



Plant resources of Palamau Tiger Reserve, Eastern India and their utilitarian perspectives

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Abstract

Tribal communities rely on forest-based products for livelihood security and have extensive knowledge of the traditional uses of plants and plant-based products. The present study aimed to determine the forest composition along with the indigenous knowledge related to the utilitarian perspectives of plant resources of Palamau Tiger Reserve (PTR), Eastern India in fulfilling the sustenance needs of the local tribes of Jharkhand. Fifty three forested grids were sampled out of 90 by laying one belt transect of 0.50 ha in each, while 9 random quadrats were sampled for shrub (size: 5 m × 5 m) and herb (size: 1 m × 1 m). For the quantitative ethnobotanical study, interview-based fieldwork was conducted to determine various indices such as informant consensus factor (F_{IC}), use-value index (UV_i), and fidelity level (FL). A total of 170 plant spp. of 143 genera and 58 families were recorded in the present study of which, 100% spp. (170 spp.) had various miscellaneous utilities followed by 85% (147 spp.) with medicinal utilities, 36% (62 spp.) with food value (edibles raw), 21% (35 spp.) each with utility for fuelwoods and furniture and building materials, 19% (32 spp.) with food value (edibles cooked), and 13% (22 spp.) with fodder values. Traditional knowledge plays an important role in the socio-economic development of rural tribal communities that further helps in the conservation of natural forests and their sustainable management. The abundant plant diversity (170 spp.) of the tiger reserve is the main source of income for locals and tribal communities in several ways. The majority of the plant species were used by the locals in traditional medicines to cure several ailments specifically 48 spp. were used by women for gynaecological disorders while others were used for furniture and building materials, fodder, fuelwood, edibles (cooked), edibles (raw), and other miscellaneous purposes. Therefore, conservation and protection of biodiversity through policy intervention is necessary for socio-economic development and sustainable management of forest ecosystems to achieve SDGs.

Keywords Ethnobotanical indices · Plant resources · Sustainable utilization · Traditional knowledge · Women's health

Introduction

Around 40% of the world's land area is covered by forests that play a vital role in the conservation of biodiversity, providing different ecosystem goods and services, and enhancing numerous opportunities for climate change mitigation (Gebeyehu et al. 2019; Lim et al. 2022; Ali et al. 2024). India stands among 17 global mega-diverse nations constituting 7% flora of the world by accounting for ~45,000

species of plants (Saikia and Khan 2018; Kumar and Saikia 2020a). A sum of 1,44,000 plant species are cultivated in India out of 3,74,000 reported from all over the world (Christenhusz and Byng 2016). A significant number of medicinal plants used in the medieval period have been reported from the Indian subcontinent (Bagchi et al. 2011). India's various topographic, edaphic, and climatic conditions support a rich biodiversity, especially the floral wealth of the nation accompanying cultural history and traditional knowledge (Roy and Pradhan 2022). Tribal communities rely on forest-based products for their livelihood and have extensive knowledge of the traditional uses of plants and plant-based products (Haq et al. 2021). Traditional knowledge is one of the preservation conventions, strategies, and protocols initiated worldwide for the preservation of biological diversity (Haq et al. 2021). Since the beginning of human civilization,

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plant resources have been one of the major suppliers of food and medicine (Shaheen et al. 2012; Raj and Jhariya 2023) with high nutritional and health benefits, low cost, high accessibility, and strong acceptance by a significant number of populations in many rural and isolated villages (Mir et al. 2022). As per the World Health Organization (WHO), 80% of the population especially in the developing world relies on traditional medicines in the twenty-first century (Goenowski et al. 2006). A sum of 25,000 plant species is used in traditional medicinal system by *ca.* 1.5 million traditional healers and practitioners in India, of which only 10% are used by pharmaceutical companies (Mir et al. 2021, 2022).

Plant supplies a range of ecosystem goods including fuelwood, fodders, wild edibles, and traditional medicines that considerably provide inexpensive healthcare access and livelihood security to local tribal communities (Jordan et al. 2010; Yang et al. 2014). Overexploitation and unsustainable harvesting of forest products to satisfy the needs and greed leads to forest degradation (Kumar and Saikia 2020b). Hence, proper maintenance, sustainable management and conservation are necessary to limit the further exploitation of plant resources from their natural habitats. Local communities inhabiting the forests play an important role in controlling, managing, monitoring, conserving, and sustainable harvesting of plant resources to prevent their extensive exploitation (Singh and Pandey 2019). To stop commercial agriculture from growing and to protect natural forests, it is necessary to either expand protected areas or guarantee tenure rights for tribal and indigenous communities (Soares-Filho et al. 2010).

Jharkhand is known for its rich floristic diversity with high forest cover (28.09%) (FSI 2021) and is the hospice of numerous tribal communities (Roy et al. 2023). 26.21% of the total population are tribes (FSI 2021) that predominantly inhabit forest edges and depend on forest-based products to fulfil their sustenance needs (Kumar and Saikia 2020a). Forest resources are the backbone of rural tribal communities since they link with their socio-cultural life and satisfy most livelihood requirements (Singhal et al. 2021). A majority of the local villagers use flowers, fruits, barks, stems, roots, and other parts of the plant for foods, medicines, furniture-making, oil-yielding, dye-extraction, and raw materials for domestic uses (Shikha and Kumar 2023). Local villagers have extensive ecological knowledge of the rapidly endangered folk plants (Molnár and Berkes 2018). Several research studies were conducted in Palamau Tiger Reserve based on the medicinal uses of plant species and the economic importance of non-timber forest products (NTFPs) (Kumari et al. 2017, 2018), but, research works focusing on the overall utilitarian perspective of plant species are not attempted yet.

Therefore, the present study aimed to determine the forest composition along with the indigenous knowledge

pertaining to the utilitarian perspectives of plant resources of Palamau Tiger Reserve (PTR), Eastern India to fulfill the sustenance needs of the local tribes of Jharkhand.

Materials and methods

Study area

The study was conducted in four forest ranges (Garu East range, Garu West range, Baresnar range, and Mahuadan range) of PTR, Eastern India out of eight. PTR is situated on the western part of the Chotanagpur Plateau in the Palamau district of Jharkhand (23° 25' to 23° 55' N latitude and 83° 50' to 84° 36' E longitude) at an elevation from 200 to 1100 m above sea level. It became one of the tiger reserves under Project Tiger in 1974 covering a core area of 576 sq. km and a buffer area of 731 sq. km. The reserve encompasses Palamau Wildlife Sanctuary (979 sq. km) and Betla National Park (226 sq. km) surrounded by rivers Koel, Auranga, and Burha. The total number of villages in PTR is 191, of which Morwai Kalan, Chumma, Juruhar, Wopag, Nawadih, Lat, Harhe, Bere, Hesag, Garu, Bartoli, Netarhat, and Ladi are major villages located at non-forested zones (Kumari et al. 2020).

Vegetation sampling and analysis

PTR has a total of 90 (4 km × 4 km) forested grids (Fig. 1), of which sampling has been done by laying one belt transect (each of 0.50 ha) in 53 grids. Shrubs and tree saplings were sampled in nine random quadrats each of 5 m × 5 m, while herbs and tree seedlings in 1 m × 1 m quadrats (Fig. 2). A close-ended (locals knowing the significance of the surrounding plant species) interview-based fieldwork was conducted where a list of queries (Appendix I in Supplementary) was asked and based on the individual's response the quantitative analysis was done. The interview-based fieldwork was conducted to gather information regarding the traditional use of various plant species and their parts by interviewing locals (N = 53) (17 females and 36 males) in different age groups (32–69 years). The information ratio for the utilitarian perspective varied based on the knowledge of the respondent about the plant use and the availability of the locals. Quantitative ethnobotanical indices have been used to assess the species values based on their relevance and relative importance among the locals. Fifty three individuals (traditional healers, local ayurvedic doctors, forest trackers, forest guards, NTFP gatherers, etc.) were interviewed for data collection for further quantitative analysis. All the species were further classified into seven major use categories based on their prime utilization patterns such as fuelwoods, furniture and building materials, medicinal,

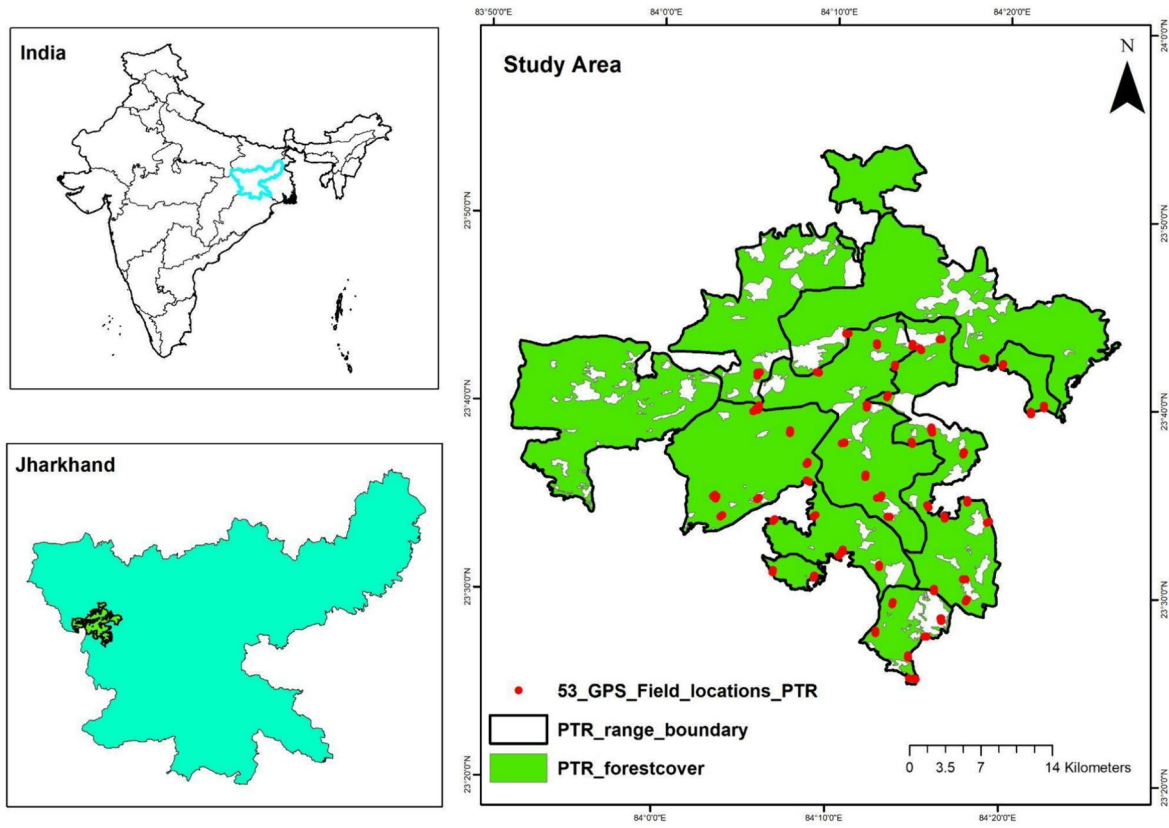
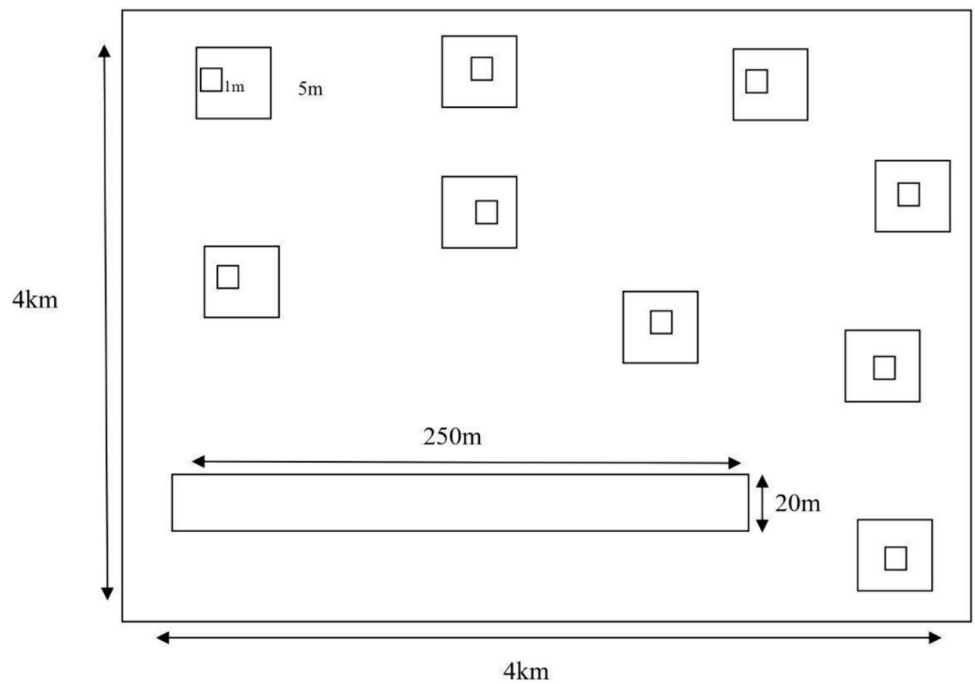


