

Traditional plant use and cultural practices sustaining Nyishi livelihoods in Northeast Himalayan region, India

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Abstract. *Taba, Pant N, Akash. 2025. Traditional plant use and cultural practices sustaining Nyishi livelihoods in Northeast Himalayan region. Asian J Ethnobiol 8: 192-202.* The Northeastern Himalaya has a wealth of plants that have been used by the forest dwelling communities. This huge valuable knowledge of these communities is yet to be documented. The present study explored ethnobotanical usage of plants, plant-based traditional skills and technologies by Nyishi tribes in Lower Subansiri District in Arunachal Pradesh, India. An extensive field study was conducted from 2021 to 2023 in the towns of Yazali and Yachuli. Field survey included semi-structured interviews, questionnaire-based survey, focused group discussion, participatory observation, interview of primary respondents and open discussion to provide the data on various traditional plant technologies used in food preparation, cooking, homemade storage structures, fishing, hunting, drying and conservation pattern of related biocultural resources. In the present study, ethnobotanical data were recorded for 39 plant species belonging to 22 families. Information regarding their botanical name, family, common name, local name, and their ethnobotanical uses, along with various indigenous uses of plants, along with traditional tools, traps, utensils, ornaments and accessories, along with food habits used by the Nyishi tribe for sustainability and livelihood. Additionally, observations were made to assess the process of making and using plant technologies.

Keywords: Arunachal Pradesh, ethnoecological record, ethno-ecological, ethnomedicinal plants, Nyishi tribe

INTRODUCTION

Ethnomedicinal plants are used by a large number of people worldwide, in both developing and developed countries (WHO 2002; Brandão 2006). All ethnic groups rely on plants around them for healthcare practices, primarily based on observation, need, and trial and error (Kunwar et al. 2018). The Indian Himalayas harbor approximately 8,000 species of angiosperms, out of which 1,748 species of plants have been used for various pharmacological purposes (Malik et al. 2015). It has been estimated that about 84% of the total rural population mainly depends on wild plants for curing different diseases (Ahmad et al. 2016), which passed generation after generation (Khan et al. 2015). In the past, it was observed that indigenous traditional knowledge of medicinal plants has long been a source of livelihood sustainability for the tribal population.

In India, approximately 65% of the population depends on forests for folk medicines (Timmermans et al. 2003). The indigenous knowledge is often transferred orally, a cultural practice that is frequent in less developed areas (Akash et al. 2020a). Northeast is an important part of the India Himalayan region, which is known for its rich biodiversity and huge cultural diversity as well as indigenous traditional knowledge. The State Arunachal Pradesh, also popularly known as "The Land of the Rising Sun" is the largest Himalayan state in Northeast India. It is located between 26°28'-29°30'N latitude and 91°30'E longitude. The state is also known as "The Land of the Downlit Mountains". The

state of Arunachal Pradesh is rich in its floristic heritage, with ethnobotanical, ecological, and economic significance distributed along different altitudinal gradients, ranging from tropical to snow-clad alpine mountains. There are 25 districts in Arunachal Pradesh, including the Lower Subansiri District. The state is inhabited by more than 26 major tribes and over 100 sub-tribes. The tribal people live in balance with nature and maintain a very close link between humans and nature (Sharma et al. 2014).

Due to the lack of a modern healthcare system, the villagers in the remote areas of Arunachal Pradesh depend on local traditional practitioners and folk medicine. The tribal people have personal classification, identification, and use of medicinal plants. However, the ethnobotanical plants used in folk healing and their indigenous uses have not yet been explored and categorized for any community in Arunachal Pradesh (Tag and Das 2007; Murtem 2014). There are unknown medicinal plants or folk medicines that still require taxonomic and pharmacological documentation for database and clinical trial validity. The culturally important plant-based tools, such as chairs, tables, kitchen utensils, fishing nets and tools, dishes, and storage and preservation tools, made of wood, cane, and bamboo, are more popular and economically viable among the Nysihi tribe. The role of plant materials and technology in trade has also become increasingly clear in recent years in Arunachal Pradesh. The importance of plant-based foods and medicines to the Nysihi people is well appreciated; however, the documentation of plants used in traditional handicraft technology among the Nysihi was found to be

overlooked (Ramakrishnan et al. 2002).

Keeping all these in consideration, the present study was undertaken to document plant-based traditional skills, technologies and ethnobotanical usage of plants practiced by the Nyishi tribes of Lower Subansiri District, Arunachal Pradesh. Despite the rich ethnobotanical knowledge and traditional plant-based technologies practiced by the Nyishi tribe in the Northeastern Himalayas, there is a significant lack of systematic documentation and understanding of how these practices support sustainable livelihoods and biocultural conservation.

MATERIALS AND METHODS

Study area

The present study was conducted from 2021-2023 in the Lower Subansiri District of Arunachal Pradesh. Data collection was conducted in Yazali and Yachuli towns in the Lower Subansiri District (Figure 1). Geographically, the Lower Subansiri District is located between 92°40' and 94°21' E and 26°55' and 28°21' N, covering an area of 3,460 km². Generally, December to February is cold winter season where the temperature reaches 3.8°C and March to May is pre-monsoon season. Nyishi are one of the most dominant and traditionally rich tribes in Lower Subansiri District. The Nyishi are the sons of Abo Tani, the first ancestor and his ideal son, Ato Niya. They are one of the largest tribes belonging to the Tani group in Arunachal Pradesh, constituting one-third of the population of Arunachal Pradesh and distributed in various villages of seven districts. Although Nyishi people have been exposed to modernization in recent days, agricultural activities are still performed traditionally in most parts of the Nyishi-inhabited area. It is the main occupation, and Jhum cultivation remains the predominant method of cultivation. They celebrate Nyokum Yullo as their main festival. Like other tribes in Northeast India, boiled rice is a staple food for the Nyishi. Boiled rice is complemented with various green vegetables and bamboo shoots.

