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FLORISTIC DIVERSITY AND TRADITIONAL USES OF PLANT RESOURCES OF KALI GANDAKI WATERSHED, NEPAL

Kunjani Joshi*

Department of Botany, Patan Campus, Tribhuvan University, P. O. Box 11121, Kathmandu, Nepal

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For Correspondence:

Kunjani Joshi

Department of Botany, Patan Campus, Tribhuvan University, P. O. Box 11121, Kathmandu, Nepal

E-mail:

kunjanijoshi@gmail.com

ABSTRACT

Wild plants are widely used for domestic purposes to fulfill the basic needs in the villages of the Kali Gandaki Watershed, Nepal. In the present paper all together 156 plants belonging to 67 families with their traditional uses and practices are documented based on a field survey. Local people have remarkable detailed knowledge of species identity and characteristics and uses of plant resources. At present, these useful plants and their habitats are under serious threat due to anthropogenic pressure indicating the need of action for inventory, documentation and conservation of the species and their habitats in this area.

INTRODUCTION

Nepal's position at the junction of the Indo-Malayan and Palaearctic biogeographic realms along with its diverse physiography and varying climatic zones have contributed to the occurrence of many species of useful plants on diverse habitats. These plant resources have been used to fulfill various basic needs by the rural people, such as food, firewood, timber, fodder, agricultural tools and raw drugs. The existing traditional knowledge and practices may lead to the establishment of plant-based rural industries that may lead to improvement of economic status of the local communities. However, at present, this vast store of information is being eroded as a result of human activities i.e. unsustainable land use practices and over-exploitation of natural resources etc. The loss of traditional knowledge within cultures undergoing rapid change is just as irreversible as the loss of species. Hence efforts should be made to document the various uses of plants before some of these plants are eliminated from the area. In this context, despite some works related to the documentation of useful medicinal plants of the Kali Gandaki watershed have already carried out (Joshi, 1997; Joshi and Joshi, 2000; 2007), the vast store of ethnobotanical information on the various uses of wild plants has not been comprehensively documented. In the present paper, an attempt has been made to enumerate the wild plants which are being used by local people of the villages and surrounding areas of the Kali Gandaki Watershed, Nepal.

METHODOLOGY

The study is carried out in Setibeni, Harmichur, Mirmi, Bote Gau,(Adhi Muhan), Balam, Malunga, Jaipate, Beltari, Derpek, Ridi, Birgha villages and surrounding areas of the watershed of Kali Gandaki. The ecosystems of these areas are very complex with diverse physical, biological and social characteristics. The major characteristics are as follows:

1. The land forms of the areas are characterized by moderate to steep sloppy mountainous terrains.

2. The major rock types of the areas are dolomitic limestone and calcareous phyllite. There are also minor areas with quartzite, slate and chert.

3. The areas have temperate and subtropical climate with a hot and wet summer and a rather cool and comparatively dry winter. Monsoon rainfall during May to September accounts for about 80% of the annual rainfall. However, the climate is strongly affected by altitude, and as a consequence substantial differences occur over very short distances.

4. The major river of the watershed is Kali Gandaki originating from the Tibetian highland. The river bed is covered by a low level alluvium consisting of bouldery gravel, sand and silt

5. The study areas are endowed with rich and varied ecosystems and vegetation. Land which is not cultivated consists of open grassland, wooded grassland and secondary forest. In places where the grass is not cut for fodder a densely woodland develops, and often takes the form of a secondary forest dominated by a few large and many small trees. The most dominant trees are *Acacia catechu, Bombax ceiba, Bauhinia variegata, Ficus semicordata, Litsea monopetala*.

6. The watershed area is inhabited by different ethnic tribes which are rich in folk-lore.

Several field trips in and around the study area were undertaken during the years 2005, 2007 and 2008 with a view to document the existing floral diversity and uses of plants and their resources with the indigenous practices. Ethnobotanical information was gathered using various techniques such as open and structured interview, and discussion with local informants, such teachers, experienced village elders, farmers, and workers and by direct observations on the way different plant materials were being collected and used (Joshi and Edington, 1990). The taxonomic identity of the plants was determined using available floras (Bista *et.al*. 2002; DPR, 2001; Polunin and Stainton, 1984; Press *et al,* 2000) and was confirmed comparing collected voucher specimens with those of known identity in the National Herbarium and Botanical Laboratories, Department of Plant Resources, Godavari, Nepal. Voucher specimens are stored in the Department of Botany, Patan Campus. Tribhuvan University, Nepal and Environmental and Biodiversity Research Laboratory, SchEMS, Pokhara University,Nepal.

RESULTS AND DISCUSSION

Vegetation and Floristic diversity

Although the upper reaches of the Kali Gandaki watershed include alpine as well as sub-alpine vegetation types, the study areas contain subtropical vegetation type only and can be categorized into five major sections.

Mixed Hardwood Forest

The mixed hardwood forest is a very wide-spread forest type in the watershed. The major floristic components are *Acacia catechu, Adina cordifolia, Schima wallichii, Bombax ceiba, Terminalia belerica* with a rich moss and fern flora. *Shorea robusta* is sporadic in distribution in the forest. Herbs and grasses are relatively dense in comparison with other forest types. These forests are in degraded conditions due to heavy lopping and tree cutting for fuel wood.

Mixed Hardwood and Pine Forest

This type of forest is found on uphill slopes and ridges in the Kali Gandaki watershed. A few scattered *Pinus roxburghii, P. wallichinna* are found mixed with *Shorea robusta* in the upper elevation and *Acacia catechu, Adina cordifolia, Schima wallichi, Ficus semicordata, Litsea monopetala* in lower elevation. Most parts of the forest are disturbed by human activities.

