Forest ecology and ethnobotany of NTFPs in Sirdibas, Gorkha of Manaslu Conservation Area, Gandaki Province, Nepal

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Research

Abstract

Background: Nepal's mountainous forests support diverse Non-Timber Forest Products (NTFPs) essential for local livelihoods and traditional medicine. This study aimed to document the diversity and traditional uses of NTFPs species among the Gurung communities of Pangsing and Nyaak settlements of the Manaslu Conservation Area.

Methods: Field work involved key informant interviews, group discussion, field observations, and ecological sampling. Voucher specimens were collected, identified and deposited at ASCOL Herbarium. Vegetation was assessed across three elevation bands using systematic random sampling, with 30 tree plots, 30 nested shrub plots, and 90 nested herb subplots. Importance Value Index was calculated for each species. Site level differences in NTFPs richness were tested using an independent samples t-test, and the relationship between diameter at breast height (DBH) and tree height was examined using simple linear regression.

Results: A total of 84 NTFPs species belonging to 47 families were recorded. NTFP species richness did not differ significantly between Pangsing and Nyaak ($t = 2.44$, $P = 0.69$). DBH accounted for 68.6% ($R^2 = 0.686$) and 63.1% ($R^2 = 0.631$) of the variance in tree height in Pangsing and Nyaak, respectively. Five species *Artemisia dubia*, *Asparagus racemosus*, *Bergenia ciliata*, *Juglans regia* and *Zanthoxylum armatum* were identified by the Gurung community as priority NTFPs based on use value, market price and availability.

Conclusions: NTFPs are vital to the livelihoods and cultural practices of the Gurung communities, with medicinal use forming the largest traditional use category. Conservation of five priority species requires regular monitoring and sustainable harvesting.

Keywords: Ethnobotany; Asteraceae, Indigenous communities, Herbal medicine

Background

Non-Timber Forest Products (NTFPs) includes all biological resources (besides industrial round wood and wood like panels, pulps, wood chips and derived sawn timber) which may be extracted through natural ecosystems, managed plantations etc., that can be utilized inside household, in the market or have religious, cultural or social significance (Edwards, 1993). It is more than just biological resources that come from forests which include services that people don't use like cultural and religious services, tourism and recreation services, ecological and environmental services and so on (Walter, 2001). In simple terms NTFPs are biological resources aside from wood which are obtained from forests, forested areas and trees that are not located in forested regions. Bamboo, plant exudates, fruits, tannins, edible insects, insect galls, cosmetics made from forests, wild mushrooms, maple syrup, palm goods, wild honey, medicinal plants and other commodities are all included in this category (FAO AGRIS, 2013, Lee & Park 2024) and represent a major source of subsistence income and government revenue in forest-dependent economies (Wong, 2000).

Nepal's diverse ecology, topography and numerous ethnic communities have generated one of the world's richest indigenous traditional knowledge (Sharma *et al.* 2009). The dense forest in Nepal which occupies 44.74% of the country's land (FRTC, 2018), It is estimated about over 2000 NTFPs species are useful (Ghimire *et al.* 2008) along with about 100 species of medicinal plants. The diverse ecosystem consists of different plants accounting for 2% of the flowering plants, 3% of pteridophytes and 6% of bryophytes in global flora. The plant species composition change is regulated by environmental factors which also significantly affect species that occupy specialized niches. Aspect, slope and altitude are the main factors influencing plant species richness, variety and distributions (Salick *et al.* 2014). Therefore, an altitudinal gradient is one of the primary factors determining changes in a range of traits that affect species diversity (Grytnes & Vetaas, 2002) and these environmental gradients directly influence the distribution and abundance of NTFPs (Chapagain *et al.* 2017). Sustainable management of natural and ecological resources depends on a sound understanding of their ecology, distribution and local availability (Wong, 2000), which in turn depends on continued ethnobotanical documentation of indigenous knowledge, use and practice (Kurmi & Baral, 2004; Shah *et al.* 2019). These studies provide information about traditional practices helping in economic development and support the conservation of natural and ecological resources. The cultural and economic uses of plants, specifically NTFPs, have been practiced as a staple of daily living since ancient times.

The Manaslu Conservation Area (MCA) in Gorkha district is home to Gurung communities whose livelihoods, particularly in the Pansing and Nyaak settlements of Sirdibas, remain closely tied to forest resources. Indigenous plant use by Gurung communities elsewhere in Gorkha district has previously been documented (Shah *et al.* 2019), and broader NTFP inventories exist for the MCA (NTNC-MCAP, 2021). However, no study to date has combined systematic ethnobotanical documentation with quantitative vegetation assessment specifically for Pangsing and Nyaak, so the diversity, traditional use patterns, population status and specific pressures facing NTFPs in these two settlements remain undocumented. A combined ethnobotanical ecological approach is needed here because traditional use data alone cannot indicate whether currently harvested species are ecologically abundant, declining, or vulnerable to overharvesting information that is essential for community management planning under the MCA's operational plan.

Therefore, this study aimed to document the diversity and traditional uses of NTFP species among the Gurung communities of Pangsing and Nyaak, assess the ecological abundance and population status of these species using vegetation parameters, compare NTFP richness and composition between the two sites and identify priority NTFP species requiring sustainable management and conservation attention.