Data collection

A field survey was conducted to record the ethnoecological data, along with exploring their traditional skills and technologies sustaining the livelihood. Ten villages (i.e., Kebi, Sekhi, Depo, Seer, Pitapool, Peni, Zara, Migo, Peker, and Deli Hapa) were selected on the basis of forest cover, ethnicity and people's dependency on forest resources and traditional plant technologies. Data were gathered from 80 respondents, comprising 40 females and 40 males, with an age range of 40-65 years. Informants were grouped into 40-50 years and 50-65 years to gather the information. This age group showed a marked interest in contributing knowledge related to traditional tools and techniques. More comprehensive interviews provided data on various traditional plant technologies used in food preparation, cooking, homemade storage structures, fishing, hunting, drying, and conservation patterns of related biocultural resources. Additionally, observations were made to document the process of creating and utilizing plant technologies. Deeper observations by staying in Nyishi houses in forest areas were made to learn about the cultural aspects of utensils, handicrafts and other technologies used in daily life. For qualitative analysis, semi-structured interviews were conducted to obtain more detailed information. The interviews were also conducted at the district handicrafts center and cooperatives to understand the economics, various projects run by the state and central governments, and the network of handicrafts makers. During the field visit, translation of the local nomenclature of plants and documentation of plant-based traditional knowledge were assisted by local knowledge holders, field guides and traditional healers of Nyishi community who had expertise in their local dialect, indigenous cultural system and local ethnoecological landscape. Data were collected with ethnobotanical aspects, i.e., local names, common names, parts used, mode of use, habits, habitats of each plant and their indigenous uses were recorded in field notebooks. Locally available medicinal plants were collected for identification and herbarium preparation following standard methods (Jain and Rao 1977).

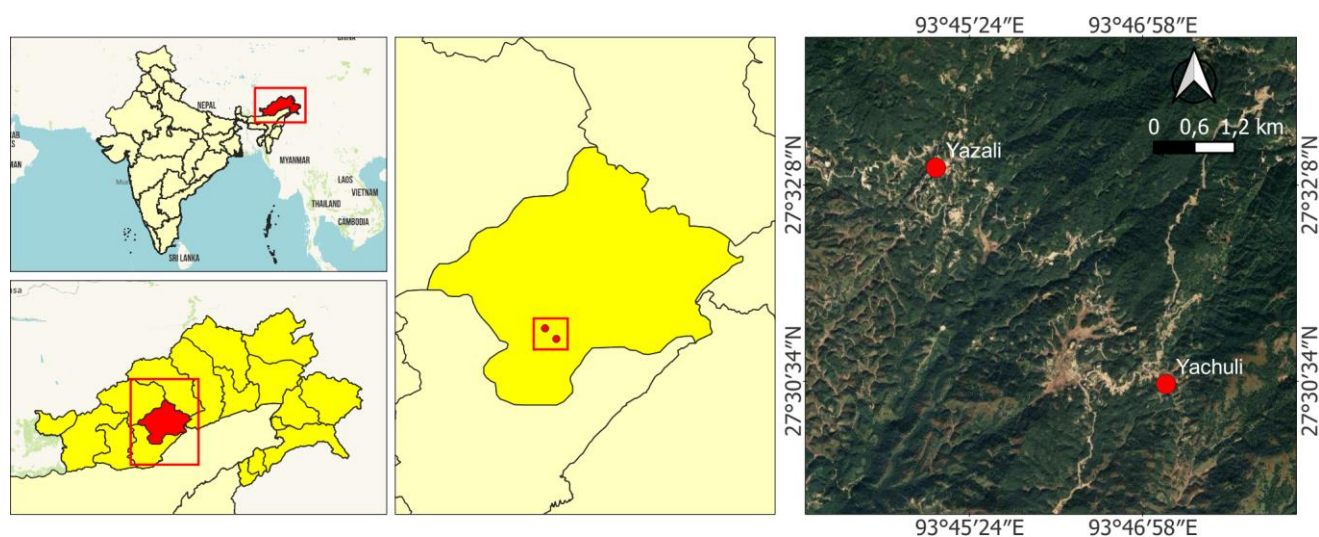


Figure 1. Map of study area in Yazali and Yachuli, Lower Subansiri District, Arunachal Pradesh, India

Data analysis

For quantitative analysis, Analysis of Variance (ANOVA) was performed using SPSS version 20 for statistical analysis to test for significant differences among parameters. For qualitative analysis, all the parameters of plant-based tools and techniques that sustain the life of Nishi were compiled.

RESULTS AND DISCUSSION

The Nyishi people of Lower Subansiri have a tradition of artistic craftsmanship and a wide variety of handicraft practices, including weaving, painting, pottery, metalwork, basketry, and wood carving (Table 1). The crafting of mats, wooden vessels and pottery speaks itself eloquently about their skills in handicraft technology. Crafting in the Nyishi society is exclusively done by the male folk, and all of the craftsmen under the present study were observed to be male. The raw materials, bamboo, wood and cane, were always collected from the forest areas by them. They are able to recognize trees and bamboo of interest to them. One-way ANOVA was performed with the parameters of consumption, harvest, and conservation of wild and edible plants, which were recorded as significantly different ($P < 0.001$).

Plant-based technology and livelihood of Nyishi tribe

Cane and bamboo-based plant technology of the Nyishi tribe includes hats of different sizes and shapes, various kinds of baskets, cane vessels and a wide variety of cane belts, elaborately woven brassier of cane and fiber, bamboo mugs with carvings (Figure 2). It was observed from the study that Nyishi were mastered in the technique of basketry, storage items and kitchen utensils, and the design of such items among the villagers has been found to be entirely need-based, practical and aptly suitable to their socio-cultural and geographical landscape. Metallic work, carpentry, and pottery are other crafts practiced by the Nyishi people. The arts of crafting traditional utensils and handicraft items of immense utility from the forest hood, clay and metal are inherited from ancient wisdom, which is

still practiced in Nyishi locality. The plant-based crafts, such as *egin* (bamboo or cane-made basket for carrying rice, etc.), *paha* (for carrying firewood), *muda* and *pirah* (bamboo or cane made for sitting), *nara* (cane made for carrying food items and beverages while going for work or to forests), *opyi* (cane made for cleaning rice), *buiya* (daw holder, made of cane), etc. (Figure 2), are mostly crafted by the male folk and form a source of income to Nyishi. Furthermore, various household items such as *pwter* (cane or bamboo made for house for chickens), *chiye* (local grinder for grinding rice made of wood), *chuha* (cane or bamboo made pockets), and *sahiya* (cane made local rope) are also used in their day-to-day life (Figure 2). In every household in remote areas, people possess skill to make these technologies and sell them in nearby towns. Some of the wooden, cane, and bamboo plant technology is sold through district handloom and handicraft centre. With the help of various central and state government sponsored training and entrepreneurship development schemes, an emphasis is given on plant technologies for capacity building and empowerment of Nyishi people.