Fig. 1 Map of the study site showing the sampled grids with red dots

Fig. 2 Sampling design used for the vegetation sampling in the PTR, Eastern India



edibles (raw), edibles (cooked), fodder, and miscellaneous (including dye yielding, used in textiles and fibre, religious rituals, ornamental, spiritual, and with various ecological significance).

To identify plants with unique intercultural importance and their utilization potential for various purposes, an informant consensus factor (F_{IC}) was determined to examine the uniformity of respondents' responses (Trotter and Logan 1986).

$$F_{IC} = N_{ur} - N_t / N_{ur} - 1$$

where N_{ur} represents the number of respondents; N_t represents the number of users among the respondents. The value of F_{IC} varies from 0.00 to 1.00, where the value near 1.00 represents higher utilization potential for the specific purpose, while the value near 0.00 represents lower utilization potential for the specific purpose.

Likewise, to analyze the relative importance of each species in the particular category based on the relative use by the respondents, a use-value index (UV_i) was calculated for particular species (Phillips and Gentry 1993).

$$UV_i = \sum U_i / N_i$$

where i represents the particular species, U_i represents the no. of users of a particular species for the particular category, and N_i represents the no. of respondents who were interviewed for a particular plant species.

Similarly, the fidelity level (FL) is calculated to determine the reliability of a particular species for a specific purpose, it is the ratio of the number of informants used by the particular species for a particular purpose with respect to the total number of informants interviewed for similar purpose (Friedman et al. 1986).

$$FL (\%) = N_p \times 100 / N$$

where N_p is the number of informants using the particular species for a particular purpose and N is the total number of informants interviewed for similar purposes. The value of FL ranges from 0 to 100, where 100% FL signifies that all the informants use that particular plant species for similar purposes.

Results and discussion

Forest composition

The present study recorded a total of 170 plant species belonging to 143 genera and 58 families in 53 forested grids of PTR, Eastern India of which 88 are trees, 32 shrubs,

and 50 herbs (Table 1). Similar studies in different tropical deciduous forests in Jharkhand recorded comparatively poor species richness like 77 plant species belonging to 41 families in the tropical deciduous forests of Ranchi (Kumar and Saikia 2020a), 62 plant species belonging to 41 families in the forests of Jharkhand (Linda 2020), 139 plant species belonging to 56 families in PTR and Betla National Park (Kumari et al. 2017), 95 plant species belonging to 51 families in Hazaribag (Lal and Singh 2012), and 80 plant species belonging to 50 families in Gumla, Simdega, Latehar, and east Singhbhum (Tomar et al. 2012). Out of all recorded plant species, 142 species are of native Indian origin, while 28 species are introduced intentionally or unintentionally. Some native plant species recorded in the present study are *Adina cordifolia* (Roxb.) Brandis, *Andrographis paniculata* (Burm.f.) Wall. ex Nees, *Blumea lacera* (Burm.f.) DC., *Cajanus scarabaeoides* (L.) Thouars, and *Dillenia pentagyna* Roxb., while *Ageratum conyzoides* L., *Ageratum houstonianum* Mill., *Bauhinia galpinii* N.E.Br., and *Chromolaena odorata* (L.) R.M.King & H.Rob. are some of the introduced plant species. A very high percentage of the total plant species (63 plant species; 37%) are in the IUCN red lists, of which the majority are Least Concern (LC: 60 spp.) followed by Near Threatened (NT: 02 spp.) and Endangered (EN: 01 sp.). *Tectona grandis* L.f. is the Endangered tree recorded in the tropical deciduous forests of Jharkhand, *Aegle marmelos* (L.) Correa and *Pterocarpus marsupium* Roxb. are the Near Threatened tree species. Critical LC plant species recorded in the present study include *Adenanthera pavonina* L., *A. conyzoides*, *Albizia lebbek* (L.) Benth., *Bauhinia tomentosa* L., and *Bridelia retusa* (L.) A.Juss. The highest diversity of species is recorded in the family Fabaceae (30 spp.), while 32 families are monotypic (Fig. 3). In conformity with the present report, Fabaceae was the most dominant family in the tropical forests of Ranchi, Jharkhand (Kumar and Saikia 2020a), West Bengal (Mandal and Rahaman 2022), and Singhori Wildlife Sanctuary, Madhya Pradesh (Soni and Modak 2014). The dominance of the Fabaceae signifies a high rate of nitrogen fixation that ultimately results in a better forest regeneration status leading to high species richness and diversity of different growth forms in the tropical deciduous forests of Jharkhand.

Plant utilization pattern

Low land revenue and limited ownership in Jharkhand lead to the development of a diverse range of occupations by the local villagers and tribal communities such as daily labour, crafting, local businesses such as fruits and vegetable vendors, cobblers, carpenters, and other necessities in the streets. After agriculture, forests are the second largest source of income for the locals in Jharkhand. Locals' dependence on forests for livelihood has shown a strong

Table 1 List of species recorded (N = 170) in PTR, Eastern India with family, habit, origin, IUCN category, and their major use category

Species	Family	Habit	Origin	IUCN red-list category	Primary use category
<i>Acmella paniculata</i> (Wall. ex DC.) R.K.Jansen	Asteraceae	H	Native	LC	Medicinal
<i>Adenanthera pavonina</i> L	Fabaceae	T	Native	LC	Fuelwood
<i>Adiantum incisum</i> Forssk	Pteridaceae	H	Native	–	Miscellaneous
<i>Adina cordifolia</i> (Roxb.) Brandis	Rubiaceae	T	Native	–	Miscellaneous
<i>Aegle marmelos</i> (L.) Correa	Rutaceae	T	Native	NT	Miscellaneous
<i>Ageratum conyzoides</i> L	Asteraceae	H	Introduced	LC	Medicinal
<i>Ageratum houstonianum</i> Mill	Asteraceae	H	Introduced	–	Medicinal
<i>Ailanthus excelsa</i> Roxb	Simaroubaceae	T	Native	–	Miscellaneous
<i>Albizia chinensis</i> (Osbeck) Merr	Fabaceae	T	Native	–	Furniture
<i>Albizia lebbek</i> (L.) Benth	Fabaceae	T	Native	LC	Fuelwood and Furniture
<i>Alternanthera sessilis</i> (L.) DC	Amaranthaceae	H	Native	LC	Miscellaneous
<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Acanthaceae	H	Native	–	Medicinal
<i>Anisomeles indica</i> (L.) Kuntze	Lamiaceae	H	Native	–	Medicinal
<i>Antidesma ghaesembilla</i> Gaertn	Phyllanthaceae	T	Native	LC	Miscellaneous
<i>Arisaema heterophyllum</i> Blume	Araceae	H	Native	LC	Medicinal and Edible
<i>Artocarpus heterophyllus</i> Lam	Moraceae	T	Native	–	Miscellaneous
<i>Artocarpus lacucha</i> Buch.-Ham	Moraceae	T	Native	–	Medicinal
<i>Asparagus racemosus</i> Willd	Asparagaceae	H	Native	–	Medicinal
<i>Bacopa monnieri</i> (L.) Wettst	Plantaginaceae	S	Native	LC	Miscellaneous
<i>Bauhinia galpinii</i> N.E.Br	Fabaceae	S	Introduced	LC	Medicinal
<i>Bauhinia purpurea</i> L	Fabaceae	T	Native	LC	Miscellaneous
<i>Bauhinia tomentosa</i> L	Fabaceae	T	Introduced	LC	Edible
<i>Bauhinia variegata</i> L	Fabaceae	T	Native	LC	Medicinal
<i>Bidens pilosa</i> L	Asteraceae	H	Introduced	–	Miscellaneous
<i>Blumea lacera</i> (Burm.f.) DC	Asteraceae	H	Native	–	Medicinal
<i>Bombax ceiba</i> L	Malvaceae	T	Native	LC	Miscellaneous
<i>Boswellia serrata</i> Roxb	Burseraceae	T	Native	–	Fuelwood
<i>Bridelia retusa</i> (L.) A.Juss	Phyllanthaceae	T	Native	LC	Medicinal
<i>Butea monosperma</i> (Lam.) Kuntze	Fabaceae	T	Native	LC	Medicinal
<i>Butea superba</i> Roxb. ex Willd	Fabaceae	S	Native	–	Medicinal
<i>Cajanus scarabaeoides</i> (L.) Thouars	Fabaceae	S	Native	LC	Miscellaneous
<i>Careya arborea</i> Roxb	Lecythidaceae	T	Native	–	Medicinal
<i>Carissa carandas</i> L	Apocynaceae	S	Native	–	Medicinal
<i>Carissa spinarum</i> L	Apocynaceae	S	Native	LC	Medicinal
<i>Casearia tomentosa</i> Roxb	Salicaceae	T	Native	–	Medicinal
<i>Cassia fistula</i> L	Fabaceae	T	Native	LC	Medicinal
<i>Catunaregam spinosa</i> (Thunb.) Tirveng	Rubiaceae	T	Native	LC	Miscellaneous
<i>Cerisoides turgida</i> (Roxb.) Tirveng	Rubiaceae	T	Native	–	Miscellaneous
<i>Chromolaena odorata</i> (L.) R.M.King and H.Rob	Asteraceae	S	Introduced	–	Miscellaneous
<i>Cissampelos pareira</i> L	Menispermaceae	H	Native	–	Medicinal
<i>Clerodendrum infortunatum</i> L	Lamiaceae	S	Native	LC	Miscellaneous
<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	H	Native	–	Miscellaneous
<i>Cochlospermum religiosum</i> (L.) Alston	Bixaceae	T	Native	–	Medicinal
<i>Colebrookea oppositifolia</i> Sm	Lamiaceae	S	Native	LC	Miscellaneous
<i>Combretum roxburghii</i> Spreng	Combretaceae	T	Native	–	Medicinal
<i>Cordia macleodii</i> (Griff.) Hook.f. and Thomson	Boraginaceae	T	Native	–	Miscellaneous
<i>Crassocephalum crepidioides</i> (Benth.) S.Moore	Asteraceae	H	Introduced	–	Miscellaneous
<i>Crotalaria alata</i> Buch.-Ham. ex D.Don	Fabaceae	S	Native	–	Miscellaneous
<i>Crotalaria pallida</i> Aiton	Fabaceae	S	Native	–	Miscellaneous