Materials and Methods

Study area

Manaslu Conservation Area (MCA) located in the mountainous region of northern Gorkha district of Gandaki province of Nepal (Figure 1). MCA is the third and youngest of its kind, succeeding in the Annapurna Conservation Area (established in 1985) and the Kanchenjunga Conservation Area (established in 1997). It was established on 28th December 1998 under the National Parks and Wildlife Conservation Act of Nepal, 2029 B.S with an area of 1663 sq. km. which encompasses seven rural municipality viz. Samagaun, Lho, Prok, Bihi, Sirdibas, Chumchet and Chhekampar. Its elevation spans significant variations from 1400 meters at Jagat to the summit of Mount Manaslu at 8163 meters. The MCA shares its borders with the Tibetan plateau of China to the north, the Langtang National Park to the east, the Annapurna Conservation Area to the west and the central part of Gorkha district to the south. The survey plots were distributed in the northwest aspect between 4° to 5° of slope (Table 1).

Table 1. Location of the two different study sites.

Sites	Latitude	Longitude	Altitude (m)	Geographical landscape
Pangsing	28°24'38.8"N	84°53'18.8"E	1814	Rocky & steep
Nyaak	28°26'26.6"N	84°53'37.6"E	2277	Plain & steep

It is focused in Sirdibas ward no. 3 of Chum-Nubri Rural Municipality of the Manaslu Conservation Area that occupies 314.91 sq. km² (31,491 ha). This region is mostly favored with subtropical to nival climatic zones of Nepal. The majority of ethnic group is Gurung in both the community of Pangsing and Nyaak. Pansing which consists of 128 households having 327 females and 312 males while Nyaak which consists of 40 households having 99 females and 108 males (MOP-CAMC, Sirdibas 2079).

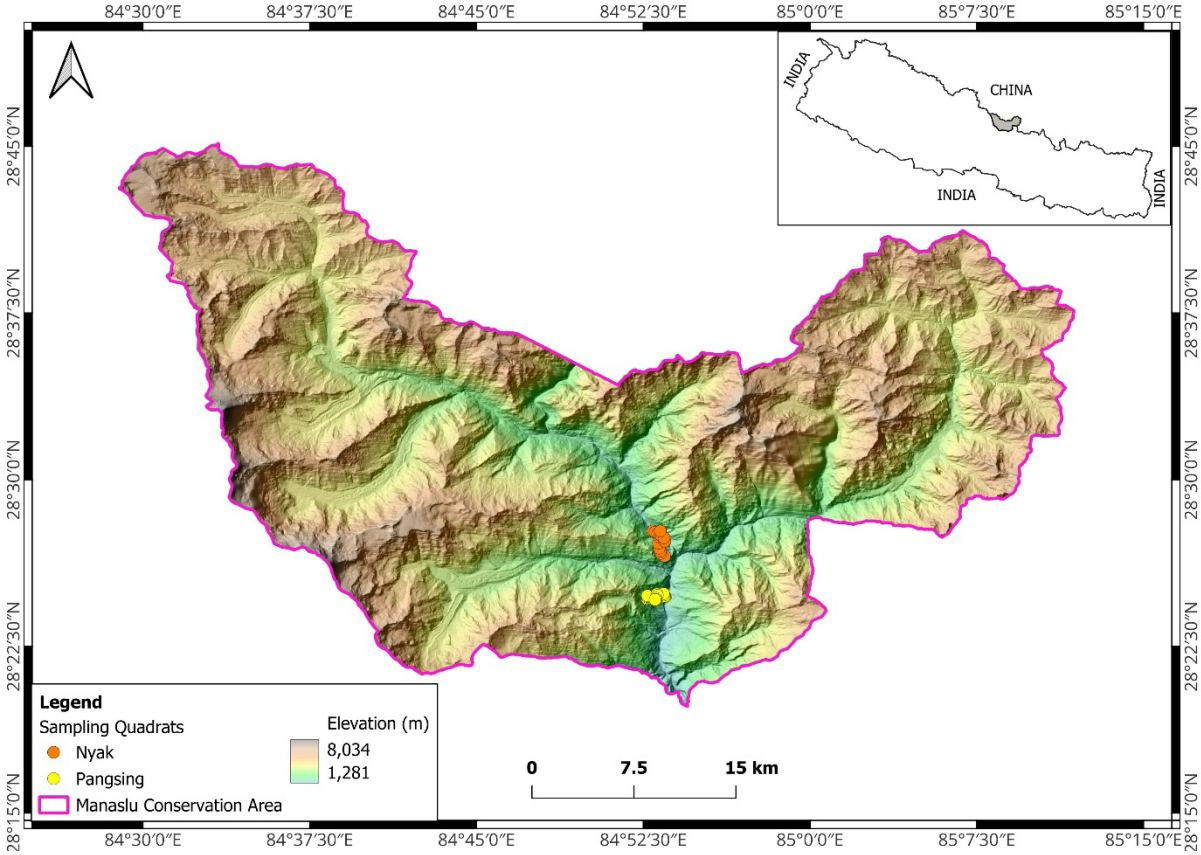


Figure 1. Map of the study area in Pangsing and Nyaak sites of MCA.

The climate of Gorkha is mainly generated by the southeasterly monsoon. For the past 30 years, it has been recorded 1252mm mean annual rainfall occurred at Gorkha (Mainali *et al.* 2015). The temperature generally is high during the monsoon period and low during the winter months. In July there is heavy rainfall for a year.

Inventories of NTFPs species

NTFPs encompasses a variety of species each with variation in their ground condition, growth environment, habitat, reproduction and sporadic distribution. The entropy of NTFPs can't be a one size fit all approach with inventory thus specific methods used for NTFPs must be flexible where they occur naturally (Ghimire 2007). The inventory process should be participatory of the local community (Wong 2000). These inventories which provide qualitative information are important for the formulation of forest resources management. Informants were selected using purposive sampling based on youth age of 25 to 55 years and have recognized plant use knowledge. Interviews were semi-structured and were conducted in Nepali, with translation assistance where required. Local vernacular names and reported uses were cross checked against repeated citation across informants as well as published floras (Uprety *et al.* 2016) and uses cited independently by multiple informants were treated as validated. Prior to each interview, the aims of the study were explained, and Free and Prior Informed Consent was obtained verbally from each participant, consistent with the ethical approval described under Declarations.