Tools and traps used for hunting

The Nyishi resort to hunting in their leisure time in order to supplement their food requirements. The weapons commonly used and made by them are spears, bows, arrows, and daw (a flat iron piece with sharp edge on one side crafted in the form of sword, about 30-70 cm). The daw is a necessity tool in households. It is one of the most important tools as it is used in every aspect like in their day today life and also stands as a symbol of pride for in the people of this tribe. The bow and arrow used for hunting are known as *eel upu*. Some of the arrow's tips are fitted with sharp metallic head, which is capped with poison prepared from the roots of alpine herb (locally called omyi), *Aconitum ferox* Wall. ex Ser. and are carried in quivers of bamboo tubes. Such poison arrow is mostly used for killing large animals, such as bear, wild boar and lion. The paste of omyi poison used on arrow tip is prepared in special type of traditional utensil made of stone.

Table 1. Plant-based traditional tools used by Nyishi Tribe in Lower Subansiri District, Arunachal Pradesh, India

Category	Examples of tools/items	Material used	Main purpose
Agriculture and field	<i>Chucha, mudhu, appin, dekumpwchi</i>	Bamboo, clay, leaves	Sowing, seed storage, insect protection
Hunting and fishing	<i>Daw, eel upu</i> (bow & arrow), <i>ghurw</i> (trap), <i>edwr, quiver</i> , fishing nets, <i>salah</i>	Bamboo, cane, iron, poison plants	Hunting animals, trapping, fishing
Cooking and utensils	<i>Chindhu, phuniya, udu, durw, hukhu, harcha, opo patah, sahder, sab sohrw</i>	Bamboo, gourd, horn, clay	Cooking, eating, storing food and beverages
Storage and utility	<i>Hodo, dusin, huuch, lohdu, pwter, chuha, dimber, masap, sobku</i>	Bamboo, cane	Storing rice, salt, meat, chickens, fire tools
Crafting and handicrafts	<i>Egin, paha, muda, nara, opyi, toko-patta items, quercus/Thaumatococcus leaves</i>	Bamboo, cane, palm leaves	Weaving, sitting, roofing, food wrapping
Ornaments and identity	<i>Dumpin, rubin, belling, huhu, koji, bopiya, soruh, tasnara, setum, lolup, tammah, lurum</i>	Beads, cane, palm, leather, metal	Decoration, protection, ethnic identification

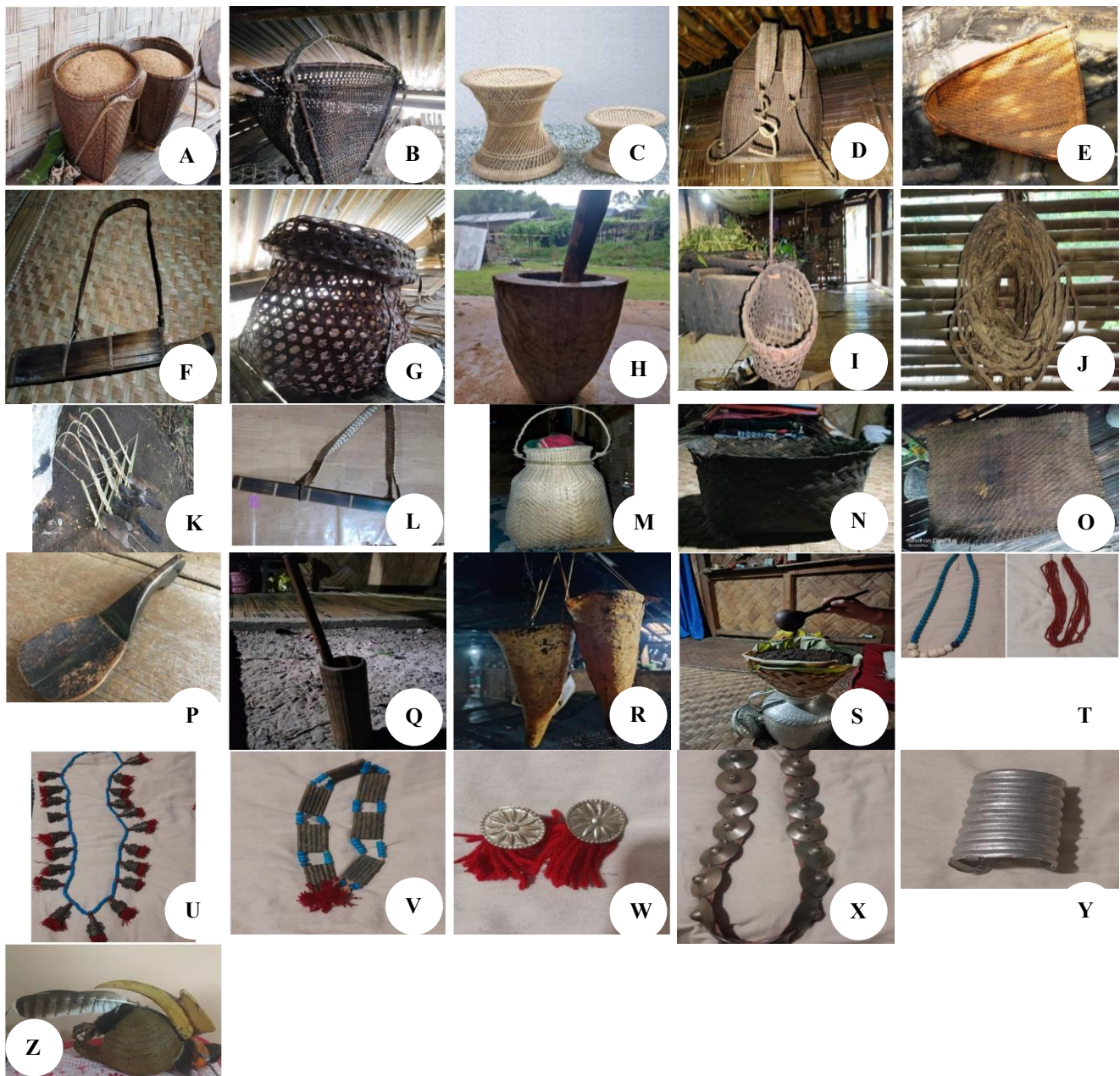


Figure 2. Traditional tools used by Nyishi tribes in Lower Subansiri District, Arunachal Pradesh, India. Note: A. *Egin* (for carrying rice), B. *Paha* (for carrying firewood), C. *Muda* (cane-made tool), D. *Nara* (local backpack for men), E. *Opyi* (cane-made for winnowing rice), F. *Buhiya* (dow carrier), G. *Pwter* (house for chickens), H. *Chipir* (local rice grinder), I. *Chuba* (small pockets for storage), J. *Sahiya* (local ropes), K. *Ghurw* (mouse and bird trap), L. *Salah* (locals word), M. *Dusin* (rice storage), N. *Huuch* (storage basket), O. *Appin* (local mat), P. *Puniya* (local spoon), Q. *Udu* (grinder), R. *Sabsohrw* (storage), S. *Sahder* (apongfilter), T. *Tasang* (local beads), U. *Maji*, V. *Dumpin* (female headgear), W. *Rubin* (earring), X. *Huhi* (local belt), Y. *Koji* (local bangles), Z. *Bopiya* (Nyishi headgear)