Table 1 (continued)

Species	Family	Habit	Origin	IUCN red-list category	Primary use category
<i>Croton persimilis</i> Müll.Arg	Euphorbiaceae	T	Native	–	Miscellaneous
<i>Curculigo capitulata</i> (Lour.) Kuntze	Hypoxidaceae	H	Introduced	–	Miscellaneous
<i>Cyanthillium cinereum</i> (L.) H.Rob	Asteraceae	H	Native	–	Medicinal
<i>Cyathocline purpurea</i> (Buch.-Ham. ex D.Don) Kuntze	Asteraceae	H	Native	LC	Medicinal
<i>Cynodon dactylon</i> (L.) Pers	Poaceae	H	Native	–	Medicinal
<i>Cyperus rotundus</i> L	Cyperaceae	H	Native	LC	Medicinal
<i>Dalbergia sissoo</i> Roxb. ex DC	Fabaceae	T	Native	LC	Fuelwood
<i>Dendrocalamus strictus</i> (Roxb.) Nees	Poaceae	T	Native	–	Furniture
<i>Dillenia pentagyna</i> Roxb	Dilleniaceae	T	Native	–	Medicinal
<i>Dioscorea alata</i> L	Dioscoreaceae	H	Native	–	Miscellaneous
<i>Dioscorea bulbifera</i> L	Dioscoreaceae	H	Native	–	Medicinal
<i>Diospyros melanoxylon</i> Roxb	Ebenaceae	T	Native	–	Fuelwood and Medicinal
<i>Diospyros montana</i> Roxb	Ebenaceae	T	Native	–	Miscellaneous
<i>Dolichos trilobus</i> L	Fabaceae	S	Native	–	Medicinal
<i>Drimia indica</i> (Roxb.) Jessop	Asparagaceae	H	Native	–	Medicinal
<i>Elephantopus scaber</i> L	Asteraceae	H	Native	–	Medicinal
<i>Elytraria acaulis</i> (L.f.) Lindau	Acanthaceae	H	Native	–	Medicinal
<i>Emilia sonchifolia</i> (L.) DC	Asteraceae	H	Native	–	Medicinal
<i>Eucalyptus globulus</i> Labill	Myrtaceae	T	Introduced	LC	Furniture
<i>Evolvulus nummularius</i> (L.) L	Convolvulaceae	H	Introduced	–	Medicinal
<i>Ficus benghalensis</i> L	Moraceae	T	Native	–	Medicinal
<i>Ficus microcarpa</i> L.f	Moraceae	T	Native	–	Miscellaneous
<i>Ficus racemosa</i> L	Moraceae	T	Native	LC	Medicinal
<i>Ficus religiosa</i> L	Moraceae	T	Native	LC	Medicinal
<i>Firmiana colorata</i> (Roxb.) R.Br	Malvaceae	T	Native	LC	Miscellaneous
<i>Flacourtia indica</i> (Burm.f.) Merr	Salicaceae	T	Native	LC	Medicinal
<i>Flemingia chappar</i> Buch.-Ham. ex Benth	Fabaceae	H	Native	–	Medicinal
<i>Flemingia semialata</i> Roxb. ex W.T.Aiton	Fabaceae	S	Native	–	Miscellaneous
<i>Flemingia strobilifera</i> (L.) W.T.Aiton	Fabaceae	S	Native	–	Edible
<i>Galinsoga quadriradiata</i> Ruiz and Pav	Asteraceae	H	Introduced	–	Miscellaneous
<i>Gardenia latifolia</i> Aiton	Rubiaceae	T	Native	–	Furniture
<i>Glycosmis cochinchinensis</i> (Lour.) Pierre ex Engl	Rutaceae	T	Introduced	–	Fuelwood
<i>Gmelina arborea</i> Roxb. ex Sm	Lamiaceae	T	Native	LC	Medicinal
<i>Grewia asiatica</i> L	Malvaceae	T	Native	LC	Medicinal
<i>Hemidesmus indicus</i> (L.) R.Br	Apocynaceae	H	Native	–	Edible
<i>Hemionitis opposita</i> (Kaulf.) Christenh	Pteridaceae	H	Native	–	Miscellaneous
<i>Hemionitis tenuifolia</i> (Burm.f.) Christenh	Pteridaceae	H	Native	–	Miscellaneous
<i>Heptapleurum stellatum</i> Gaertn	Araliaceae	T	Native	–	Miscellaneous
<i>Holarrhena pubescens</i> Wall. ex G.Don	Apocynaceae	T	Native	LC	Medicinal
<i>Holoptelea integrifolia</i> (Roxb.) Planch	Ulmaceae	T	Native	–	Medicinal
<i>Hymenodictyon orixense</i> (Roxb.) Mabb	Rubiaceae	T	Native	–	Furniture
<i>Hypoestes phyllostachya</i> Baker	Acanthaceae	S	Introduced	–	Miscellaneous
<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	Apocynaceae	S	Native	–	Medicinal
<i>Impatiens balsamina</i> L	Balsaminaceae	H	Native	–	Miscellaneous
<i>Imperata cylindrica</i> (L.) Raeusch	Poaceae	H	Introduced	–	Medicinal
<i>Indigofera cassioides</i> Rottler ex DC	Fabaceae	S	Native	–	Miscellaneous
<i>Justicia adhatoda</i> L	Acanthaceae	S	Native	LC	Medicinal
<i>Lagerstroemia parviflora</i> Roxb	Lythraceae	T	Native	LC	Fuelwood
<i>Lannea coromandelica</i> (Houtt.) Merr	Anacardiaceae	T	Native	LC	Medicinal

Table 1 (continued)