Plant collection, identification and herbarium preparation

The NTFPs species were collected prioritizing the flowering and fruiting stages. One branch was collected for shrubs, trees, climbers and whole herbs plants were collected to present all parts of the plants. The field notes with collection date, collection number, location, altitude, flower and fruit color vegetation were noted, and photographs were also taken in the field. The NTFP species were identified in the field mostly through floristic literature (Cullen, 2006) and comparing photographs of the plants (KEW and KATH) as well as with the help of experts.

Potential ranking of NTFPs species by Gurung community

A potential ranking exercise was done before starting field sampling based on ranking tables. The list of available NTFPs species in the study area was prepared with knowledge and experience from local informants which was tabulated in the most chosen order based on use value, marked price and availability. The use categories of the NTFPs species which were listed in the ecological sampling plot were tabulated based on categorization table (Table 2).

Table 2. Categorization of NTFPs utilization (extended from Danekhu *et al.* 2018).

NTFPs categories	**Use**
Food	Vegetable, Food & Fruit
Medicine	Treatment of man
Ornamental	Symbolic, Beauty & Decoration
Construction material	Wooden tools, Baskets & Mat
Dying and tannin	Dying & Tanning
Fodder	Cattle feeding & rearing
Veterinary medicine	Treatment of animal
Utensils and handicraft	Utensils, Paper and Pulps & Cushions
Crop management	Fencing, Manure & Pesticide
Insecticides	Insect pest
Religious	Religious, Festival & Culture
Miscellaneous	Others

Ecological sampling

Vegetation sampling was conducted on 10th March 2025 using systematic random sampling stratified across three elevation bands: lower (1550–1780 m), mid (1950–2180 m) and upper (2350–2580 m) (Chapagain *et al.* 2017). In each elevation band the three horizontal transects were established at 75–100 m vertical intervals. Each transect had five 10 × 10 m plots laid out at 50–100 m intervals for tree sampling, giving 5 plots × 3 transects × 3 elevation bands × 2 sites = 30 tree plots in total. In each tree plot, one nested 5 × 5 m subplot was established for shrub sampling (30 shrub subplots in total), and each 5 × 5 m subplot was further divided into three 1 × 1 m subplots for herb sampling (90 herb subplots in total). Altogether, 30 tree plots + 30 shrub subplots + 90 herb subplots = 150 sampling units were surveyed across the two sites (Figure 2), and all individuals of NTFPs species encountered within them were recorded and identified. Environmental parameters (longitude, latitude, elevation, slope and aspect) were recorded at each plot using a digital compass. Square plots were used as they are considered superior and are the most common plot shape for vegetation sampling in Nepal (Pokhrel, 2023). Secondary information on the study area's geography, socio-economy, population, land use and NTFPs operational plan were also compiled.

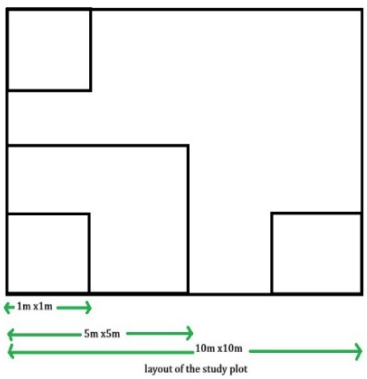


Figure 2. Sampling plot and sub-plot layout (30 tree plots of 10 × 10 m, each nested with one 5 × 5 m shrub subplot further divided into three 1 × 1 m herb subplots; 150 sampling units in total).

Importance Value Index (IVI)

The sum of the relative frequency (RF), relative density (RD) and relative cover(dominance) (RC) provides importance value index which shows species dominancy in the surveyed areas (Zobel *et al.* 1987).

IVI= RF + RD + RC

Results

Traditional knowledge of NTFPs species

The NTFPs species with different traditional use knowledge and practices value that contribute to the local livelihood mostly were listed (Table 3).

Informant demographic profile

A total of 28 informants (14 males, 14 females; age range 25 to 55 years) were interviewed, including key informants. The earnings through the collection and trade of NTFPs species in the present study area among 28 respondents was mostly one lakh in Nepalese rupee annually in average among which 19 species were traded. This earning was maximum up to 2.5 lakhs where standard deviations (SD) remained approximately 158.36 ± 336.18 (Table 4).

Table 4. Annual income from NTFP trade.

Income (in NRs)	HHs of Gurung Communities	%
Up to 1 lakh	19	67.9
1 to 1.5 lakhs	2	7.1
1.5 to 2 lakhs	3	10.7
2 to 2.5 lakhs	4	14.3
Grand Total	**28**	**100**

The mean NTFPs which were sold by the local community per HH ≈ 158.36 ± 336.18 (SD).

Distribution of NTFPs

The study listed seven species of trees, 14 species of shrubs, 25 species of herbs and one species of climbers in Pangsing while 13 species of trees, 15 species of shrubs, 34 species of herbs and three species of climbers in Pangsing (Figure 3). There was no significant difference in the distribution of the NTFPs species *P* = value and the significance threshold set at α = 0.05 (*P*=0.69), while the independent t-test measured t-value was 2.44 tested by SPSS (version 25) (Figure 3).