The villagers have their own indigenous ways of trapping animals and birds using traditional plant-based technologies. They make various traps, big and small, with or without valves, made of bamboo and cane for fishing and such trapping items are popularly known as *edwr* among the Nyishis. Fishing nets of various types, such as hand nets and cast nets, are also in use, which are made from locally available plant resources. The art of trapping wild rats using bamboo made traps called *ghurw* is quite popular among Nyishi tribe to protect their crops and vegetables in fields and in stores. This type of trap (*ghurw*) is also used

to trap birds, squirrels, etc. in the forest. *Salah* (Nyishi sword) is made of iron and wood, long in shape, kept in the home and used in *buya* dance.

Traditional utensils and food habits

Some of the significant observations made during the field investigation were the dynamics of traditional utensils made from various locally available plant species and other ethnobotanical resources used as traditional items. In the early days, when the Nyishi were unfamiliar with modernization and its technologies, they were dependent only on the plant-

based technologies and developed various plant-based traditional skills. From their food habits to the utensils they used were plant-based. Although the new technologies are well introduced now, tribal people are still practicing traditional skills. Many household utensils were observed including *hodo* (large bamboo basket) used for the storage of wheat, rice, corn etc.; *dusin* (bamboo or cane basket) used for storing rice; *huuch* (small bamboo basket) used for measuring rice; *phuniya* (local spoon made of bamboo); *appin* (bamboo or cane made) local mat used as a carpet and also used in drying rice under sun; *dekumpwchi* (earthen pots made up of sticky clay) used for cooking rice and vegetables; *chindhu* (bamboo cylinder) used for cooking rice and fish mostly used while in forest or fields; *hukhu* (local plate made of bamboo); *lohdu* (made of bamboo) used for storing salt; *harcha* made of dried shell of wild bottle guard covered with cane trip used for carrying beverages like water and apong in Jhum field and storing apong; *opo patah* used as local jug for drinking apong or water; *mudhu* made of bamboo (small cylinder) carried by them tied in their waist and a tiny spark of fire with dried local leaves are placed together in this small cylinder which produces smoke for a long time which protects them from mosquitoes and insects while they work in the fields; *udu* and *durw* bamboo cylinder used for chutney and grinding spices respectively; *chucha* used for storing and also used by women in Jhum fields for carrying rice paddy grains while sowing; *masap* and *sobku* local pliers made of bamboo mainly used for working near the fire; *dimber* (bamboo or cane made) used for storing dried meat and it also plays a major role in marriage; *uju* made of deceased bottle guard used as jug mainly used for serving apong; *sab sohrw* (horns of Mithun) kept as a case for storing small things or money; *sahder* is mostly used in the filtration of apong. *Quercus* sp. and *Thaumatococcus daniellii* (Benn.) Benth. ex Eichler leaves are used for packing rice and used as a plate. These leaves are of two types, Kohum Ook and Hemir Ook, which are considered holy leaves and play an important role in the Nyokum yullo festival.

These are some examples of utilizing the bioresources of the surrounding in traditional utensils, arts, crafts, and food habits. The reason behind using such a range of traditional utensils made of plant resources is their intrinsic attachment to ecosystems and food habits. The special kind of flavor, keeping quality, and storage duration, for which traditional utensils are a source, are major reasons cited by experienced elders of the community. Traditional utensils are believed to be one of the main parts of a household property and are kept under the custodian of the older generation of the family. They are familiar with the history of origin and the traditional mythology and folklore associated with utensils. Having rice in Ook is considered tastier and good for digestion. With the availability of low-cost utensils, preservation of such traditional utensils is decreasing and thus losing their prestige and value to the young generation. In interior and remote villages, the Nyishi villagers are still using the traditional utensil made of wood and bamboo. However, the bamboo utensils are still used by the Nyishi people living in transitional socio-ecological systems because they are inexpensive and readily

available. The dynamics of these factors are found more in remote villages. Various external factors such as influence of media, modernization, changing livelihood systems and various socio-political aspects, are weakening the traditional intrinsic value and skill of making plant technology.

Ornaments and accessories

In earlier days, the Nyishi tribe used to travel across countries like China and Tibet to obtain ornaments made from elephant teeth. Craftsmen and blacksmiths in these places were specialized individuals who created these ornaments for the local people. The way to those places was extremely dangerous, and local people used to face difficulties while travelling across the road. They used the barter system to get the ornaments or any other stuff they wanted in exchange for wild animal's body parts although it is a long-gone tradition now. As every female in any society would love jewels, the females of this tribe loved those handmade ornaments. Males of this tribe had their own preferences, such as decorating the cover of their swords with the hide of wild animals and also with the teeth of tigers. They also loved designs on their swords, but maintained the sleekness and sharpness of their sword simultaneously. The Nyishi tribe members usually like beads in jewelry known, as Tasang and use bells of different kinds, known as Maji. The ornament that women generally wear on their heads is called as a Dumpin. There are other special ornaments such as Rubin and belling that are used as earrings. They also adorn themselves with a belt made up of round discs, known as Huhi or Hufyi. The women often wear a various bangles Koji. Traditional dresses are marker of ethnic identity along with ornaments and other items for adoration for both male and female in traditional context as reported from various villages. These ornaments which has immense value were once had different significance in past during wars. Many of these ornaments or accessories are used as a protective gear in the area. For example, *bopiya* (headgear) is used as a helmet, *soruh* (local belt) for protecting their chest and waist, *tasnara* and *setum* made of palm tree and skin of wild yak, respectively, are used as a shield, Lolup (arm protection) and many other accessories like *eel upu* (bow and arrow), *olioh* (daw) local sword type are used as a weapon. Accessories like *tammah* (palm tree made belt) and *lurum* (cane made) are used for identification purposes for men.