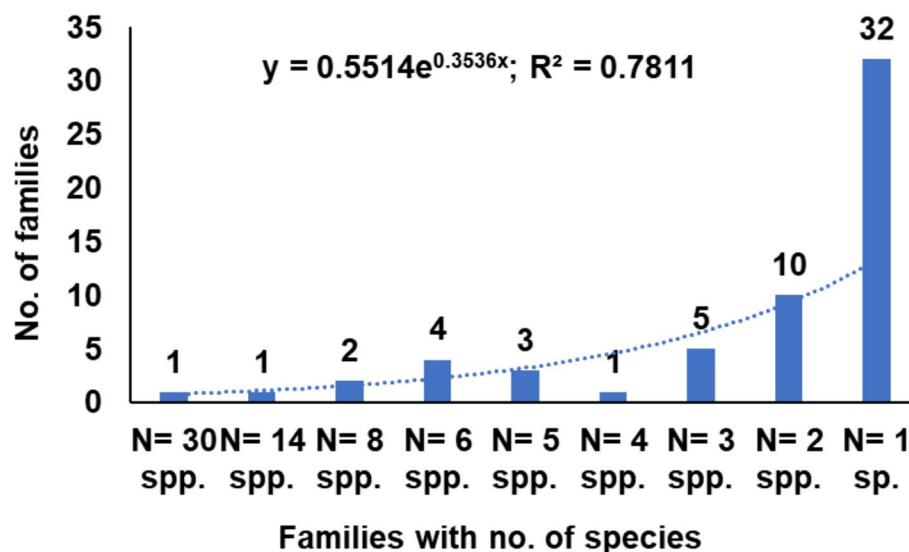
Species	Family	Habit	Origin	IUCN red-list category	Primary use category
<i>Lantana camara</i> L	Verbenaceae	S	Introduced	–	Medicinal
<i>Lapsana communis</i> L	Asteraceae	H	Native	–	Edible
<i>Leea macrophylla</i> Roxb. ex Hornem	Vitaceae	H	Native	–	Miscellaneous
<i>Leucas cephalotes</i> (Roth) Spreng	Lamiaceae	H	Native	–	Miscellaneous
<i>Limonia acidissima</i> L	Rutaceae	T	Native	–	Miscellaneous
<i>Lobelia nummularia</i> Lam	Campanulaceae	H	Native	–	Medicinal
<i>Lygodium japonicum</i> (Thunb.) Sw	Schizaeaceae	H	Native	–	Miscellaneous
<i>Madhuca longifolia</i> (L.) J.F.Macbr	Sapotaceae	T	Native	–	Fuelwood
<i>Mallotus philippensis</i> (Lam.) Müll.Arg	Euphorbiaceae	T	Native	LC	Fuelwood
<i>Mangifera indica</i> L	Anacardiaceae	T	Native	–	Edible
<i>Megathyrsus maximus</i> (Jacq.) B.K.Simon and S.W.L.Jacobs	Poaceae	H	Introduced	–	Miscellaneous
<i>Melia azedarach</i> L	Meliaceae	T	Native	LC	Medicinal
<i>Mesosphaerum suaveolens</i> (L.) Kuntze	Lamiaceae	S	Introduced	–	Medicinal
<i>Meyna laxiflora</i> Robyns	Rubiaceae	T	Native	–	Edible
<i>Miliusa tomentosa</i> (Roxb.) Finet and Gagnep	Annonaceae	T	Native	–	Fuelwood
<i>Miliusa velutina</i> (DC.) Hook.f. and Thomson	Annonaceae	T	Native	–	Medicinal
<i>Mimosa pudica</i> L	Fabaceae	H	Introduced	LC	Medicinal
<i>Mitracarpus hirtus</i> (L.) DC	Rubiaceae	H	Introduced	–	Miscellaneous
<i>Mollugo verticillata</i> L	Molluginaceae	H	Introduced	–	Miscellaneous
<i>Moringa oleifera</i> Lam	Moringaceae	T	Native	–	Miscellaneous
<i>Musa acuminata</i> Colla	Musaceae	T	Native	LC	Miscellaneous
<i>Nyctanthes arbor-tristis</i> L	Oleaceae	T	Native	LC	Medicinal
<i>Ougeinia oojenensis</i> (Roxb.) Hochr	Fabaceae	T	Native	–	Furniture
<i>Oxalis corniculata</i> L	Oxalidaceae	H	Native	–	Medicinal
<i>Parthenium hysterophorus</i> L	Asteraceae	H	Introduced	–	Medicinal
<i>Phanera vahlii</i> (Wight and Arn.) Benth	Fabaceae	S	Native	–	Miscellaneous
<i>Phoenix acaulis</i> Roxb	Arecaceae	S	Native	–	Miscellaneous
<i>Phyllanthus emblica</i> L	Phyllanthaceae	T	Native	LC	Edible
<i>Phyllodium pulchellum</i> (L.) Desv	Fabaceae	S	Native	LC	Miscellaneous
<i>Pinus roxburghii</i> Sarg	Pinaceae	T	Native	LC	Fuelwood
<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	Lamiaceae	S	Native	–	Miscellaneous
<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	T	Native	LC	Medicinal
<i>Psidium guajava</i> L	Myrtaceae	T	Introduced	LC	Edible
<i>Pterocarpus marsupium</i> Roxb	Fabaceae	T	Native	NT	Medicinal
<i>Rungia pectinata</i> (L.) Nees	Acanthaceae	H	Native	–	Medicinal
<i>Salacia chinensis</i> L	Celastraceae	S	Native	–	Medicinal
<i>Schleichera oleosa</i> (Lour.) Oken	Sapindaceae	T	Native	LC	Medicinal
<i>Schrebera swietenoides</i> Roxb	Oleaceae	T	Native	LC	Miscellaneous
<i>Scleromitron diffusum</i> (Willd.) R.J.Wang	Rubiaceae	H	Native	–	Miscellaneous
<i>Scoparia dulcis</i> L	Plantaginaceae	S	Introduced	–	Medicinal
<i>Semecarpus anacardium</i> L.f	Anacardiaceae	T	Native	LC	Fuelwood
<i>Senegalia catechu</i> (L.f.) P.J.H.Hurter and Mabb	Fabaceae	T	Native	LC	Miscellaneous
<i>Senegalia megaladena</i> (Desv.) Maslin, Seigler and Ebinger	Fabaceae	T	Native	–	Fuelwood
<i>Senna tora</i> (L.) Roxb	Fabaceae	S	Introduced	–	Medicinal
<i>Setaria pumila</i> (Poir.) Roem. and Schult	Poaceae	H	Native	–	Miscellaneous
<i>Shorea robusta</i> C.F.Gaertn	Dipterocarpaceae	T	Native	LC	Fuelwood
<i>Sida acuta</i> Burm.f	Malvaceae	S	Native	–	Miscellaneous
<i>Sida rhombifolia</i> L	Malvaceae	S	Native	–	Medicinal
<i>Solanum torvum</i> Sw	Solanaceae	S	Introduced	–	Medicinal

Table 1 (continued)

Species	Family	Habit	Origin	IUCN red-list category	Primary use category
<i>Sophora bakeri</i> C.B.Clarke ex Prain	Fabaceae	S	Native	–	Miscellaneous
<i>Soymida febrifuga</i> (Roxb.) A.Juss	Meliaceae	T	Native	–	Furniture
<i>Spondias pinnata</i> (L.f.) Kurz	Anacardiaceae	T	Native	–	Miscellaneous
<i>Stachytarpheta urticifolia</i> Sims	Verbenaceae	S	Introduced	-	Miscellaneous
<i>Stereospermum chelonoides</i> (L.f.) DC	Bignoniaceae	T	Native	LC	Medicinal
<i>Symplocos racemosa</i> Roxb	Symplocaceae	T	Introduced	–	Medicinal
<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	T	Native	LC	Medicinal
<i>Syzygium nervosum</i> A.Cunn. ex DC	Myrtaceae	T	Native	LC	Edible
<i>Syzygium salicifolium</i> J.Graham	Myrtaceae	T	Native	–	Edible
<i>Tamarindus indica</i> L	Fabaceae	T	Introduced	LC	Edible
<i>Tectona grandis</i> L.f	Lamiaceae	T	Native	EN	Furniture
<i>Terminalia anogeissiana</i> Gere and Boatwr	Combretaceae	T	Native	–	Fuelwood
<i>Terminalia bellirica</i> (Gaertn.) Roxb	Combretaceae	T	Native	LC	Medicinal
<i>Terminalia chebula</i> Retz	Combretaceae	T	Native	LC	Furniture
<i>Terminalia tomentosa</i> Wight and Arn	Combretaceae	T	Native	–	Furniture
<i>Thysanolaena latifolia</i> (Roxb. ex Hornem.) Honda	Poaceae	H	Native	–	Miscellaneous
<i>Urena lobata</i> L	Malvaceae	H	Native	LC	Medicinal
<i>Veronica persica</i> Poir	Plantaginaceae	H	–	–	Medicinal
<i>Woodfordia fruticosa</i> (L.) Kurz	Lythraceae	T	Native	LC	Edible
<i>Wrightia arborea</i> (Dennst.) Mabb	Apocynaceae	T	Native	LC	Medicinal
<i>Ziziphus mauritiana</i> Lam	Rhamnaceae	T	Native	LC	Edible
<i>Ziziphus rugosa</i> Lam	Rhamnaceae	T	Native	–	Miscellaneous
<i>Ziziphus xylopyrus</i> (Retz.) Willd	Rhamnaceae	T	Native	–	Edible

T tree, *S* shrubs, *H* herbs, *NT* near threatened, *LC* least concern, *EN* endangered

Fig. 3 Families with the number of species and the number of families in the study area



positive link with socioeconomic circumstances (Islam et al. 2015). The collaborative work of local women, from collecting NTFPs in the forest to selling them in the market for economic sustainability or domestic use, has played an important role in maintaining family livelihoods (Sinha and

Tripathi 2017). Additionally, they gather leaf litter and wood for heating and cooking, fruit and vegetables for household consumption and to sell in the market. Various plant species are used to make plates and containers, while forest herbs are used to make essential oils that can be traded or used in

the home. Due to high species richness and diversity, the forest offers a wide range of livelihood opportunities through self-employment, business groups, self-help groups, etc. (Shendage et al. 2009). The present study reported that the majority of the plant species were used by the local villagers for miscellaneous purposes (170 spp.) followed by medicinal uses (147 spp.), edibles (raw) (62 spp.), fuelwoods as well as, furniture and building materials (35 spp. each), edibles (cooked) purposes (32 spp.), and fodder (22 spp.) (Table 2 and Fig. 4). A similar study was conducted in two upper Assam districts (Golaghat and Jorhat) of northeast India especially on the use of plant species for different purposes highlights that 18% of species showed utilization potential for timber and miscellaneous categories followed by other categories (Saikia et al. 2012). Plants used for construction purposes (97%) hold the higher value followed by edible purposes (27%), and fuelwood (10%) in Sainte Luce and Mandena regions of south-eastern Madagascar (Račevska et al. 2022). Community well-being, societal demands, and moral and ethical principles must be taken into care for the sustainable use of forests and related land resources as it will enhance the conservation perspective and the diversity of forests. Therefore, a multidisciplinary approach to sustainable harvesting of forest goods must be implemented to avoid over-exploitation and further degradation of forests.

Different indices showed a wide range of dispersion in different use categories (Table 3). The higher FIC values were assessed in the case of fuelwood collection (137 spp.), furniture and building materials purposes (137 spp.), medicinal purposes (25 spp.), edibles (raw) purposes (110 spp.), edibles (cooked) purposes (140 spp.), fodder purposes (150 spp.), and for miscellaneous uses (98 spp.). The use-value index (UVi) signifies higher values in fuelwood category (32 spp.), furniture and building materials category (34 spp.), medicinal (61 spp.), edibles (raw) category (6 spp.), edibles (cooked) category (17 spp.), fodder category (21 spp.), and miscellaneous use category (7 spp.). The 100% fidelity level (FL) had been found in the case of 32 spp. in the fuelwood category, 34 spp. in furniture and building materials, 61 spp. in the medicinal, 6 spp. in the edibles (raw) category, 17 spp. in edibles (cooked) category, 21 spp. in the fodder category, and 7 spp. in the miscellaneous category. Out of the seven use categories, *Pongamia pinnata* (L.) Pierre was the only species having the highest utilization potential, satisfying six use categories followed by 11 different plant spp. that satisfied five use categories, 24 plant spp. satisfied four use categories, 25 plant spp. satisfied three use categories, 58 plant spp. satisfied two use categories, and 48 plant spp. satisfied only one-use category (Table 3). *Psidium guajava* L., *Dysphania ambrosioides* (L.) Mosyakin & Clemants, *Ruta chalepensis* L., *Byrsonima crassifolia* (L.) Kunth, and *Cissampelos pareira* L. were the important medicinal plants with higher potential for the treatment of a range of

ailments reported in a similar study conducted in Mexico based on F_{IC} (Heinrich et al. 1998). On the other hand, *Croton macrostachyus* Hochst. ex Delile and *Zehneria scabra* (L.f.) Sond. were the most used medicinal plant for malaria, while *Cynoglossum coeruleum* Hochst. ex A.DC. for mitch that had been reported by the majority of the informants in Ethiopia (Giday et al. 2007). In New Guinea, it is observed that the majority of plant species (88 spp.) were used for the treatment of tuberculosis (Case et al. 2006). Likewise, *Matricaria chamomilla* L., *Hypericum perforatum* L., and *Mentha × piperita* L. were the plant species having higher values for curing different diseases in the Pčinja district of South-Eastern Serbia (Živković et al. 2020). Information gathered based on the utilization potential of different plant species for several purposes and various ailments signifies the exploitation of species for that particular purpose for more than one generation. The higher values of the F_{IC} index, use value, and fidelity level with a large number of plant species manifest the overuse of plant resources by the locals to fulfil their sustenance needs. All the species recorded in the study are either economically valuable or ecologically significant. The majority of them are overharvested by the locals for domestic and economic purposes leading to ecological imbalance, loss of canopy cover, and decreased biodiversity. Therefore, management, monitoring, and sustainable utilization of natural forests through capacity-building programmes should take utmost priority based on the aspects of protection, conservation, and sustainable development as entirely and moderately dependent populations' livelihood reliance on forests varies among regions and this should be taken into account in devising management plans for safeguarding forests from further depletion.