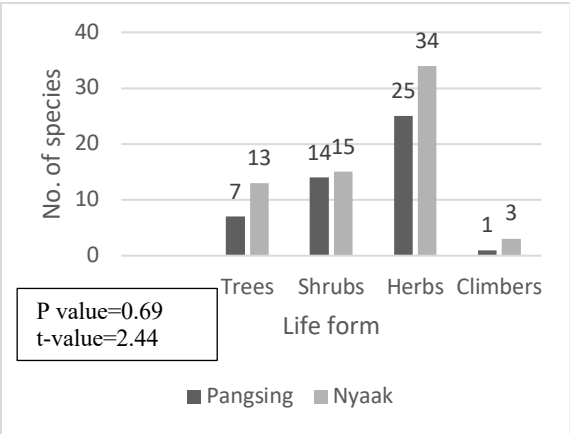


Figure 3. Lifeform richness of NTFPs species in Pangsing and Nyaak.

DBH and Height Regression

The relationship between DBH and tree height was examined using simple linear regression, with DBH as the independent variable and height as the dependent variable, fitted separately for Pansing and Nyaak (n = 15 trees per site). Model fit was assessed using the coefficient of determination (R^2). Linear regression fitted separately for each site, between DBH (cm) and tree height (m) showed that DBH explained 63.1% (R^2 = 0.631) of the variance in height in Nyaak and 68.6% (R^2 = 0.686) in Pangsing (n = 15 trees per site; Figure 4). The R^2 values indicate a moderately strong positive DBH and height relationship at both sites.

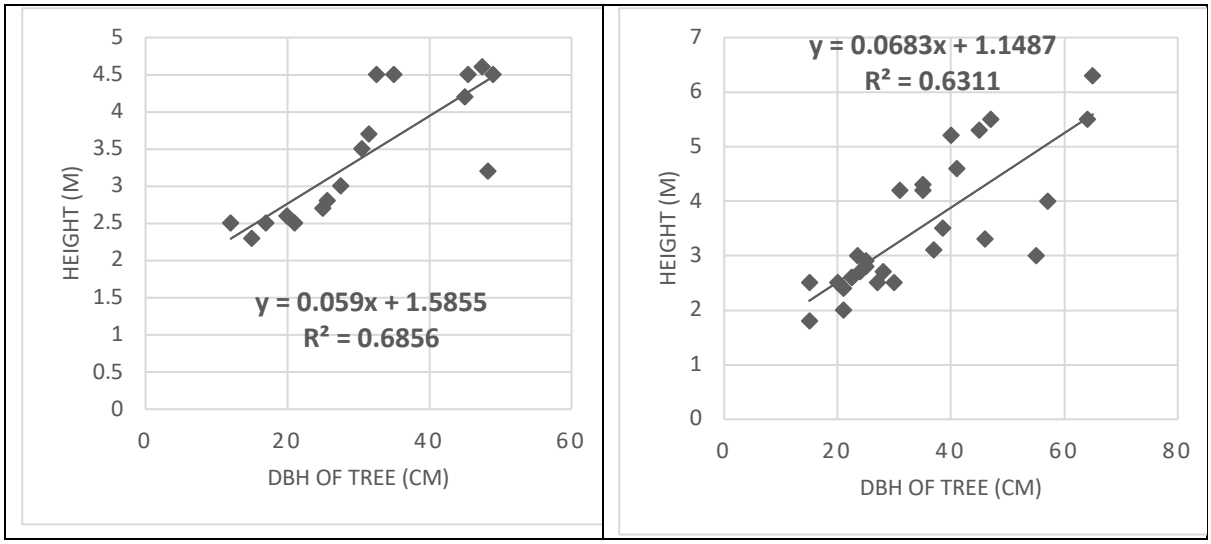


Figure 4. A simple regression between DBH (cm) and Height (m) of tree species in Pangsing and Nyaak respectively (n=15).

Prioritized and important NTFPs

The social survey and ethnobotanical survey have resulted in the selection of top five prioritized and important NTFPs species which were listed both in FGDs based on rank categorization as well as in the study area of the present study. Socio-economic use of these species was computed further based on the information collected from study area (Figure 5).