Wildlife, culture, plant biodiversity, and skill

The integration of wildlife and plant biodiversity, which are life support systems for the Nyishi tribes and ethnicity, depict the degree of skill and imagination power in making handicrafts. For example, bamboo species such as *Dendrocalamus hookeri* Munro and *Bambusa vulgaris* Schrad. ex J.C.Wendl. are mostly employed in traditional house construction and used as ritual and cultural gift items offered to benevolent almighty gods during local festival such as *Nyokum* and *Lungte* apart from using them in crafting traditional handicraft items. Some of the indigenous species of perennial trees and palm species, like toko-patta (*Livistona jenkinsiana* Griff.) are considered multipurpose species.

For example, the leaves of took-patta are used after proper drying as a roofing material for local houses. The new shoots of toko-patta are used as vegetable, while unripe fruits are used as chutney. The leaves are also used in nursery as overhead shade. The entire plant is used as an ornamental and avenue plant, while the fibrous sheaths are utilized in the production of rope and water-resistant shields for shoulder bags. The cut stem is used as temporary log bridge to crossover village streams and as posts for supporting temporary structures.

The local plants including bamboos, palms, and perennial tree species are invaluable in making various handicraft, utensils, for various purposes. The degree of use of such biocultural resources is determined by the factors such as ethnicity, economic status, ethical level, variability in ecological system and types of art and skill possessed by a particular community. The use of various traditional plant technologies is higher in remote area with traditional socio-ecological systems than in area with transitional system as suggested by the elderly people and Gaon buras of Nyishi community. It was recorded that higher cultural attachment towards a particular plant technology leads to greater degree of use in present study. In present study, the effect of higher degree of cultural attachment and use level are observed to be higher towards degree of conservation of plant biodiversity. Furthermore, the cultural erosion and loss related to plant technology among younger generations as happening in transitional socio-ecological system has been recorded in the present study. Hence, this is the potential time to harness these culturally rich resources and conserve them with the bottom-up approach provided they are economically and socio-politically empowered. This can be achieved by taking the help of formal institutions, marketing and economic institutions, who value and commercialize the products and secure the intellectual property of traditional communities. The entire approach adopted in integrated manner will help in conserving biocultural resources used in traditional plant technology.

Documentation of ethnobotanical information

In present study, ethnobotanical data on 39 plant species belonging to 22 families were recorded. Information regarding their botanical name, family, common name, local name, and their ethnobotanical uses are presented in Tables 1, 2, and 3. The largest number of species were recorded from family Asteraceae (5 spp.), followed by Solanaceae (4 spp.), Poaceae (4 spp.), Urticaceae (3 spp.), Ranunculaceae (2 spp.), Brassicaceae (2 spp.), Lamiaceae (2 spp.), Zingiberaceae (2 spp.), Arecaceae (2 spp.) and rest of the family represented with one species each (Figures 3 and 4). ANOVA showed that family wise distribution of ethnomedicinal plants showed significant different ($P < 0.05$) among all the deras (local term for community shelter) of Nyishi.

As many as 28 species are used for medicinal purposes (49%) followed by 18 species of vegetable yielding or edible plants (27%), 9 species used as plant-based tools (16%), 2 plant species used as poisons (4%) and 2 species of sacred plants (4%) (Figure 3).

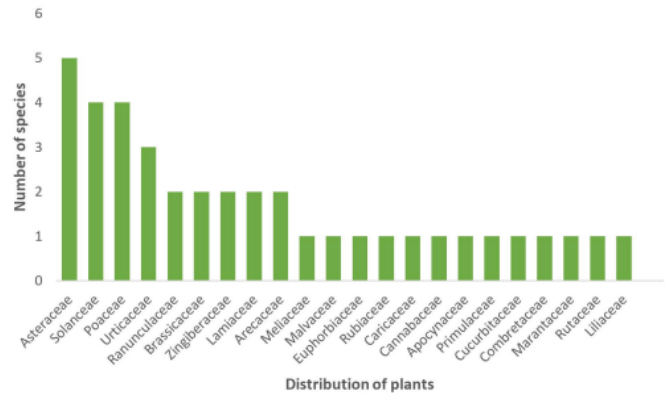


Figure 3. Family-wise distribution of plant species used by Nyishi tribe in Lower Subansiri District, Arunachal Pradesh

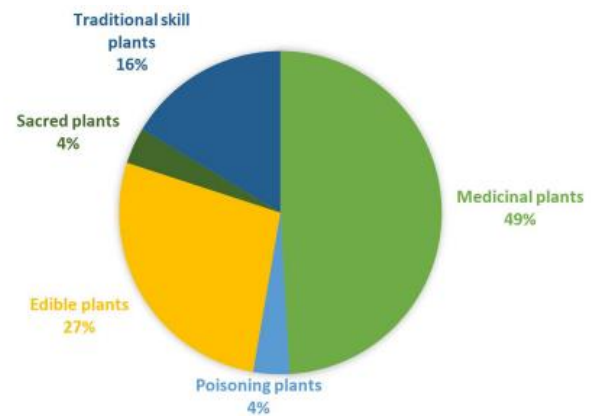


Figure 4. Ethnobotanical uses of the plants by Nyishi tribe in Lower Subansiri District, Arunachal Pradesh

Table 2. Total number of wild plants and their parts used in different ailments/problems

Category of ailments	No. of taxa	Plant parts used
Diarrhea and dysentery	3	Stem, fruit
Skin disease	3	Leaves, rhizome, bark, fruit
Healing cut and wounds	3	Leaves, oil
Cold and cough	4	Bulb, whole plant, leaves, fruits
Stomach problems	1	Whole plant, roots, fruits, leaves
Other liver problems	3	Fruits, stem, leaves, bark, seeds
Tooth problems	1	Leaves, flower, fruit
Dengue	1	Fruit
Muscle, abdominal pain and swelling	2	Whole plant
Piles	1	Bark, fruit
Asthma	1	Leaves
Snake, scorpion bite	1	Leaves
Insect repellent	1	Leaves
Ringworms	1	Leaves

The finding of this study suggests that Nyishi tribe are good in ethnomedicinal practices. Some notable plants used in preparation of herbal medicines are *Abroma augustum* (L.) L.fil., *Ageratum conyzoides* L., *Carica papaya* L., *Leucas indica* (L.) R.Br., 1811, *Pouzolzia bennettiana*, *Solanum nigrum* L., *Coptis teeta* Wall., *Saccharum officinarum* L., *Spilanthes paniculata* Jacq. ex S.S.Renner, Balslev & Holm-Niels., and *Zanthoxylum oxyphyllum* Edgew. for curing various common ailments such as dysentery, fever, anemia, cancer, snake bite, dengue, cough, cold, toothache, jaundice, asthma, and eye problems etc., and some of the plants used either singly or in combined form for an ailments or different ailments. The rhizome of *C. teeta* is very famous in traditional medicine to treat cough, cold, digestive system, inflammatory, eye problems and skin disorders. It regulates blood pressure and also helpful in anti-tumor and antibacterial activities. It is a rare and endangered plant species and also endemic to Arunachal Pradesh.