Plants used in traditional medicines, especially in women's health

Almost 70% of modern pharmaceuticals are used in India's traditional and indigenous medical systems, and many of their synthetic counterparts are made using plant extracts from the country's natural forests (Shi et al. 2021). Around 1200–1800 plant species were used in ayurvedic medicine throughout the globe, meanwhile in India, 7500 plant species were used in various remedies by indigenous and tribal communities (Sen and Chakraborty 2017). The present study recorded a majority (147 plant species belonging to 129 genera and 56 families) of the total recorded plant species having medicinal utilities of which a maximum is woody (73 trees and 29 shrubs), and few are non-woody herbs (45 herbs). Comparatively poor medicinal plant richness in the present study (147 spp.) as compared to the earlier records (160 spp.) in Jharkhand (Sharma et al. 2016) may be due to the prevalence of ecological disturbances in the form of grazing, overharvesting, fuelwood and forage collection,

Table 2 Plant species and their parts used in day-to-day necessities with special emphasis on medicinal plants

Species	Major uses	Plant parts and their medicinal utilities
<i>Acmella paniculata</i> (Wall. ex DC.) R.K.Jansen	Edibles (cooked) Medicinal	Whole plant: mouth ulcer, bleeding, wound, toothache Flower and fruit: Ulcer in mouth
<i>Adenanthera pavonina</i> L	Fuelwood Furniture Medicinal	Leaf: ant bite
<i>Adiantum incisum</i> Forssk	Miscellaneous	Whole plant: diabetes
<i>Adina cordifolia</i> (Roxb.) Brandis	Fuelwood Medicinal	Bark: malarial fever, abdominal diseases, ulcer
<i>Aegle marmelos</i> (L.) Correa	Medicinal Edible (raw)	Fruits and leaves: stomach-related problems; Bark: fever Buds: sexual debility
<i>Ageratum conyzoides</i> L	Medicinal	Whole plant: menstruation pain Leaves and young shoots: leprosy and cut and wound
<i>Ageratum houstonianum</i> Mill	Medicinal	Leaf: cut and wound
<i>Ailanthus excelsa</i> Roxb	Fuelwood Furniture and building materials	–
<i>Albizia chinensis</i> (Osbeck) Merr	Furniture and building materials	–
<i>Albizia lebeck</i> (L.) Benth	Furniture and building materials	–
<i>Alternanthera sessilis</i> (L.) DC	Medicinal	Whole plant: skin diseases, fever, spleen diseases, dyspepsia
<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Medicinal	Whole plant: malaria, dyspepsia, asthma, cancer
<i>Anisomeles indica</i> (L.) Kuntze	Medicinal	Whole plant: fever, epilepsy, ulcer, chest congestion
<i>Anogeissus latifolia</i> (Roxb. ex DC.) Wall. ex Guill. and Perr	Furniture and building materials	–
<i>Antidesma ghaesembilla</i> Gaertn	Medicinal	Fruit: malaria
<i>Arisaema heterophyllum</i> Blume	Medicinal Edible (cooked)	Roots and tubers: blood clotting, pain reliever, intestinal parasite killer
<i>Artocarpus heterophyllus</i> Lam	Fodder Edible (cooked) Medicinal	Whole plant: ulcer, asthma, fever, skin diseases
<i>Artocarpus lacucha</i> Buch.-Ham	Furniture and building materials Edible (raw) Medicinal	Stem and Bark: stomach pain, body ache
<i>Asparagus racemosus</i> Willd	Medicinal	Leaves: kidney stone, fever, measles, inflammation on urinary tract, stomach pain Root and tubers: increase lactation, leucorrhea, increases fertility and conceiving power in women
<i>Bacopa monnieri</i> (L.) Wettst	Medicinal	Whole plant: asthma Leaves: enhance memory
<i>Bauhinia galpinii</i> N.E.Br	Fodder Edible (cooked) Medicinal	Leaves: infection Bark: inflammation, digestion problems
<i>Bauhinia purpurea</i> L	Medicinal	Fruit: bone fracture, dysentery Flower and bark: tumors in stomach
<i>Bauhinia tomentosa</i> L	Fodder Fuelwood Edible (cooked) Medicinal	Leaves: wound, liver infection Stem and Bark: skin infection Twigs: tumors
<i>Bauhinia variegata</i> L	Fodder Medicinal	Twigs: pyorrhea
<i>Bidens pilosa</i> L	Medicinal	Leaves: cough, fever, skin diseases

Table 2 (continued)

Species	Major uses	Plant parts and their medicinal utilities
<i>Blumea lacera</i> (Burm.f.) DC	Medicinal	Leaves: cut and wounds, skin infection Whole plant: fever, diarrhea, bronchitis
<i>Bombax ceiba</i> L	Miscellaneous Medicinal	Leaves: head, tooth, ear and body pain, bone fracture Seed: abortion Bark and flower: hydrocele, leucorrhea, gonorrhoea, menstrual disorders
<i>Boswellia serrata</i> Roxb	Fuelwood Fodder Furniture and building materials Medicinal	Whole plant: rheumatism, cough, impotency, menorrhagia
<i>Bridelia retusa</i> (L.) A.Juss	Fuelwood Furniture and building materials Medicinal	Bark: hemiplegia, diabetes, rheumatism, develop sterility, contraceptive
<i>Butea monosperma</i> (Lam.) Kuntze	Fodder Medicinal	Leaves: dysentery, cough, cold, toothache, wound, menstrual problems, oligomenorrhea, fever Flower: irregular periods Seed: abortion Bark: control bleeding after child birth, leucorrhoea
<i>Butea superba</i> Roxb. ex Willd	Medicinal	Seed: skin diseases, herpes, arthritis, constipation
<i>Cajanus scarabaeoides</i> (L.) Thouars	Medicinal	Whole plant: contraceptive, spermatorrhoea, skin problems
<i>Careya arborea</i> Roxb	Medicinal	Leaves: wound, ulcer Bark: cold, fever, cough Flower and fruit: labor pains, piles, infertility, cold, malaria, dysentery
<i>Carissa carandas</i> L	Edible (raw) Medicinal	Leaves: diabetes Root: fever Bark: wound healing
<i>Carissa spinarum</i> L	Fodder Edible (raw) Medicinal	Whole plant: skin diseases, asthma, rheumatism
<i>Casearia tomentosa</i> Roxb	Fuelwood Medicinal	Leaves and fruit: bone fracture
<i>Cassia fistula</i> L	Furniture and building materials Medicinal	Leaves: constipation, infant mouth infection, inflammation, flatulence, wounds
<i>Catunaregam spinosa</i> (Thunb.) Tirveng	Medicinal	Fruit and root: inflammation, pain, vomiting
<i>Chromolaena odorata</i> (L.) R.M.King and H.Rob	Medicinal	Leaves and seed: cough, fever, malaria, skin infection
<i>Cissampelos pareira</i> L	Medicinal	Whole plant: blood purification, abortion, liver problems, fever, headache, fistula
<i>Clerodendrum infortunatum</i> L	Medicinal	Leaves: inflammation, infection, skin disease, cough Root: constipation, mental disorder, memory enhancer
<i>Coccinia grandis</i> (L.) Voigt	Medicinal	Whole plant: diabetes, scabies, skin infection
<i>Cochlospermum religiosum</i> (L.) Alston	Miscellaneous Medicinal	Leaves: jaundice, gonorrhoea, cough
<i>Colebrookea oppositifolia</i> Sm	Medicinal	Leaves and root: epilepsy, wound
<i>Combretum roxburghii</i> Spreng	Edible (cooked) Medicinal	Leaves: gastric problems, diarrhea Seed: eczema
<i>Cordia macleodii</i> (Griff.) Hook.f. and Thomson	Medicinal	Leaves: chest pain

Table 2 (continued)

Species	Major uses	Plant parts and their medicinal utilities
<i>Crassocephalum crepidioides</i> (Benth.) S.Moore	Medicinal	Leaves and twigs: stomach problems
<i>Crotalaria pallida</i> Aiton	Medicinal	Leaves: skin diseases, fever; root- bronchitis Seed: fever
<i>Croton persimilis</i> Müll.Arg	Medicinal	Bark and root: liver infection, sprain, rheumatic pains
<i>Curculigo capitulata</i> (Lour.) Kuntze	Medicinal	Whole plant: promote lactation, fetal health, gonorrhea, gynecological problems, indigestion, piles
<i>Cyanthillium cinereum</i> (L.) H.Rob	Medicinal	Leaves: abdominal pain, diarrhea, skin infection
<i>Cyathocline purpurea</i> (Buch.-Ham. ex D.Don) Kuntze	Medicinal	Whole plant: tuberculosis, malaria, menstrual pain
<i>Cynodon dactylon</i> (L.) Pers	Medicinal	Whole plant: painful menstruation, abortion, contraceptive Roots: diabetes
<i>Cyperus rotundus</i> L	Edible (cooked) Medicinal	Leaves and tubers: control weight gain
<i>Dalbergia sissoo</i> Roxb. ex DC	Fuelwood Furniture and building materials Miscellaneous Medicinal	Leaves: menorrhagia
<i>Dendrocalamus strictus</i> (Roxb.) Nees	Fuelwood Furniture and building materials Miscellaneous	-
<i>Dillenia pentagyna</i> Roxb	Medicinal	Bark: diabetes, rheumatic pains
<i>Dioscorea alata</i> L	Medicinal	Tubers and bulb: postpartum health, gastritis, piles, mouth cancer
<i>Dioscorea bulbifera</i> L	Edible (cooked) Medicine	Tubers: burning, pneumonia, wound Whole plant: contraceptive, abortion
<i>Diospyros melanoxylon</i> Roxb	fuelwood Edible (raw) Miscellaneous Medicinal	Leaves: cough, asthma, skin diseases Flower and seed: diarrhea Bark and fruit: chest pain
<i>Diospyros montana</i> Roxb	Medicinal	Bark: bone fracture, jaundice, anorexia, paralysis, joint pains
<i>Dolichos trilobus</i> L	Medicinal	Whole plant: abortion
<i>Drimia indica</i> (Roxb.) Jessop	Medicinal	Tuber: typhoid
<i>Elephantopus scaber</i> L	Medicinal	Whole plant: wound Root: tonic
<i>Elytraria acaulis</i> (L.f.) Lindau	Medicinal	Leaves and root: cold, hip pain
<i>Emilia sonchifolia</i> (L.) DC	All the parts are used for medicinal purposes	Whole plant: sore throat, night blindness Flower: diarrhea
<i>Eucalyptus globulus</i> Labill	Furniture and building materials Miscellaneous	-
<i>Evolvulus nummularius</i> (L.) L	Edible (cooked) Medicinal	Roots: wound healing
<i>Ficus benghalensis</i> L	Medicinal	Roots: leucorrhea, gonorrhea Bark: dysentery, diarrhea, diabetes
<i>Ficus microcarpa</i> L.f	Medicinal	Fruit: wounds, dandruff
<i>Ficus racemosa</i> L	Fodder Medicinal	Bark: abortion
<i>Ficus religiosa</i> L	Medicinal	Leaves and shoots: skin diseases, contraceptive Fruits: leucorrhea
<i>Firmiana colorata</i> (Roxb.) R.Br	Medicinal	Leaves: jaundice, intestinal disorders, cholera