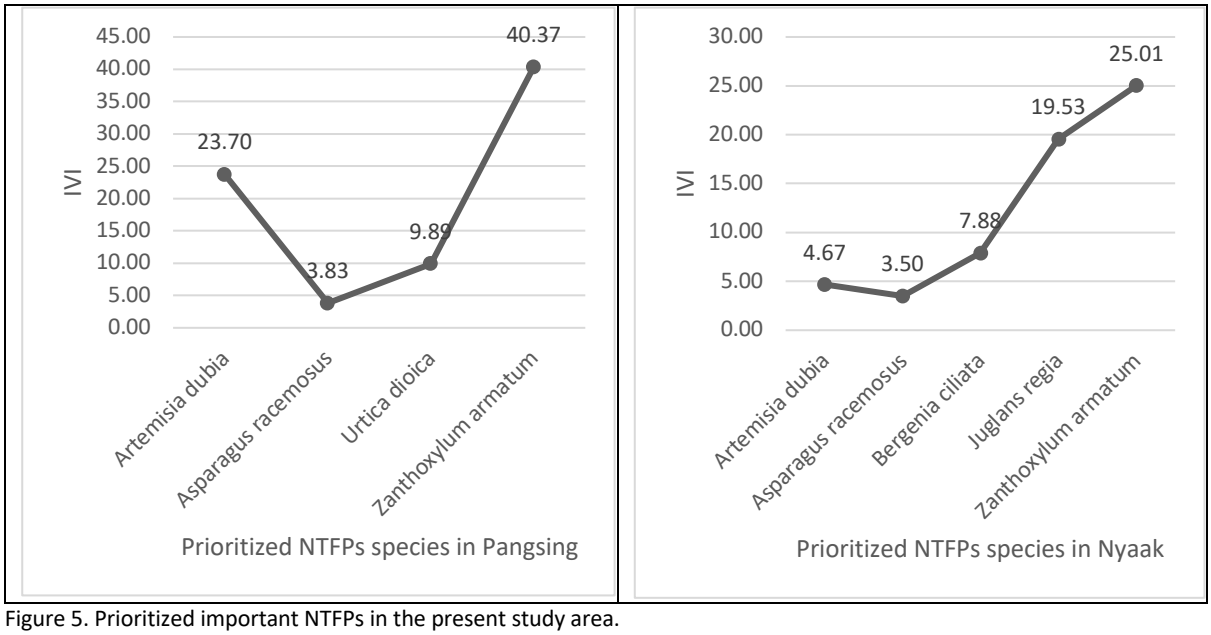


Figure 5. Prioritized important NTFPs in the present study area.

Table 3. Documentation of NTFPs with their uses in the Manaslu Conservation Area

Family	Species	Vernacular name	Habit	Part used	Use category	Altitudinal range (m)
Acanthaceae	*Justicia adhatoda L.*	**Asuro**	Shrub	Leaves	Medicine	500-1600
Amaranthaceae	*Alternanthera sessilis* (L.) DC.	**Saranchi**	Herb	Leaves, Twigs	Medicine, Food	200-2000
Amaranthaceae	*Cyathula capitata* Moq.		Herb	Leaves, Root	Fodder, Medicine, Insecticide	1300-2900
Anacardiaceae	*Rhus chinensis* Mill.	**Bhakimlo**	Tree	Fruit, Flower	Food, Medicine, Dying and tannin	1000-2700
Asparagaceae	*Asparagus racemosus* Willd.	**Kurilo**	Herb	Shoot	Food, Medicine	300-2200
Asteraceae	*Ageratum conyzoides* L.	**Guddhe**	Herb	Whole plant	Medicine	200-200
Asteraceae	*Anaphalis contorta* (D.Don) Hook.f.	**Pansan**	Herb	Aerial parts	Insecticides, Miscellaneous, Medicine	1700-4500
Asteraceae	*Artemisia dubia* var. dubia	**Titepati**	Herb	Whole plant	Insecticides	1200-3400
Asteraceae	*Bidens pilosa* L.	**Kalo Kuro**	Herb	Whole plant	Medicine	500-2500
Asteraceae	*Duhaldea cappa* (Buch.-Ham. ex D.Don) Pruski & Anderb.	**Gathihare**	Shrub	Root	Medicine	100-2500
Asteraceae	*Galinsoga parviflora* Cav.	**Chitlange jhar**	Herb	Whole plant	Fodder, Medicine	850-3000
Asteraceae	*Sonchus wightianus* DC.	**Dhude jhar**	Herb	Root	Medicine	300-2300
Asteraceae	*Taraxacum tibetanum* Hand.-Mazz.	**Khenpa-Karpo**	Herb	Whole plant	Medicine	1200-2560
Asteraceae	*Youngia japonica* (L.) DC.	**Dudhe**	Herb	Leaves, Latex	Food, Medicine	230-2900
Begoniaceae	*Begonia picta* Sm.	**Makar kach**	Herb	Fruit	Medicine	600-2800
Berberidaceae	*Berberis asiatica* Roxb. ex DC.	**Chutro/Musa lede**	Shrub	Root, Fruit	Food, Medicine, Dying and tannin	1200-2500
Berberidaceae	*Berberis napaulensis* (DC.) Spreng.	**Jamane mandro**	Shrub	Leaves	Crop management, Medicine	1400-2900
Betulaceae	*Betula alnoides* Buch.-Ham. ex D.Don	**Lekh painu/Saur**	Tree	Bark	Medicine, Food	1200-2600
Betulaceae	*Corylus ferox* Wall.	**Lekh katus**	Tree	Fruit	Food	2500-3500
Brassicaceae	*Cardamine hirsuta* L.	**Simrayo**	Herb	Leaves	Medicine, Food	500-3000
Buxaceae	*Sarcococca hookeriana* Baill.	**Chile kath**	Shrub	Root, Stem, Flower	Medicine, Construction materials, Ornamental	1800-3500
Cannabaceae	*Cannabis sativa* L.	**Bhang**	Herb	Leaves & Shoot	Veterinary medicine, Religious	150-2700
Cucurbitaceae	*Herpetospermum pedunculosum* (Ser.) C.B.Clarke	**Ban Karela**	Climber	Fruit	Medicine	1500-3600
Dioscoreaceae	*Dioscorea bulbifera* L.	**Githa/ Ban Tarul**	Climber	Rhizome	Food, Miscellaneous, Medicine	150-2100
Equisetaceae	*Equisetum ramosissimum* Desf.	**Kurkure jhar**	Herb	Aerial parts	Medicine	1000-2600
Ericaceae	*Gaultheria fragrantissima* Wall.	**Dhasingre**	Shrub	Leaves	Medicine, Fodder, Religious	1200-2600
Ericaceae	*Pieris formosa* (Wall.) D.Don	**Lek angeri**	Tree	Leaves	Medicine	2000-3300
Ericaceae	*Rhododendron arboreum* Sm.	**Lali gurans**	Tree	Flower	Medicine, Food	1400-3600
Euphorbiaceae	*Euphorbia hirta* L.	**Aankle jhar**	Herb	Whole plant	Medicine	150-1500
Euphorbiaceae	*Euphorbia pseudosikkimensis* (Hurus. & Yu.Tanaka) Radcl.-Sm.	**Thangnum**	Herb	Latex	Crop management	1700-3100