Nyishi people use different parts of the plant species for various ailments. It was recorded from our study that leaves were the most common used plant part followed by fruits, flowers, roots, whole plants, rhizomes, bark and bulbs. In some cases, their folk medicine preparation techniques generally start with the chanting of sacred mantra. Furthermore, it was also revealed that Nyishi community has a very interesting way of treating different diseases.

The Nyishi not only use the plants to cure diseases but also uses as food, firewood, wild edible fruit and vegetable. Some of the notable medicinal plants consumed by the Nyishi people as a main staple food besides its medicinal importance are *S. nigrum*, *B. vulgaris*, *Allium hookeri* Thwaites, *Pouzolzia bennettiana*, *Brassica campestris* Hegetschw., 1839, *S. paniculata* and *Raphanus sativus* L., *B. vulgaris* and *S. nigrum* are commonly used in curry and considered to be the main food of Nyishi people. The mature stem of *B. vulgaris* is used in building houses, bridges, furniture etc., and *Thaumatococcus daniellii* (Benn.) Benth. ex Eichler are also used in packing food materials by tribal people. Bark of *Nauclea orientalis* (L.) L. are used by the Nyishi community as fish poison for catching fish, i.e., the active ingredients are released by macerating the plant parts with the help of wooden stick or hammer, and then introduced into the water environment. While the roots of *A. ferox* Wall are crushed into paste, which is then caped in the metallic head of arrow, used for hunting large animals. Fishing and hunting are an important part of socio-cultural life of indigenous Nyishis. In earlier days, there was custom of community hunting. Nowadays, there is lots of concern about preserving wildlife in the studied area.

The traditional consumption of a variety of alcoholic beverages has been happening since time immemorial and is still an integral part of ethnic communities in the northeastern region of India. Popular traditional beer, locally known as *pona*, is prepared from rice (*Oryza sativa* L.). Pona has traditionally been used and served in all festive occasions like *Nyokum*, *Lungte*, birth and marriage ceremonies. During the present study, the young leaves and twigs of *Solanum lasiocarpum* Dunal were used as growth supplements in the preparation of fermentation starter as common cultures containing brewer's yeast (locally called *opap*).

Discussion

The Himalayan region is well known for its biodiversity and cultural mosaic. However, due to anthropogenic activities, including deforestation, functioning ecosystems have been degraded, leading to continuous soil loss (Akash and Navneet 2020a,b). This condition has intensified in recent years with growing demand for agricultural land and forest products, converting vast forest areas into plains and reducing forest nutrient dynamics. Therefore, it is essential to generate alternative income sources to support livelihoods and sustainability (Akash and Bhandari 2018; Akash and Navneet 2018; Akash et al. 2018, 2019; Akash and Zakir 2020). The Himalaya is also rich in medicinal plants (Dhar et al. 2002). Modern chemical medicine is costly and often causes side effects compared to traditional systems. Local communities living near forests continue to rely on ethnomedicinal plants for treating diseases due to their affordability, effectiveness, and lack of side effects (Negi et al. 2011).

Due to the modernization, the traditional skills and technologies which sustained the livelihood among the communities residing in rural areas has declined in last few years. It was observed in the present study that ornaments, headgear, belts, combs, baskets, smoking pipes, mats, fishing and hunting tools, storage items, kitchen utensils, and food systems are still available among the Nyishis. They totally depend upon the plant-based technologies in their day-to-day life, exclusively for constructing their dwellings, utensils, furniture, weapons such as bows and arrows, spears, armor, and implements like hunting and fishing traps, and even in constructing their houses.

The Nyishi tribes are considered good engineers and are experts in building long suspension bridges made of cane and bamboo over the rivers. The mature stem of *B. vulgaris* and *D. hookeri* are used in building houses, bridges and furniture. *Thaumatococcus daniellii* is also used in packing food materials by tribal people. Modernization and cultural erosion among younger generation have affected the dynamics of traditional knowledge and use of plant technology in life support system of Nyishi tribes. Majority of Nyishi community of transitional socio-ecological systems have medium degree of cultural attachment with their traditional plant-based technology. It was observed from the different studies that wild and edible plants provide extensive support to the local communities.

The study by Gao et al. (2024) revealed that traditional knowledge is exceeded by illiterate people as compared to the modern and it was also higher in men as compared to women. It is also noted that there is no such relation of knowledge of ethnomedicinal plants and level of education (Yaro 2018) but in the study of Dassou et al. (2024) recorded that traditionally women are not livestock owners or they don't have much knowledge as compared to men. Various studies have focused on diverse range of edible plants by indigenous groups in comparable with the current study results (Namsa et al. 2011; Showkat and Akhtar 2018; Gairola et al. 2021). Most of the folk healers are from old age who are strongly linked with their indigenous system of medicine (Tripathy et al. 2017).

