets and during weekly haat bazaars. In contrast to Kharwar and Gond, the Baiga are an impoverished tribe that likes to sell wild things directly to the public rather than through middlemen, who pay a lesser price for the goods in order to make more money. The tribal households in the Vindhyan highlands derived a significant portion of their yearly revenue from wild foods. According to the tribal people of Pathanamthitta district in Kerala (Binu 2010), southern Shan State in Myanmar (Shin et al. 2018), and Sichuan province in China (Wang et al. 2020), they thus gather fruits for their own consumption, while other fruits are collected and sold in the towns. The production of edible wild plants reduces the additional strain on wild resources and gives tribal and rural residents possibilities for extra revenue (Harris and Mohammed 2003; Singh 1999).

(F) The Proportion of Citations and Use Values

Each species' indigenous significance in connection to those who provided information about these types of therapeutic plants is indicated by the proportional frequency of citations. Musculoskeletal issues are treated using C. quadrangualris extract, and the plant is also combined with Dillenia pentagyna root to make a juice for mending the fractured bone. According to reports from the Mayurbhanj district of Orissa (Singh et al., 2014) and the Western Ghats of India (Upadhya et al., 2012), the dried stem of this plant has long been used to treat rheumatoid arthritis, asthma, and other bone ailments.

Glycosides, alkaloids, flavonoids, tannins, saponins, and calcium are among the compounds of C. quadrangularis that have been identified as key components of the plant (Nawghare et al. 2017). A. cordifolia bark decoction and roots is applied to fever, pain, and gastrointestinal

 [ISSN 2581-5369]

issues. Additionally, a powder made from bark and Opuntia dillenii root is used to treat snake bites. The Irula tribe of Tamil Nadu's Hasanur hills also uses the bark paste of A. cordifolia to treat gynaecological issues and physical weakness.

Bark from E. glaucum is used as a decoction to prevent poisonous bites. In Chhattisgarh's deciduous forests, the root of this plant is also used to treat snake bites (Kala 2009). For cardiac glycoside, two nor-derivatives, elaeodendrol and elaeodendradiol, were extracted from E. glaucum bark (Anjaneyulu and Narayanarao 1980).A popular metric used to measure the relative significance of a particular species in a group is use value (UV). Harvesting high-use species was more common in the research area to treat a specific ailments than low-use species. Nyctanthes arbor-tristis (1.40), Nicotiana tabacum (1.14), E. glaucum (1.56), F. religiosa (1.27), C. quadrangularis (1.24), H. binnata (1.20), and G. turgida (1.17), had the highest use values.

All three communities used plants with high RFC and UV to treat various illnesses. To combat typhoid, for instance, N. arbor-tristis leaf decoction and Piper nigram seeds was used. The leaf juice was used to treat rheumatism, piles, malarial fever, chronic and intermittent fever, and liver problems (Akki et al., 2009; Banerjee et al., 2007). It was discovered that N. arbor-tristis's raw extracts and isolated chemicals had therapeutic activity against viral infections, inflammation, malaria, and as an immunostimulant (Agrawal and Pal 2013). According to Jain et al. (2005), the Central Indian tribal people employed several portions of N. arbor-tristis to treat snakebite, cough, and diarrhoea. The leaf juice is taken orally by the Jayantia tribes of northeastern India as an anthelmintic and flower as an antispasmodic, in addition to honey (Jaiswal 2010). On injured skin, a paste made from the ashes of F. Religiosa's burned bark and mustard oil is administered topically. Similar research has also been reported to cure skin conditions in Ayurveda (Lansky et al. 2008), Karnataka's Shimoga district (Rajkumar and Shivanna 2009), and Mayurbhanj district in north Orissa (Rout et al. 2009).

IV. ANALYSIS OF STATISTICS

The number of times an informant revealed their individual usage of a species and the quantity of plant uses among a participant sample were positively correlated, as indicated by UV and RFC have a 0.6265 Pearson association coefficient with a P-value less than 1%. It suggests that the number of useful medicinal plants increased as a result of the informants' increased use of certain species. The general connection between RFC and UV showed a positive correlation, and their trends were comparable among species. The findings indicated that the study plays a vital role in the application of therapeutic plants, and that additional phytopharmacological research may aid in determining the active components of the frequently gathered plants. 39%

of the variability in UV may be described in terms of RFC, according to the study's r2 value of 0.39.