Euphorbiaceae	*Euphorbia royleana* Boiss.	**Siude**	Shrub	Latex, Whole plant	Medicine, Religious	1100-1800
Fabaceae	*Sunhangia elegans* (DC.) H.Ohashi & K.Ohashi	**Rate Bakhre Ghas**	Shrub	Bark	Medicine	1000-4000
Fabaceae	*Trifolium repens* L.	**Seto Behuli**	Herb	Whole plant	Fodder, Food	1500-3800
Gentianaceae	*Swertia chirayita* (Roxb.) H.Karst.	**Tida/Chraito**	Herb	Whole plant	Medicine	1200-3000
Hypericaceae	*Hypericum hookerianum* Wight & Arn.	**Doli phul**	Shrub	Leaves	Fodder	1500-3000
Juglandaceae	*Juglans regia* L.	**Okhar**	Tree	Fruit	Food, Medicine, Religious	1200-3000
Lamiaceae	*Colebrookea oppositifolia* Sm.	**Dhursil**	Shrub	Root, Leaves	Medicine	250-1700
Lamiaceae	*Elsholtzia fruticosa* (D.Don) Rehder	**Chhinki**	Shrub	Plant, Leaves, Spikes, Roots	Religious, Medicine	1800-4200
Lauraceae	*Cinnamomum tamala* (Buch.-Ham.) T.Nees & C.H.Eberm.	**Tejpat**	Tree	Leaves & Bark	Food, Medicine	450-2000
Lauraceae	*Lindera neesiana* (Wall. ex Nees) Kurz	**Siltimur**	Tree	Fruit, Bark	Medicine, Food	1800-2700
Malvaceae	*Bombax ceiba* L.	**Simal**	Tree	Fruit pods	Utensils and handicraft, Medicine	500-1500
Malvaceae	*Malvaviscus arboreus* var. *arboreus*	**Khursani ful**	Shrub	Flower	Food, Ornamental, Crop management	150-2000
Mazaceae	*Mazus surculosus* D.Don	**Khasre buti**	Herb	Whole plant	Medicine	900-3000
Melastomataceae	*Osbeckia stellata* Buch.-Ham. ex D.Don	**Angeri**	Shrub	Fruit, Root	Medicine	1300-2600
Meliaceae	*Azadirachta indica* A.Juss.	**Meemee**	Tree	Leaves	Religious, Medicine, Insecticides	60-1200
Moraceae	*Ficus sarmentosa* Buch.-Ham. ex Sm.	**Ban Timilo**	Tree	Fruit	Food, Medicine	250-2500
Moraceae	*Ficus semicordata* Buch.-Ham. ex Sm.	**Khaniu**	Tree	Fruit, Leaves	Fodder, Food, Medicine	200-2700
Myricaceae	*Myrica esculenta* Buch.-Ham. ex D.Don	**Kafal**	Tree	Fruit	Food	1200-2300
Orchidaceae	*Coelogyne cristata* Lindl.	**Sunakhari**	Herb	Whole plant	Medicine	1000-2000
Oxalidaceae	*Oxalis corniculata* L.	**Chari amilo**	Herb	Leaves	Food, Medicine	300-2900
Pinaceae	*Pinus wallichiana* A.B.Jacks.	**Gobre salla**	Tree	Trunk, Leaves	Miscellaneous, Food	1800-3300
Poaceae	*Cynodon dactylon* (L.) Pers.	**Dubo**	Herb	Leaves	Medicine	100-2000
Poaceae	*Drepanostachyum falcatum* (Nees) Keng f.	**Sano Nigalo**	Herb	Whole plant	Construction material	1200-1800
Poaceae	*Himalayacalamus hookerianus* (Munro) Stapleton	**Nigalo/Pareng**	Herb	Whole plant	Construction material	2000-2500
Poaceae	*Saccharum spontaneum* L.	**Kans**	Herb	Leaves	Fodder, Crop management	100-2000
Poaceae	*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda	**Amriso**	Herb	Leaves, Inflorescence	Medicine, Construction materials	100-2000
Polygonaceae	*Fagopyrum esculentum* Moench	**Phapar**	Herb	Leaves	Medicine	1800-4100
Polypodiaceae	*Nephrolepis cordifolia* (L.) C.Presl	**Pani amala**	Herb	Tuber, Leaves	Food, Fodder, Ornamental, Medicine	500-2000
Primulaceae	*Primula denticulata* Sm.	**Simful**	Herb	Flower	Ornamental	1500-4100
Ranunculaceae	*Clematis montana* Buch.-Ham. ex DC.	**Junge lahara**	Climber	Root	Medicine	1600-4000
Ranunculaceae	*Thalictrum foliolosum* DC.	**Dampate**	Herb	Root	Medicine	1300-3400