Table 3. List of plant species with their ethnomedicinal uses and traditional skills to sustain the livelihood of Nyishi tribe, Arunachal Pradesh, India

Botanical name	Family	Common name	Local name	Collector no. assigned	Habit	Uses/ earlier literature
<i>Abroma augustum</i> (L.) L.fil.	Malvaceae	Devil's cotton	Ulat kombol	NY-1	S	Root juice is used to increase appetite whereas stem bark is used in dysentery / NA
<i>Aconitum ferox</i> Wall. ex Ser.	Ranunculaceae	Indian Aconite	Omi	NY-2	H	Roots are preparing hunting used poison large animals / NA
<i>Ageratum conyzoides</i> L.	Asteraceae	Chickweed	Paspai	NY-3	H	Leaves are used as insecticide and nematocide / (Gaur 1999; Akash et al. 2020b, 2021)
<i>Allium hookeri</i> Thwaites	Liliaceae	Hooker chives	Nyishi talap	NY-4	H	Bulb is used in cough and cold problem and also consumed as vegetables / NA
<i>Azadirachta indica</i> A.Juss.	Meliaceae	Neem	Neem	NY-5	T	All parts of this plant are used in skin infections, dental problems / NA
<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl.	Poaceae	Dibang bamboo	Tabih	NY-6	S	The mature stems are used in construction of house bridges, furniture and for kitchen utensils. Young shoots are edible / NA
<i>Brassica campestris</i> Hegetschw., 1839	Brassicaceae	Mustard	Honyir	NY-7	H	Leaves are used in food and oil is extracted from the seed / (Kadel and Jain 2008; Semwal et al. 2010; Akash et al. 2020b, 2021)
<i>Calamus rotang</i> L.	Arecaceae	Rattancane	Osho sanh	NY-8	S	The cane is used in making various household, furniture, handicrafts, also used for making headgear / NA
<i>Cannabis sativa</i> L.	Cannabaceae	Marijuana	Bhang	NY-9	H	Paste of leaves is used to against ringworms / NA
<i>Carica papaya</i> L.	Caricaceae	Papaya	Papita	NY-10	S	Fruits are consumed and young leaves are used to cure dengue / (Akash et al. 2020b)
<i>Coptis teeta</i> Wall.	Ranunculaceae	Mamoera	Tahiyo	NY-11	H	Rhizome is used in digestive system and also as anti- inflammatory and skin disorders / NA
<i>Curcuma amada</i> Roxb.	Zingiberaceae	Mango gmger	Takih	NY-12	H	Rhizome is used to treat liver disorder, sore throat and also used as spices / NA
<i>Dendrocalamus hookeri</i> Munro	Poaceae	Bhutan green Bamboo	Tabih	NY-13	S	Bamboos are used in house construction and young bamboo shoots are consumed as vegetables / NA
<i>Elatostema platyphyllum</i> Wedd.	Urticaceae	Elatostema	Hoj	NY-14	S	Roots are used to induce inflammation and vomiting / NA
<i>Embelia ribes</i> Burm.fil.	Primulaceae	Falseblack pepper	Vidang	NY-15	S	Fruits are used to treat liver disorder, liver worm infection / NA
<i>Emilia sonchifolia</i> (L.) DC. ex Wight	Asteraceae	Tassel flower	Genta	NY-16	H	Leaves juice is used against eye inflammation and also consumed as salad / NA
<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Asteraceae	Bitterbush	Puuhm	NY-17	H	Paste of leaves is used in treatment of wounds, skin infections, inflammation, insect repellents / (Akash et al. 2020b)
<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall. ex G.Don	Apocynaceae	Kurchi	Kutaja	NY-18	T	Bark, fruits are used to treat dysentery. It is also used in colic, dyspepsia, piles, diseases of the skin and spleen / (Singh and Rawat 2011)
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Ginger	Takih	NY-19		Rhizome is used for stomach upset, motion sickness, nausea, vomiting and is edible / NA
<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae	Wild bottle guard	Upum	NY-20	C	Fruit is used for making utensils for storage, carrying liquids and for filtering the kala apong (alcohol) and also edible / NA
<i>Laportea crenulata</i> (Gaudich.) Chew	Urticaceae	Elephant nettle	Pospoi	NY-21	S	Young shoots are used in gastric problems / NA
<i>Leucas indica</i> (L.) R.Br., 1811	Lamiaceae	Thumba	Guma	NY-22	H	Whole plant is used in coughs, cold, abdominal pain and also to treat snake bites / NA

<i>Livistona jenkinsiana</i> Griff.	Arecaceae	Fanpalm	Toko patta	NY-23	T	Leaves are used for making coarse broom and also used in nursery as overhead shade. Whole plant is used as an ornamental and avenue plant, while fibrous sheaths are used in making ropes and various utensils and ornaments. It is also consumed as chutney / NA
<i>Mikania scandens</i> (L.) Willd.	Asteraceae	Climbing hempweed	Terhi	NY-24	C	Leaves are used in treating loose motion, paste used in cuts and wound / NA
<i>Nauclea orientalis</i> (L.) L.	Rubiaceae	Burtree	Tom	NY-25	T	Bark of the tree is crushed and used in fish catching as poison / NA
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	HolyBasil	Tulsi	NY-26	H	Seed powder and leaves are used in cough and cold. Plant is also used in worship (Akash et al. 2020b, 2021)
<i>Oryza sativa</i> L.	Poaceae	Rice	Chawal	NY-27	H	Consumed as a staple food and used for making beer by fermentation.
<i>Physalis minima</i> L.	Solanaceae	Bladder cherry	Bayam	NY-28	H	The fruit is used as appetizer, bitter, diuretic, laxative and tonic / NA
<i>Pouzolzia bennettiana</i> Wight	Urticaceae	Hirta	Oyik	NY-29	S	Leaves are used to remove constipation and also edible / NA
<i>Raphanus sativus</i> L.	Brassicaceae	Radish	Mulla	NY-30	H	Roots and stem used as anthelmintic. Leaves are used to treat cholera, dysentery and also edible / NA
<i>Ricinus communis</i> L.	Euphorbiaceae	Cator oil plant	Rok plant	NY-31	S	Fruits and leaves are used to cure rheumatism, worm infection and in constipation as well as in abdominal problems / NA
<i>Saccharum officinarum</i> L.	Poaceae	Sugarcane	Taab	NY-32	H	Raw cullum is used in jaundice treatment and are also edible / NA
<i>Solanum indicum</i> Dunal	Solanaceae	African egg plant	Kacha byak	NY-33	H	The twig is used to ferment rice and millet and preparation of local beverage <i>apong</i> and <i>pona</i> . Fruit as Chutney / NA
<i>Solanum nigrum</i> L.	Solanaceae	Kala Dhatura	Roor	NY-34	H	Its leaves are used to treat pneumonia, toothache and also used in stomach pain and consumed as vegetables / NA
<i>Solanum khasianum</i> C.B.Clarke	Solanaceae	Dutch egg plant	Taah byak	NY-35	S	Paste of fried fruit is used to treat dental pain / NA
<i>Spilanthes paniculata</i> Jacq. ex S.S.Renner, Balslev & Holm-Niels.	Asteraceae	Tootache plant	Mersha	NY-36	H	Flower is used to treat toothache and leaves are consumed as salad / NA
<i>Terminalia microcarpa</i> Decne.	Combretaceae	Rollock	Rollock	NY-37	T	Wood is used in making local grinder and various house hold tools / NA
<i>Thaumatococcus daniellii</i> (Benn.) Benth. ex Eichler	Marantaceae	Sweet prayer plant	Ook	NY-38	H	Leaf is used in making local plate, dish, and paste of leaves is used as antidote against venoms, sedative, diabetes / NA
<i>Zanthoxylum oxyphyllum</i> Edgew.	Rutaceae	Pricklyash	Honam	NY-39	S	Leaves can be used as carminative, depurative, treating rheumatism, asthma, dyspepsia / NA