(A) The Consensus Factor of Informants

Three indigenous communities' illnesses were divided separated into 14 groups. With an average value of 0.96, the ICF pertaining to the ethno-medical The range of information about the Gond, Kharwar, and Baiga tribes was 0.94 to 1.0. Medicinal plants with a high ICF value are thought to be effective in treating certain diseases, like Having a high ICF and night blindness (1.0) is treated with C. Tora while Otalgia is treated with calotro-pis procera. According to this ICF value, use reports for treating a certain condition had a greater consensus level. The ICF of 0.97 for plants used to treat malaria and circulatory issues shows that these plants are good at repelling mosquitoes and purifying blood.

In comparison to similar studies from South Africa (Cock et al., 2019) and the Southern Western Ghats, India (Venkatachalapathi et al., 2016), it can be explained that the region receives approximately 85% of its annual rainfall during the monsoon season due to the south-west monsoon, which offers a favourable environment for the growth of insects, including mosquitoes. For the treatment of conditions such as musculoskeletal disorders, respiratory issues, dental issues, poisonous bites, reproductive diseases, ethno-veterinary, and additional usage categories show that individuals are well aware of the indigenous plants' therapeutic qualities for curing these conditions.

Along with Kenyan plants (Owuor and Kishangau 2006), the Inuit people in Nunavut indicated that medicinal plants had an ICF value of 0.88 for respiratory problems and antidote qualities (Bernard 2017). Ragupathy and Newmaster (2009) also revealed the ICF value for treating the most ailment categories in the Kodiakkarai reserve forest in India among the Irula tribe. The ICF for plants used to cure skin and gastrointestinal issues was 0.95 each, suggesting that respondents knew a lot about both dermatological and general illnesses. Skin issues are prevalent in the research location, and they could be brought by the soil's high iron oxide (Fe2O3) content leads to skin-related issues, including foot deterioration during rice field irrigation and crop sowing. Using plants to treat fever and pain had the lowest ICF value (0.94), indicating that it is a prevalent condition in the studied location.

(B) The Severity of The Risks to Medical Care

The current study identified 13 different anthropogenic risks that the Vindhyan highlands' medicinal flora must contend with. Of these, livestock-induced overgrazing posed the greatest hazard (29.5%), followed by the introduction of invasive alien species (25%) and cement

 [ISSN 2581-5369]

industry pollution (23.2%). These factors were the main dangers that caused the region's biodiversity to be significantly destroyed. Activities caused by humans that involve converting grasslands and forests for sand and agriculture caused the vegetation and forest structure to deteriorate from the river bed (Cardelús et al., 2019; Sahoo et al., 2020; Sfair et al., 2018). Despite being the least accountable hazards, soil erosion and illegal commerce were crucial contributors to deforestation.

One of the main threats to these plant species was the overharvesting of medicinal plants (such as Acacia catechu, Boerhavia diffusa, and C. longus) by locals and traditional healers for herbal purposes and for export to other countries in order to increase profits (Ganie and Tali 2013; Mahapatra and Tewari 2005; Singh 1999).The Investigation of the total impact of the threat (OTI) of medicinal plants revealed that 9.5% of the species were at very high risk, 24.2% were at high risk, and 9.5% were at medium risk. Plants used as medicine are primarily at significant risk include Helicteres isora, Abrus precatorious, B. serrata, B. lanzan, and A. catechu, which are native to the tropical dry deciduous forest.

Threats like deforestation, forest fires, harvesting too much for feed, and alien species invasion have the potential to significantly reduce the variety of both individual and group medicinal herbs. When it comes to changing the ecosystem's composition and functionality, invasive species have detrimental ecological effects (Sharma and Raghubanshi 2007). The apical portion of the plants, which contains growth and reproductive parts, was killed by grazing and fodder gathering (Jaweed et al. 2018). According to reports by Dar and Reshi (2006) and Ganie et al. (2019), the aforementioned operational hazards, either separately or in combination, caused medicinal plants in their natural environment to deteriorate in Kashmir.[13]

(C) Policy Interventions and Sustainable Management of Medicinal Plant Resources

The authors of this study have seen a sustainable use of traditional knowledge to guarantee food security and herbal remedies under 13 different hazards in forest regions. According to the survey, traditional knowledge mostly focusses on medical procedures for preservation in the form of ritual and cultural values. The sustainable management of current resources and the regulation of their optimal usage are also seen to require restrictions in the form of "taboo."Since cordi-folia is used to treat a variety of ailments, the overharvesting of the plants was prohibited by the karma celebration of Kharwar, which is associated with A. Similar research was also conducted in the Central Himalayan state of Uttarakhand (Negi 2010). Traditional herbalists of

[13] Kala CP (2009) Aboriginal uses and management of ethnobotanical species in deciduous forests of Chhattisgarh state in India. J Ethnobiol Ethnomed 5(1):1–9.