Rhamnaceae	*Ziziphus incurva* Roxb.	**Hade Bayer**	Tree	Fruit, Leaves, Stem	Food, Medicine, Fodder, Religious, Crop management	800-1900
Rosaceae	*Cotoneaster microphyllus* Wall. ex Lindl.	**Pribi**	Shrub	Root	Medicine	2000-5000
Rosaceae	*Fragaria nubicola* (Lindl. ex Hook.f.) Lacaita	**Bhui ainselu**	Herb	Fruit, Leaves	Food, Veterinary medicine	1600-4000
Rosaceae	*Potentilla fulgens* Wall. ex Sims	**Bajradanti**	Herb	Whole plant	Medicine	1600-4800
Rosaceae	*Prinsepia utilis* Royle	**Phekray/Dhatelo**	Shrub	Seed	Food	1500-2900
Rosaceae	*Prunus cerasoides* Buch.-Ham. ex D.Don	**Payun**	Tree	Fruit, Stem, Flower	Food, Medicine, Religious	1300-2400
Rosaceae	*Pyrus pashia* Buch.-Ham. ex D.Don	**Mayal**	Tree	Fruit, Bark	Medicine, Construction materials	750-2600
Rosaceae	*Rosa sericea* Lindl.	**Sewa/Darimpate**	Herb	Flower	Medicine	2200-4600
Rosaceae	*Rubus ellipticus* Sm.	**Aiselu**	Shrub	Fruit	Food	1700-2600
Rosaceae	*Rubus pedunculosus* D.Don	**Kalo ainselu**	Shrub	Fruit, Leaves	Food, Medicine, Fodder	2100-3600
Rubiaceae	*Rubia manjith* Roxb.	**Majitho**	Herb	Rhizome, Whole plant	Medicine, Dying and tannin	1200-2100
Rutaceae	*Zanthoxylum acanthopodium* DC.	**Boke Timur**	Shrub	Fruit	Food, Medicine	1600-2800
Rutaceae	*Zanthoxylum armatum* DC.	**Parpare Timur**	Shrub	Fruit, Leaves	Food, Medicine	1100-2500
Saxifragaceae	*Bergenia ciliata* (Haw.) Sternb.	**Pakhnabed**	Herb	Rhizome	Medicine	900-3600
Smilacaceae	*Smilax aspera* L.	**Chopchini**	Climber	Fruit	Medicine	1200-2600
Solanaceae	*Datura stramonium* L.	**Gofatdothrabithai**	Shrub	Seeds	Medicine	200-2200
Solanaceae	*Solanum americanum Mill.*	**Kali gadi**	Herb	Fruit, Whole plant	Food, Medicine	900-2900
Thymelaeaceae	*Daphne bholua* Buch.-Ham. ex D.Don	**Seto Lokta**	Shrub	Bark	Utensils and handicraft	2000-4000
Urticaceae	*Girardinia diversifolia* (Link) Friis	**Allo**	Herb	Young shoot, Stem	Food, Medicine, Miscellaneous	1700-3000
Urticaceae	*Pilea symmeria* Wedd.	**Kamale**	Herb	Leaves, Tender shoots	Food, Fodder, Medicine	2100-3300
Urticaceae	*Urtica dioica* L.	**Sisnu**	Herb	Leaves, Young shoots	Medicine, Food, Miscellaneous	1000-4000
Viburnaceae	*Viburnum erubescens* Wall. ex DC.	**Ashare**	Shrub	Seeds, Root	Food, Medicine	2000-3500
Violaceae	*Viola pilosa* Blume	**Ghatte ghas**	Herb	Root	Medicine	1000-2800

Discussion

Traditional knowledge of NTFPs use

Traditionally the highest knowledge about the use of NTFPs species was for medicine (68 species) succeeded by food (33 species), fodder (11 species), religious (eight species) and so on. The interview with the local collector provided a multiple use of the NTFPs species along prioritized species. The least is for utensils & handicraft and veterinary medicine two species each. The present study revealed the good knowledge of NTFPs species and its use in daily life among old generations as well as amchis, local healers of the MCA. This knowledge is slowly disappearing as there is a reach of health post and medicines, similarly the new generation is involved in other occupations while other categories are high including religious, food, and construction. It is important to document indigenous knowledge on vegetation and forest management, non-timber forest products, medicinal plants, agroforestry, and biodiversity (Sheng-Ji, 2001). The traditional knowledge of medicinal plants which was rich once within countless indigenous cultures is now getting less importance. Every time collective understanding of such species is declined including distribution, types, sustainable management, benefits and ecology (Bhandari *et al.* 2025). It is even vulnerable in the mountainous region where the community relies on their forest resources. Thus, such cultures and economies must be intricately adapted to the nuances of these communities to thrive (Hamilton, 2004). Medicinal herbaceous NTFPs species are utilized widely because of collection, storage and transportation along with their abundances similar to Bhattarai and Tamang (2017). The study of ethnomedicine of Dolpa district by Kunwar and Adhikari (2005) forecasted the utilization of indigenous use and practices of NTFPs species under various category use mainly as medicine can be an important parameter for income opportunity emphasizing the economy of the nation which is consistent with our research. A study in Annapurna Conservation Area resembles with the present study which had highest use frequency of medicine (63 species) succeeded by edible plants (52 species) out of 154 species used traditionally. In a study reported by Danekhu *et al.* (2018) out of 109 NTFPs species recorded 100 species were used as medicine succeeded by fodder with 86 species, food and vegetables with 47 species in Chitwan a somewhat different ranking that may reflect differences in altitudes and the associated biotic and abiotic conditions between the two regions.

The Gurung community's main occupation is farming which involves both cattle rearing and crop production. This also has impacted the community to depend on NTFPs harvest from the forest to fulfill the basic needs. The reliance in the collection and trade of NTFPs species may be due to acceptable cultural practices besides lack of employment opportunities (Chaudhary 1998). In the agricultural region, specific tree species, which serve as fodder for animals are crucial, which helps to enhance livestock production through these resources presenting an opportunity to boost food security and income source for the Gurung community (Gemedo-Dalle *et al.* 2005).

Ecological composition

Vegetative patterns are primarily influenced by climatic factors on a regional scale (Currie & Paquin, 1987). In contrast local scale factors including land use, slope, aspect and soil moisture play a more significant role according to Sherman *et al.* (2005).