Table 2 (continued)

Species	Major uses	Plant parts and their medicinal utilities
<i>Flacourtia indica</i> (Burm.f.) Merr	Medicinal	Leaves: conjunctivitis Fruit: liver problems
<i>Flemingia chappar</i> Buch.-Ham. ex Benth	Medicinal	Whole plant: epilepsy
<i>Flemingia semialata</i> Roxb. ex W.T.Aiton	Medicinal	Whole plant: dysentery, ulcer
<i>Flemingia strobilifera</i> (L.) W.T.Aiton	Edible (cooked) Medicinal	Leaves and shoots: insect repellent
<i>Galinsoga quadriradiata</i> Ruiz and Pav	Medicinal	Leaves: malaria, liver problems Bark and flower: cancer, cold Seed: cough, inflammation
<i>Gardenia latifolia</i> Aiton	Furniture and building material Medicinal	Leaves: blisters Bark: piles, fever Fruit: boils
<i>Glycosmis cochinchinensis</i> (Lour.) Pierre ex Engl	Fuelwood Edible (cooked)	–
<i>Gmelina arborea</i> Roxb. ex Sm	Fodder Furniture and building materials Edible (cooked) Medicinal	Flower: hypertension Fruit: itchiness in body
<i>Grewia asiatica</i> L	Medicinal	Leaves: cold, cough Bark: menstrual problems Fruit: cancer, skin infection
<i>Hemidesmus indicus</i> (L.) R.Br	Edible (cooked) Medicinal	Whole plant: purifies blood, control body heat, increase semen production, leucorrhea, skin diseases, urinary diseases
<i>Hemionitis opposita</i> (Kaulf.) Christenh	Medicinal	Leaves: skin infection
<i>Heptapleurum stellatum</i> Gaertn	Medicinal	Whole plant: strengthen nervous system
<i>Holarrhena pubescens</i> Wall. ex G.Don	Medicinal	Leaves: dysentery, fever, cold, piles Bark: immune system stimulant, amoebiasis Twig: increase lactation
<i>Holoptelea integrifolia</i> (Roxb.) Planch	Fuelwood Furniture and building materials Edible (cooked) Medicinal	Leaves: treat ringworms
<i>Hymenodictyon orixense</i> (Roxb.) Mabb	Furniture and building materials Medicinal	Bark: bone fracture, menstrual pain
<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	Medicinal	Whole plant: bleeding in gum, skin disease, fever, kidney diseases
<i>Impatiens balsamina</i> L	Medicinal	Leaves: ulcers, constipation, urinary retention, arthritis
<i>Imperata cylindrica</i> (L.) Raeusch	Medicinal	Roots: intestinal worms
<i>Justicia adhatoda</i> L	Medicinal	Leaves: malaria fever
<i>Lagerstroemia parviflora</i> Roxb	Fuelwood Edible (cooked) Miscellaneous	–
<i>Lannea coromandelica</i> (Houtt.) Merr	Fuelwood Edible (cooked) Medicinal	Leaves: body pain, swellings, sprains Bark: sore, ulcers
<i>Lantana camara</i> L	Medicinal	Whole plant: dysentery
<i>Lapsana communis</i> L	Medicinal	Whole plant: cure chest tumors in women
<i>Leea macrophylla</i> Roxb. ex Hornem	Medicinal	Bulb: skin diseases
<i>Leucas cephalotes</i> (Roth) Spreng	Medicinal	Whole plant: dermatitis
<i>Limonia acidissima</i> L	Edible (raw) Medicinal	Whole plant: dysentery, diabetes, arthritis
<i>Lobelia nummularia</i> Lam	Miscellaneous Medicinal	Whole plant: cough, asthma, respiratory diseases

Table 2 (continued)

Species	Major uses	Plant parts and their medicinal utilities
<i>Madhuca longifolia</i> (L.) J.F.Macbr	Fuelwood Medicinal	Flower and fruit: wound
<i>Mallotus philippensis</i> (Lam.) Müll.Arg	Fuelwood Miscellaneous Medicinal	Whole plant: leucorrhoea, skin diseases, hydrocele
<i>Mangifera indica</i> L	Fuelwood Furniture and building materials Edible (raw, cooked) Medicinal	Seed and bud: jaundice, dental disease, dermatological disorder Fruits and seed: menorrhagia
<i>Megathyrsus maximus</i> (Jacq.) B.K.Simon and S.W.L.Jacobs	Medicinal	Whole plant: infection, wound, pain relief
<i>Melia azedarach</i> L	Medicinal	Leaves: measles, skin diseases, fever, hypertension
<i>Mesophaerum suaveolens</i> (L.) Kuntze	Medicinal	Leaves: control weight gain, boils, diabetes mellitus, eczema Stem: boils, diabetes mellitus, eczema Tuber: control weight gain
<i>Meyna laxiflora</i> Robyns	Edible (cooked) Medicinal	Leaves and seed: digestion problems
<i>Milium tomentosum</i> (Roxb.) Finet and Gagnep	Fuelwood Medicinal	Leaves and fruit: reduce body fat, strengthen muscles
<i>Milium velutinum</i> (DC.) Hook.f. and Thomson	Medicinal	Leaves: fever, wound, skin infection
<i>Mimosa pudica</i> L	Medicinal	Whole plant: leprosy, burning sensation, fever, blood pressure, abortion
<i>Mitracarpus hirtus</i> (L.) DC	Medicinal	Leaves and fruit: diarrhea, skin diseases
<i>Mollugo verticillata</i> L	Medicinal	Whole plant: abnormal menstruation, malaria, amenorrhea
<i>Moringa oleifera</i> Lam	Medicinal	Leaves and shoot: dental caries, toothache, urinary tract, throat infection Leaves: pimple problems Root: contraceptive
<i>Musa acuminata</i> Colla	Medicinal	Leaves: allergy infection, bronchitis, dysentery
<i>Nyctanthes arbor-tristis</i> L	Miscellaneous Medicinal	Whole plant: bronchitis, asthma, inflammation, worm infection Leaves: menorrhagia
<i>Ougeinia oojeinensis</i> (Roxb.) Hochr	Furniture and building materials Medicinal	Bark: dysentery, diarrhea, increase fertility, chance of pregnancy
<i>Oxalis corniculata</i> L	Edible (cooked) Medicinal	Leaves: dysentery, stomach disorders, rheumatism, toothache
<i>Parthenium hysterophorus</i> L	Medicinal	Whole plant: kidney stone, rheumatism, neuralgia, dysentery
<i>Phanera vahlii</i> (Wight and Arn.) Benth	Miscellaneous Medicinal	Leaves and flower: hair fall Flower: headache Whole plant: abortion, dysentery
<i>Phoenix acaulis</i> Roxb	Edible (raw, cooked) Miscellaneous Medicinal	Leaves: toothache
<i>Phyllanthus emblica</i> L	Edible (raw, cooked) Miscellaneous Medicinal	Leaves and fruit: hair fall, diabetes, conjunctivitis, urinary problem Fruit and seed: vaginal itching and pain
<i>Phyllodium pulchellum</i> (L.) Desv	Medicinal	Leaves: menorrhagia
<i>Pinus roxburghii</i> Sarg	Fuelwood Miscellaneous Medicine	Resin: wound
<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	Medicinal	Shoot: indigestion, cough, cold

Table 2 (continued)

Species	Major uses	Plant parts and their medicinal utilities
<i>Pongamia pinnata</i> (L.) Pierre	Fuelwood Fodder Furniture and building materials Miscellaneous Medicinal	Whole plant: piles, asthma, ulcer, diabetes, herpes, malaria
<i>Psidium guajava</i> L	Fodder Edible (raw) Miscellaneous Medicine	Bark: tooth pain and decay, abdominal pain, dysentery
<i>Pterocarpus marsupium</i> Roxb	Furniture and building materials Medicinal	Whole plant: labor pain, fertility, jaundice, menstrual problem, menorrhagia
<i>Rungia pectinata</i> (L.) Nees	Medicinal	Whole plant: ulcer
<i>Salacia chinensis</i> L	Medicinal	Whole plant: gridle pain
<i>Schleichera oleosa</i> (Lour.) Oken	Fuelwood Fodder Edible (raw, cooked) Furniture and building materials Medicinal	Fruit: control excess consumption of alcohol
<i>Schrebera swietenoides</i> Roxb	Medicinal	Fruit: eye diseases
<i>Scleromitron diffusum</i> (Willd.) R.J.Wang	Medicinal	Whole plant: tumors
<i>Scoparia dulcis</i> L	Edible (cooked) Medicinal	Stems and roots: central nervous system related problems Whole plant: kidney stone, jaundice, urinary infections
<i>Semecarpus anacardium</i> L.f	Fuelwood Furniture and building material Medicinal	Fruits and seed: rheumatism, sprain
<i>Senegalia catechu</i> (L.f.) P.J.H.Hurter and Mabb	Fodder Miscellaneous Medicinal	Latex: easy delivery Bark: abortion
<i>Senegalia megaladena</i> (Desv.) Maslin, Seigler and Ebinger	Fuelwood Furniture and building materials	–
<i>Senna tora</i> (L.) Roxb	Edible (cooked) Medicinal	Leaves: worm infection, vision problem, liver disease, leprosy
<i>Setaria pumila</i> (Poir.) Roem. and Schult	Medicinal	Whole plant: bone fracture
<i>Shorea robusta</i> C.F.Gaertn	Fuelwood Edible (cooked) Furniture and building materials Miscellaneous Medicine	Leaves and flowers: infections, any disease related to digestive, circulatory, respiratory, endocrine, and skeletal system
<i>Sida acuta</i> Burm.f	Medicinal	Root: gastric, urinary, and nervous diseases
<i>Sida rhombifolia</i> L	Edible (cooked) Medicinal	Leaves: inflammation, spermatorrhea Whole plant: tuberculosis
<i>Solanum torvum</i> Sw	Medicinal	Seed: toothache, tooth decay
<i>Sophora bakeri</i> C.B.Clarke ex Prain	Medicinal	Leaves: infection
<i>Soymida febrifuga</i> (Roxb.) A.Juss	Furniture and building materials Medicinal	Bark and stem: maintain the menstruation cycle
<i>Spondias pinnata</i> (L.f.) Kurz	Medicinal	Bark: dysentery Fruit: fever Root: diarrhea
<i>Stachytarpheta urticifolia</i> Sims	Medicinal	Leaves and root: fever, cold, asthma, diarrhea
<i>Stereospermum chelonoides</i> (L.f.) DC	Fuelwood Furniture and building materials Edible (cooked) Medicinal	Leaves and root: increase fertility, menstrual problems, wounds
<i>Symplocos racemosa</i> Roxb	Medicinal	Root: chest pain, back sprains