 [ISSN 2581-5369]

the Baiga tribe did not divulge mantras, a sacred ceremonial expressions because they feel that doing so would negate the effectiveness of their healing abilities. To improve the therapeutic effects of medicine, the holy ceremonial phrase must be recited during the night of the new moon. They informed their chosen family members—ideally their biological son—of this information.

According to Atreya et al. (2017) and Chaudhary et al. (2017), this intergenerational transfer of information is transmitted orally through their parents. Additionally, the Gond tribe possessed special knowledge regarding the gathering, processing, and therapeutic qualities of plants. To safeguard future views, they collected these plants using scientific parameters including maturity, height, colour, and other morphological characteristics. For instance, Asparagus racemosus roots are harvested in the spring when they are fully developed. They pick and choose what they gather the roots of O. turpethum and C. longus, instead of uprooting the entire plant. The Gond tribe grows these plants in their backyards for immediate use because they care about their conservation. The seeds of B. lanzan are used to make a variety of nutrient-dense meals, which are prepared using the fruits. After the seed coat is removed, their seeds are separated by boiling them for up to three or four hours and then letting them dry for two days.[14]

The Gond tribes also use these dried seeds to make delectable delicacies like kheer, laddo, and sewai (vermicelli). As Sharma and Kala (2017) also observed, the scientific method of collecting medicinal plants was based on the periodic calendar and after the roots, barks, fruits, flowers, resins, and twigs matured. Furthermore, overgrazing, land use change, forest fragmentation, overharvesting, and shifting eating habits have all contributed to the decline of the wild population of edible medicinal plants (Broegaard et al. 2017; Geyik et al. 2020; Ickowitz et al. 2019). These factors have also eroded the wild food consumption pattern (Luczaj 2012), which has resulted in a loss of dietary diversity and a disruption of food systems (Willett et al. 2019). Including There are further ramifications of consuming wild edible plants for environmental sustainability in an era of food insecurity and climate change. In order to meet the goals of SDG-15 (life on land), SDG-1 (no poverty), SDG-2 (zero hunger), and SDG-3 (excellent health and wellbeing), it may reduce agricultural footprints and lead to a move towards more sustainable food systems.

Major food crops that lack important micronutrients cannot eliminate micronutrient deficiencies or hidden hunger in underdeveloped nations (Ickowitz et al., 2019; Pingali, 2015). Being a

[14] Poonam K, Singh GS (2009) Ethnobotanical study of medicinal plants used by the Taungya community in Terai Arc Landscape, India. J Ethnopharmacol 123(1):167–176.

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significant Wild food plants with a high nutritional potential and a variety of vitamins and trace elements play a crucial role in increasing dietary diversity.In order to promote conventional knowledge-based educational frameworks, which could be a component of inclusive developmental initiatives, it may be possible to improve and establish specific criteria. It is necessary to educate and raise awareness of traditional culture and current conservation methods among the younger generation. In home gardens, pastures, or fallow sites, it is essential to promote the management and production of wild edible and medicinal plants (Broegaard et al., 2017; Patel et al., 2020).

A course on with assistance from academic institutions, the forest department and forest management committees should carry out information, plantation operations, and sustainable harvesting regarding the values of commercially viable medicinal species. Together with main and secondary collectors, traders and villagers should have access to an appropriate networking infrastructure. A varied resource basis is necessary for food security and more robust production considering the effects of climate change. To fight hidden hunger, it has also been suggested that food crops be bio-fortified with more micronutrients (Heywood 2011). Collaboration between the academics, educators, and policymakers may make it feasible. However, this wealth of traditional knowledge among tribal populations could assist ensure environmental sustainability, aid in conservation, and restore degradation.

V. CONCLUSION

The current study examined many different kinds of plants that are utilised to various illnesses and nutritional supplements by the Vindhyan highland tribes. According to this study, Baiga is the most impoverished and primitive of the three tribal populations in the area. In order to address their culinary, medical, and financial demands, this group possesses superior traditional knowledge of medicinal herbs. Key medicinal plants like A. catechu, B. diffusa, B. serrata, and C. longus are diverse and others, is greatly threatened by a number of anthropogenic stressors, such as overgrazing, cement contamination and invasive alien species manufacturers.

Planning for the future, protecting it, and managing the biodiversity in the area sustainably are critically needed, given the overall danger impact. All things considered, these tribes have a wealth of traditional understanding of medicinal plants, which serves as a vital resource basis for both the herbal and wild edible qualities to preserve diets' nutritional content, food climate change's effects on health and security. The promotion of wild edibles may result from the health advantages of ethnic cooking, increasing nutritional diversity both locally and globally. Government organisations must plan public awareness campaigns to promote traditional

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knowledge, which is dispersed throughout these communities and may soon be lost if it is not preserved.

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