The highest Rf and Rd in the tree species in this study were *Pinus wallichiana* with 79.25 IVI value succeeded by *Rhododendron arboreum* with 70.44 IVI value while *Ziziphus incurva* had lowest with 5.33 IVI value. In shrub species the highest IVI value was reported by *Zanthoxylum* species with 26.83 & 25.63 and *Prinsepia utilis* with 25.03 while the least by *Datura stramonium* with 6.10 IVI value. Similarly in herb species the highest IVI value was reported by *Drepanostachyum falcatum* with 30.67 succeeded by *Anaphalis contorta* with 18.73, *Himalayacalamus hookerianus* with 17.74 while the least was *Clematis montana* with 1.75. The focus group mentioned that there was a decline of forest resources compared to the past which may be due to over exploitation of the resources. This is important to carry good management practice from eliminating the rare and important NTFPs species.

The higher NTFPs richness recorded in Nyaak relative to Pangsing coincided with FGD reports of comparatively lower anthropogenic disturbance (e.g., fire, construction, grazing) at Nyaak. However, because disturbance was assessed qualitatively through field observation and informant perception rather than through a quantitative index, and because the two sites also differ in altitude (1,814 m at Pangsing versus 2,277 m at Nyaak) and landscape (rocky/steep versus plain/steep; Table 1), altitude, topography and habitat heterogeneity cannot be ruled out as contributing explanatory variables alongside disturbance.

Focus group participants also reported a perceived decline in forest resources relative to the past, which they attributed to overexploitation. Sustained good management practice will be important to avoid further loss of ecologically or culturally important NTFPs species.

Prioritized NTFP species

The five priority NTFP species identified by the Gurung community *Artemisia dubia*, *Asparagus racemosus*, *Bergenia ciliata*, *Juglans regia* and *Zanthoxylum armatum* had comparatively low IVI values (12.69, 3.12, 4.68, 12.13 and 26.83, respectively) (Table 5). The possible contributing factors include overharvesting, habitat fragmentation, multiple concurrent uses, and trade demand, consistent with Ghimire (2008). A study in the Annapurna Conservation Area similarly found that most prioritized species (eight of 34 recorded NTFPs) were herbs (Sherpa, 2025), parallel with the present findings, and several of the same species were previously reported for the Gurung community of Gorkha by Shah et al. (2019). It should be noted that a low IVI reflects relatively low local abundance or ecological representation within the sampled plots rather than a demonstrated conservation threat; conservation priority ideally integrates abundance with harvesting pressure, regeneration status, range-wide distribution, formal conservation status and socio-economic importance, several of which were beyond the scope of the present vegetation sampling.

Table 5. Summarizes management considerations for the five priority NTFPs based on the parts harvested, relative local abundance (IVI) and principal use recorded in this study.

Species	Part used	IVI	Principal use	Management consideration
Artemisia dubia	Whole plant	12.69	Insecticide	Rotational/seasonal harvest, avoid whole plant removal from regenerating patches
Asparagus racemosus	Shoot	3.12	Food, medicine	Very low IVI, priority candidate for cultivation/domestication near settlements
Bergenia ciliata	Rhizome	4.68	Medicine	Rhizome harvest is destructive to the parent plant, consider protected regeneration plots
Juglans regia	Fruit	12.13	Food, medicine, religious	Encourage enrichment planting near settlements to reduce wild harvest pressure
Zanthoxylum armatum	Fruit, leaves	26.83	Food, medicine	Comparatively higher IVI, monitor harvest intensity to sustain status

Conclusion

This study documented 84 potential NTFPs species across 47 families used by the Gurung communities of Pansing and Nyaak in the Manaslu Conservation Area, with medicinal use (68 species) the dominant traditional use category, followed by food (33 species) and fodder (11 species). NTFPs richness was higher in Nyaak than in Pangsing, a difference that coincided with lower reported anthropogenic disturbance at Nyaak but that may also reflect the two sites' differing altitude and landscape characteristics. Five species *Artemisia dubia*, *Asparagus racemosus*, *Bergenia ciliata*, *Juglans regia* and *Zanthoxylum armatum* were identified by the Gurung community as priority NTFPs based on use value, market price and local availability. The generally low IVI values relative to other recorded species indicate that they require closer monitoring and, where feasible, cultivation or rotational harvest measures to reduce pressure on wild populations.

These findings support continued documentation of Gurung ethnobotanical knowledge in Sirdibas and illustrate the value of pairing traditional use data with ecological sampling for NTFPs management planning. We recommend that the CAMC and local forest user groups develop species specific, rotational harvesting guidelines for the five priority NTFPs, protect known regeneration sites, particularly for rhizome and root harvested species such as *Bergenia ciliata* and *Asparagus racemosus* explore small scale cultivation of high demand medicinal species near settlements and integrate periodic, community monitoring of priority NTFPs abundance into the MCA's operational plan.

Declarations

List of abbreviations: NTFPs – Non timber forest products**;** CAMC – Conservation Area Management Community; MCA – Manaslu Conservation Area; IVI – Importance value index; Rf – Relative frequency; Rd – Relative density; Rc – Relative coverage; FGDs - Focus Group Discussions; KATH – National Herbarium and Plant Laboratory; MM- millimeter; MOP-CAMC – Management operational plan conservation area management community; MoFSC – Ministry of Forest and Soil Conservation; FAO – Food and Agriculture Organization; FRTC - Forest and Research Training Center

Ethics approval and consent to participate: The development of the study followed the ethical and legal guidelines for the development of research on traditional knowledge. The project was approved by the Department of National Park and Wildlife Conservation under the number: 1862 on 14th Feb 2025. The participation of healers was subject to the acceptance of the Free and Informed Consent Form. The project was registered with MCAP.

Consent for publication: We provide consent for publication.

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