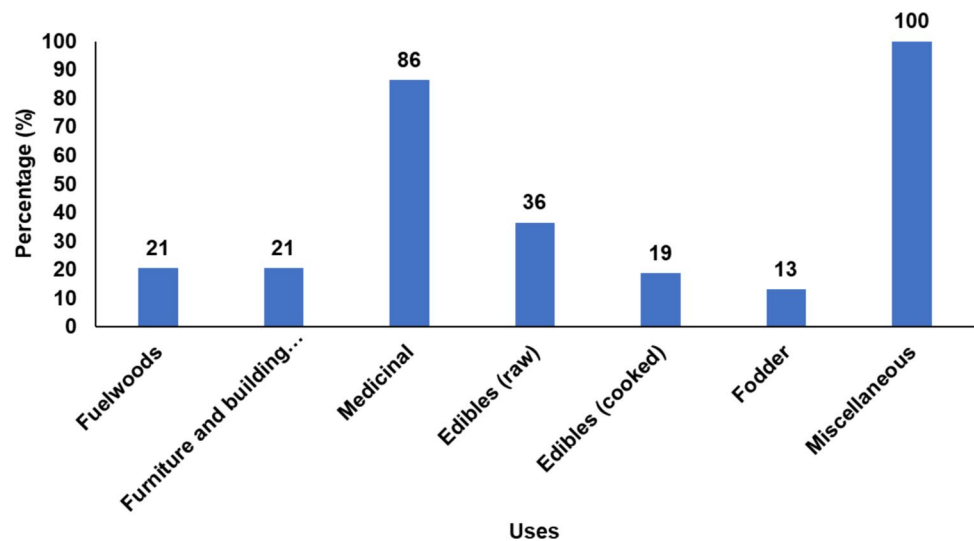
Table 2 (continued)

Species	Major uses	Plant parts and their medicinal utilities
<i>Syzygium cumini</i> (L.) Skeels	Fuelwood Fodder Furniture and building materials Medicine	Bark: leucorrhea Fruit: dysentery
<i>Syzygium nervosum</i> A.Cunn. ex DC	Furniture and building materials Edible (raw)	–
<i>Syzygium salicifolium</i> J.Graham	Furniture and building materials Edible (raw)	–
<i>Tamarindus indica</i> L.	Fuelwood Furniture and building materials Edible (raw, cooked) Medicinal	Whole plant: bone fracture, eye infection, malaria, skin diseases
<i>Tectona grandis</i> L.f	Fuelwood Furniture and building materials Miscellaneous Medicinal	Bark: piles, dysentery, leukoderma, diabetes, leucorrhea Root: urinary problem Leaves: menstrual problems, hemorrhage Flower and seed: hair growth, skin infection
<i>Terminalia anogeissiana</i> Gere and Boatwr	Fuelwood Furniture and building materials Medicinal	Bark: diarrhea Leaves: used after delivery to cure damage tissues
<i>Terminalia bellirica</i> (Gaertn.) Roxb	Fodder Miscellaneous Medicinal	Fruit: stomach problem, cough, contraceptive Bark: anemia, leukoderma
<i>Terminalia chebula</i> Retz	Fuelwood Furniture and building materials Medicinal	Fruit: cough, vomiting, stomach pain, diabetes, contraceptive Bark: contraceptive
<i>Terminalia tomentosa</i> Wight and Arn	Fuelwood Fodder Furniture and building materials Miscellaneous Medicinal	Bark: intestinal problem
<i>Urena lobata</i> L.	Leaf- medicine	Leaves: rheumatism Fruits and seeds: infection
<i>Veronica persica</i> Poir	Miscellaneous	–
<i>Woodfordia fruticosa</i> (L.) Kurz	Edible (cooked) Medicinal	Leaves and fruits: fever, toothache, bowel disease, dysentery Flower: leucorrhea, ulcer
<i>Wrightia arborea</i> (Dennst.) Mabb	Fuelwood Edible (cooked) Medicinal	Leaves: menstrual pain
<i>Ziziphus mauritiana</i> Lam	Fuelwood Fodder Furniture and building materials Medicinal	Fruits: constipation, tooth pain and as nutrients, leucorrhea
<i>Ziziphus xylopyrus</i> (Retz.) Willd	Miscellaneous Medicinal	Fruit: check oogenesis

logging, timber felling, disposal of plastic wastes, soil removal, and forest fire in the studied forest patches. Meanwhile, being a protected area the diversity of the medicinal plants in the present study was higher as compared to other studies reported in Jharkhand (Lal and Singh 2012; Mondal and Rahaman 2012; Kumari et al. 2018; Kumar and Saikia 2020a, b). On the other hand, similar studies throughout the globe have recorded contradictory information regarding

the maximum number of medicinal plants belonging to the herbaceous community (Srivastava et al. 2012; Rao et al. 2015; Jan et al. 2021; Roy et al. 2022). The leaves and young shoots (62 spp.) were reported as the most used plant parts followed by flowers and fruits (52 spp.), stems and barks (47 spp.), roots and tubers (39 spp.), and seeds (28 spp.) (Fig. 5). Similar findings with leaves as the most often used

Fig. 4 Percentage of species used for different purposes



plant part for medicinal purposes have been recorded in different parts of India and throughout the world (Rao et al. 2015; Mir et al. 2021; Roy et al. 2022), while some other studies reported roots and tubers (Marandi and Britto 2014) as well as flowers (Bhattarai et al. 2006) as the most used plant parts. Local healers and traditional practitioners have extensive knowledge of a variety of herbal remedies, their preparations, and therapeutic characteristics that are effective in treating different ailments (Majumdar et al. 2006). The majority of plant species were used as an oral decoction, infusion, maceration, chewed, powdered, raw, cooked, juice, paste, dried, fumes, and poultice, while a limited number of species were used externally (by rubbing, as a bandage, oil, etc.), especially for pain relief, wound, skin infection, ulcer, menstrual disorders, and other ailments (Table 2). Supplements like milk, honey, jaggery, clarified butter, black pepper, and warm water were also used along with plant extracts for oral consumption and external uses in different formulations. Some of the plant species that were entirely utilized for medicinal purposes where every plant part of these species have certain ethnomedicinal uses (Fig. 6). Most of the plant species were used by the locals in the treatment of common ailments like cough, cold, pain, wound, etc., while a total of 48 plant species were specifically used by local women for a range of gynaecological disorders including menstrual pain, abortion, as contraceptives, increase lactation, increase fertility and chances of pregnancy, leucorrhea, vaginal itching, vaginal infection, menorrhagia, labour pain, and other problems during menstruation, pregnancy, and after pregnancy (Table 2 and Fig. 7). In conformity with the present report, earlier studies also reported the use of a range of species for the treatment of gynaecological disorders in various parts of the country. A total of 23 plant species were reported in the Pachmarhi Biosphere Reserve, Madhya Pradesh, India (Singh and Singh 2012), while 60

plant species in the Baramulla district of the former state of Jammu and Kashmir (Jan et al. 2021) and 66 plant species in Vedaranyam (Taluk), Nagapattinam district of south India (Balamurugan et al. 2018) used for the treatment related to women health. Long-term reliance on plants for medical purposes has resulted in the formation of regional medicinal products (Hussain et al. 2022) for the treatment of ailments, including gynaecological disorders, however, the dosages of these formulations are not standardized and typically taken with the advice of the elders, traditional healers, and practitioners. The forests and the locals have a mutualistic connection that ensures the fulfilment of their daily needs and the preservation of the forests in return. Achieving the Sustainable Development Goals (SDGs), particularly SDGs 1, 2, 3, 6, 13, and 15, will be made possible by community involvement in forest stewardship through ownership and access rights.

Conclusions

Forests are crucial for the livelihood of the local and indigenous people of Jharkhand as they provide a huge range of goods (food, fodder, shelter, timber, fuelwood, furniture, fruits, medicines, etc.) and services (provisional, cultural, supporting, and regulating). The moderate climate, numerous ecosystems, and indigenous communities with diverse cultural and societal norms may all contribute to abundant plant diversity (170 spp.) in the studied forests. The utilization of different plant species for numerous purposes revealed a serious threat to these species for further survival. Species with higher utilization potential may eventually vanish from their natural habitats if unsustainable harvesting of these species continues from their natural habitat. The current study and analysis have uncovered a

Table 3 Quantitative analysis through ethnobotanical indices (informant consensus factor (F_{IC}), use-value index (UV_i), and fidelity level (FL)) of use categories with number of species ($N=53$) in PTR, Eastern India

Use categories	Ethnobotanical indices	Values	No. of species
Fuelwood	F_{IC}	0.00	32
		0.02	1
		0.04	1
		0.12	1
		1.02	135
	UV_i	0.00	135
		0.89	1
		0.96	1
		0.98	1
		1.00	32
	FL (%)	0	135
		89	1
		96	1
		98	1
		100	32
Furniture and building materials	F_{IC}	0.00	34
		0.08	1
		1.02	135
	UV_i	0.00	135
		0.92	1
		1.00	34
	FL (%)	0	135
		92	1
		100	34
Medicinal	F_{IC}	0.00	63
		0.02	12
		0.04	5
		0.06	3
		0.08	6
		0.10	4
		0.12	6
		0.13	7
		0.15	2
		0.17	5
		0.19	11
		0.21	5
		0.23	8
		0.25	2
		0.31	1
	0.35	1	
	0.38	1	
	0.40	1	
	0.56	2	
	0.65	1	
	1.02	24	
	UV_i	0.00	24
		0.36	1
0.45		2	
0.60		1	
0.62		1	

Table 3 (continued)