Note: NY: Nyishi tribe, H: Herb, S: Shrub, T: Tree, C: Climber, NA: Not applicable; we didn't find the same ethnomedicinal uses which we have recorded

The huge biodiversity of medicinal wealth in Himalayan region (Dhar et al. 2002) has great advantages for the local communities. Despite being great advancement in medical science, local communities still used plant-based products for sustainability and livelihood due to their effectiveness and availability (Semwal et al. 2010). During the present study, ethnobotanical data on 39 plant species belonging to 22 families were collected. The present study favor the results from other studies in which Asteraceae, Rosaceae and Polygonaceae were the dominant family from Kashmir Himalaya (Abdullah and Andrabi 2021) but incomparable with the study from Kashmir Himalaya in which Asteraceae, Lamiaceae, and Ranunculaceae were most dominant family.

In the present study, Asteraceae was the most dominant family of medicinal plants, which is comparable with the study of Saklani and Jain (1994). Similar findings were also documented by Tripathy et al. (2017), while studying the ethnomedicinal plants of Papum Pare district.

The knowledge of traditional knowledge is of great concern, and it has been lost generation after generation. There are various factors responsible for the erosion of indigenous knowledge including poverty and modernization. Different methods of medicinal application including infusions, decoction, powder, and juices were described in studies (Bhatia et al. 2015). The tribes use these forms with honey, milk, and with boiled water to treat fever, cold and

cough as well as other human ailments. Many of the earlier studies confirmed decoction and maceration as important and primarily mode of utilization of medicinal plants (Dounnon et al. 2017; Ouachinou et al. 2017; Busari et al. 2021). The high use of bark parts could be due to its effectiveness against pathogens. According to our study, most folk healers use leaves followed by fruits, flowers, roots, whole plants, rhizomes, bark and bulbs etc. The traditional ecological practices of the Nyishi tribe—particularly their use of bamboo, cane, and other forest resources for crafting tools, utensils, and ornaments—demonstrate a deep integration of environmental knowledge and cultural expression. When compared with neighboring tribes such as the Apatani, Monpa, and Adi, the Nyishi exhibit a more craft-based, utilitarian approach to plant use, especially evident in their male-dominated production of hunting tools, storage containers, and household items. In contrast, the Apatani practice highly structured terrace-based agriculture with integrated fish farming, which reflects a sophisticated system of landscape-level sustainability. The Monpa and Adi communities further differ by embedding conservation within their belief systems and ritual practices, using sacred groves and taboos to regulate resource use. While the Nyishi rely on oral knowledge transmission and hands-on learning within households, this system is increasingly at risk due to modernization and declining intergenerational interest. However, the strong cultural attachment to specific tools and plants among the Nyishi also presents an opportunity: by integrating conservation-oriented knowledge from neighboring tribes and reinforcing local practices through education and policy support, the Nyishi community could revitalize their traditional ecological knowledge systems while ensuring sustainable resource use for future generations. A comparative analysis between the present study on the Nyishi tribe and earlier ethnobotanical research on the Apatani and Adi communities of Arunachal Pradesh reveals both convergence and divergence in indigenous knowledge systems. While the Nyishi exhibit rich plant-based craftsmanship—crafting a wide range of traditional tools, utensils, and traps primarily from bamboo, cane, and wood—the emphasis remains on functional utility, with ecological knowledge passed down through oral traditions and hands-on experience, especially among male members. In contrast, studies on the Apatani tribe (e.g., Kala 2005; Dollo et al. 2009) highlight a more systematic and gender-inclusive transmission of ecological knowledge, particularly in agricultural practices and ethnomedicine.

In recent years, continuous unsustainable exploitation, habitat degradation, anthropogenic pressure and change in climatic conditions had led to rapid depletion of several plant species. Moreover, traditional skills and medicinal knowledge is also depleting day by day because of change in socio-cultural dynamics, migration from villages to urban areas, lack of interest of youths on traditional values and dependency on modern technologies and healthcare facilities in the region. Hence, documentation of available ethnobotanical plant species and traditional indigenous knowledge is urgently required. The Government of India through Department of Science and Technology (DST) is

trying to accelerate various aspects of bio-cultural knowledge and plant technology in Arunachal Pradesh. However, such noble initiative would bear much fruits if private land owners and community are engaged in the management of wild species used in making traditional technology. There is an urgent need to value, restore, collect and utilize this native technology of the Nyishi tribe. These technologies can be marketed with the help of information technology, NGOs, formal organizations like North-East Council, for example by promoting bamboo technology center. Furthermore, the rich heritage of arts, crafts and plan technological knowledge of Arunachal Pradesh is sure to add color to cultural heritage of the country.

In conclusion, the communities residing in the Northeastern Himalaya region use plants as a source of medicine and food for their livelihoods and primary health needs. In a few areas, people abandon the traditional knowledge because of urbanization but in recent past it has been observed that communities are more attracted to the traditional medicine system. Folk knowledge has passed from one generation to another generation in this region due to their cultural value but more attention is needed for the conservation and documentation of traditional knowledge as it is less scripted on paper and depends on the people's practices and experiences. Considering the ethnomedicinal and traditional knowledge on species, we recommend preparing various conservation management plans for threatened and endangered species. Thus, the present study clearly demonstrated that apart from many conventionally methods of using ethnomedicinal plants, traditional skills on utilizing plant - based products from the study site are similarly important in multidimensional ways. Furthermore, the policies viz. institutionalizing community-led documentation, conservation programs can empower the Nyishi people to safeguard and transmit their traditional knowledge while connecting it to livelihood opportunities such as eco-tourism, handicrafts marketing, and sustainable agriculture. Additionally, other policy such as integrating indigenous knowledge systems into regional biodiversity management plans will ensure that conservation efforts respect local cultural practices, promote sustainable resource use, and strengthen community resilience against environmental and socio-economic challenges.

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