Use categories	Ethnobotanical indices	Values	No. of species
		0.66	1
		0.70	1
		0.75	2
		0.77	8
		0.79	5
		0.81	11
		0.83	5
		0.85	2
		0.87	7
		0.89	6
		0.91	4
		0.92	6
		0.94	3
		0.96	5
		0.98	12
		1.00	63
	FL (%)	0	24
		36	1
		45	2
		60	1
		62	1
		66	1
		70	1
		75	2
		77	8
		79	5
		81	11
		83	5
		85	2
		87	7
		89	6
		91	4
		92	6
		94	3
		96	5
		98	12
		100	63
Edible (raw)	F _{IC}	0.00	6
		0.02	6
		0.04	6
		0.06	1
		0.08	3
		0.10	5
		0.12	9
		0.13	3
		0.19	2
		0.21	1
		0.23	4
		0.27	1
		0.29	1

Table 3 (continued)

Use categories	Ethnobotanical indices	Values	No. of species
		0.31	1
		0.35	1
		0.40	2
		0.42	1
		0.48	1
		0.63	1
		0.65	1
		0.67	1
		0.69	2
		0.73	3
		1.02	108
	UVi	0.00	108
		0.28	3
		0.32	2
		0.34	1
		0.36	1
		0.38	1
		0.53	1
		0.58	1
		0.60	2
		0.66	1
		0.70	1
		0.72	1
		0.74	1
		0.77	4
		0.79	1
		0.81	2
		0.87	3
		0.89	9
		0.91	5
		0.92	3
		0.94	1
		0.96	6
		0.98	6
		1.00	6
	FL (%)	0	108
		28	3
		32	2
		34	1
		36	1
		38	1
		53	1
		58	1
		60	2
		66	1
		70	1
		72	1
		74	1
		77	4
		79	1

Table 3 (continued)

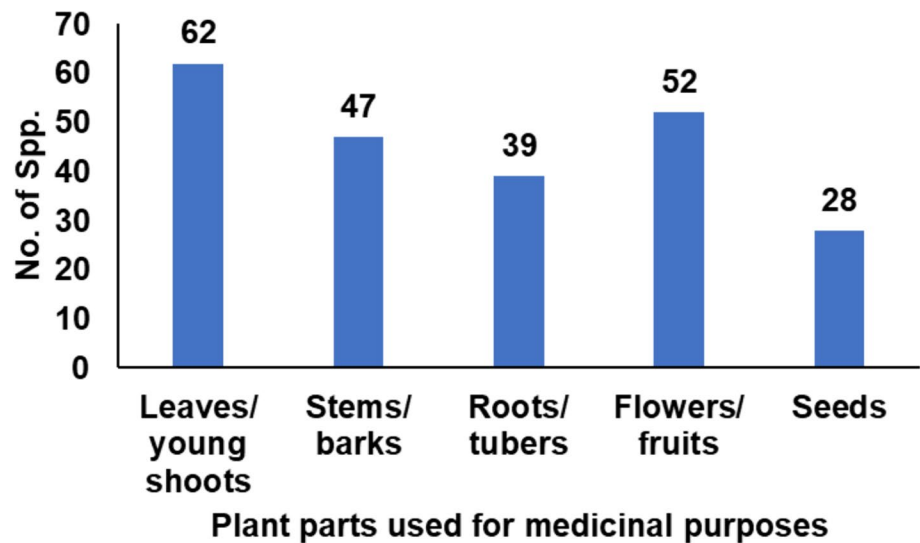
Use categories	Ethnobotanical indices	Values	No. of species
		81	2
		87	3
		89	9
		91	5
		92	3
		94	1
		96	6
		98	6
		100	6
Edible (cooked)	F _{IC}	0.00	18
		0.02	3
		0.04	1
		0.06	2
		0.08	1
		0.15	1
		0.23	2
		0.25	1
		0.27	1
		0.38	1
	0.40	1	
	1.02	138	
	UV _i	0.00	138
		0.60	1
		0.62	1
		0.74	1
		0.75	1
		0.77	2
		0.85	1
		0.92	1
0.94		2	
0.96		1	
0.98	3		
1.00	18		
Fodder	FL (%)	0	138
		60	1
		62	1
		74	1
		75	1
		77	2
	F _{IC}	85	1
		92	1
		94	2
		96	1
		98	3
		100	18
UV _i	0.00	21	
	0.02	1	
	10.2	148	
		0.00	148
		0.98	1

Table 3 (continued)

Use categories	Ethnobotanical indices	Values	No. of species
		1.00	21
	FL (%)	0	148
		98	1
		100	21
Miscellaneous	F _{IC}	0.00	88
		0.02	2
		0.04	2
		0.08	3
		0.15	1
		0.17	1
		0.19	1
		0.21	6
		0.23	1
		0.25	1
		0.29	1
		0.31	3
		0.33	1
		0.42	1
		0.46	1
		0.50	1
		0.56	1
		0.58	1
		0.65	3
		0.67	2
		0.69	1
		0.73	1
		0.90	1
		1.02	46
	UV _i	0.00	46
		0.11	1
		0.28	1
		0.32	1
		0.34	2
		0.36	3
		0.43	1
		0.45	1
		0.51	1
		0.55	1
		0.58	1
		0.68	1
		0.70	3
		0.72	1
		0.75	1
		0.77	1
		0.79	6
		0.81	1
		0.83	1
		0.85	1
		0.92	3
		0.96	2

Table 3 (continued)

Use categories	Ethnobotanical indices	Values	No. of species
		0.98	2
		1.00	88
	FL (%)	0	46
		11	1
		28	1
		32	1
		34	2
		36	3
		43	1
		45	1
		51	1
		55	1
		58	1
		68	1
		70	3
		72	1
		75	1
		77	1
		79	6
		81	1
		83	1
		85	1
		92	3
		96	2
		98	2
		100	88

Fig. 5 Plant parts used for medicinal purposes

wide range of information regarding the traditional uses of 170 plant species recorded in the 53 forested grids of PTR, Eastern India. All the species have certain utilization potential and the majority of them were used in traditional medicines. Different plant species are utilized for several

purposes such as medicine, furniture and building materials, fodder, fuelwood, edibles (cooked), edibles (raw), and other miscellaneous uses are the precursors of the diverse flora in PTR. Therefore, it is necessary to preserve these irreplaceable plant species and harvest them sustainably

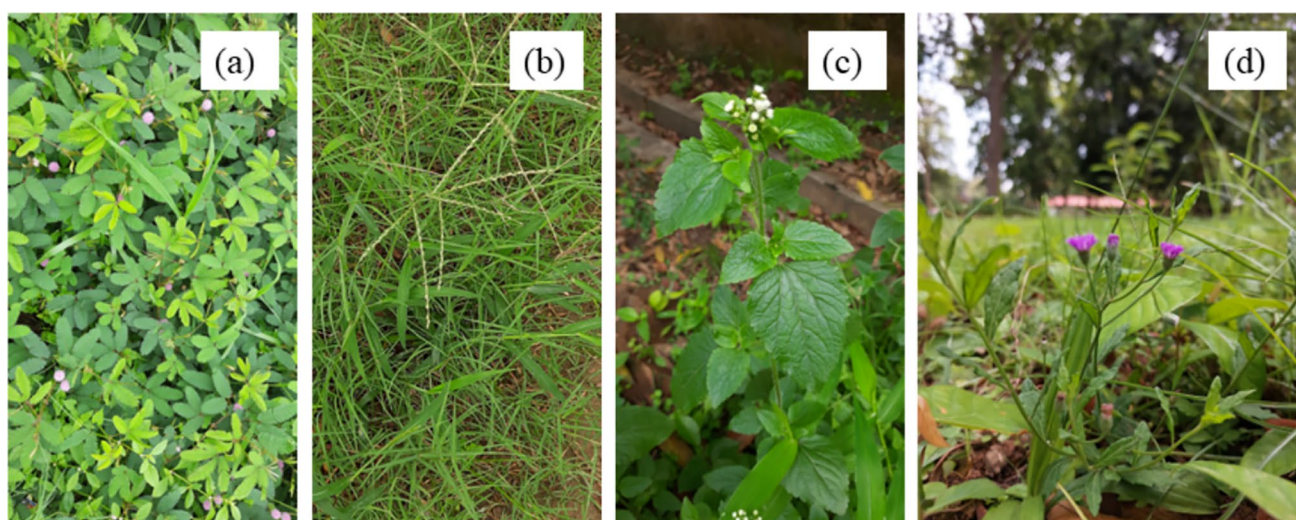
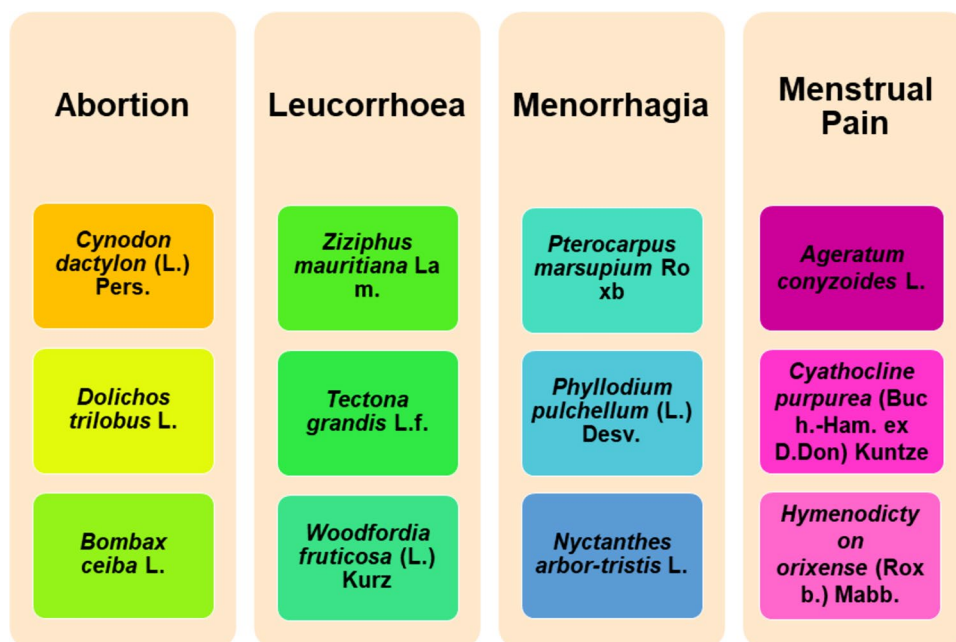


Fig. 6 Some of the species that are entirely used for medicinal purposes **a** *Mimosa pudica* L., **b** *Cynodon dactylon* (L.) Pers., **c** *Ageratum conyzoides* L., **d** *Emilia sonchifolia* (L.) DC

Fig. 7 Highly used plant species to treat major ailments related to women's health



to meet local needs. More focus should be placed on the conservation measures for such important plant species to protect them from further depletion. The findings of this research will assist policymakers in promoting certain regional and local plant species to increase the dietary and food security of forest-dependent communities.

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Author contributions SP: writing original draft, formal analysis, investigation; PS: validation, methodology, supervision.

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Data availability All data generated or analysed during this study are included in this published article.

Declarations

Competing interests The authors declare no conflict of interest.

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