Shorea forest

The sal forest occurs on steep slopes between 525 - 1000m in the watershed. Patches of pure stands of *Shorea robusta* are dominantin a few areas, mainly in Raniban, Manawa, Harmichur, Guthigaun. The major trees in the forests are *Shorea robusta, Schima wallichi, Adina cordifolia* and *Ficus* spp. trees. Common shrubs and herbs of forest edges are *Woodfordia fruticosa, Artemisia indica, Colebrookia oppositifolia* and *Maesa macrophylla, Biden pilosa, Pennisetum* sp. The sal trees are immature and intensively lopped for fodder.

Acacia forest

Regeneration of pole-size *Acacia catechu* are commonly found on the alluvial coarse materials in the flood plain or at the base of most low-gradient slopes of the watershed. Typically it is found along rivers. In some places, this forest is found mixed with *Adina cordifolia, Bombax ceiba, Ficus* spp and shrubs.

Scrub formation and Grassland

The forests cover which are degraded due to exploitation by the local population of villages represent the secondary formation of vegetation. This vegetation is common on the south and west facing slopes of the study areas.. The dominant shrubs are *Justica adhetoda*, *Woodfordia fruiticosa, Colebrookia opposifolia, Cassia tora, Zizyphus mauritiana.* The grasslands and the wooded grassesslands are dominated by the grasses *Cymbopogon microtheca, Eulaliopsis binata, Hetropogon contortus* and *Chrysopogon gryllus.* In the driest and most rocky places *Eragrostiella bifaria, Pogonatherum crinitum* and *Eriophorum comosum* are dominating. Livestock grazing, firewood collection and cutting of grass and fodder are quite common in these areas.

The overall composition of the floristic elements is greatly affected by changing topography and variable climatic condition. During the survey, 283 species belonging to 200 genera and 99 families were collected (Table 1).

Table 1. Analysis of Floral Elements

Group	Family	Genus	Species
Angiosperms			230
Dicot.	70	141	185
Monocot.	8	30	45
Gymnosperms	1	1	2
Pteridophytes	6	9	20
Bryophytes	4	5	8
Fungi	4	4	9
Algae	6	10	14
Total	99	200	283

The human pressure on these vegetative resources are very heavy except on very steep, almost vertical and inaccessible rock faces near the river. However, the margins of the rivers: Kali Gandaki and Andhi Khola and upper parts of the watershed contain many interesting species.

Enumeration and Traditional Uses of Plants

During the field survey, ethnobotanical information of 156 species of plants belonging to 67 families have been collected from various habitats of the study area (Table 2). This total was made up in the following way: Pteridophytes 5, Gymnosperms 2 and Angiosperms (Dicotyledons 134, Monocotyledons 15). Among the Angiosperms, the family Gramineane was most frequently represented with a total of 12 species, followed by Compositae 8, Rosaceae 7, Moraceae 6, Polygonaceae 5, Fagaceae 5, Euphorbiaceae 5, Amaranthaceae 4, Euphorbiacea 4, Leguminosae 4, Berberidaceae 4, Urticaceae 4, and others with less than 4 species. In Table 2, the collected species are arranged alphabetically with family, local names, habitats, parts used and uses. The analysis of the data indicate that 47 species were used as vegetables. 33 species as fruits, 41 species for fuel, 44 species for raw materials and timber, 64 species for fodder, 16 species as fish poison, 8 species as insecticides, 12 species for basket, mat, bags making, 12 species for religious purposes, 8 species as dyes etc.

Table 2. Traditional uses of plants in Kaligandaki watershed area

Botanical name / Family	**Local name**	**Habitat**	**Parts used and uses**
Acacia catechu (L. f.) Willd. ***Leguminosae***	Khayer	Forest, bank of river	Wood is used for fuel wood and raw materials for house frames, furniture; young leaves are used as fodder.
Achyranthes aspera L. ***Amaranthaceae***	Apamarg, Ulto Kuro	Shady places of forest, open meadow	Twigs are used as a toothbrush in the festival of Teej; ash of the burned plant is used for washing clothes.
Achyranthes bidentata Blume Amaranthaceae	Datiwan, Rato apamarga	Roadside, open places	Stems are used for religious purpose; twigs are used as a toothbrush in the festival of Teej.
Aconogonum molle (D. Don.) Hara Polygonaceae	Thotne	Moist places of forest, open meadow	Tender shoots are used as vegetables and pickles.
Adina cordifolia (Willd. Ex Roxb.) Benth. & Hook. f. ex Brandis Rubiaceae	Karam, Haldu	Forest	Wood is used to make furniture and agricultural tools and for house buildings.
Aegle marmelos (L.) Correa Rutaceae	Bel	Forest	Leaves are used as fodder; aromatic pulp of the ripe fruit is eaten preparing a juice with water; leaves are offered to “Shiva” in religious functions.
Aesandra butyracea (Roxb.) Baehni Sapotaceae	Chiuri	Forest; scrub	Fruits are edible; vegetable butter extracted from the seed is used for lighting lamps.

Agave cantula Roxb. Agavaceae	Ketuki	Wasteland, edges of agricultural lands, roadsides	Fiber extracted from leaves are used in making ropes and strings; plants are also planted on the roadsides in order to check erosion and landslides; squish leaf is spread in water to poison fish.
Allium wallichii Kunth. Amaryllidaceae	Jimbu jhar, Ban lansun	Shady places, forest, open meadow, scrub	Tender leaves are used as vegetables; bulbs and dried leaves are also used as spices in curry, meat and pickles..
Alnus nepalensis D. Don Betulaceae	Uttis	Forest, scrub	Wood is used as firewood and timber for making furniture; leaves are lopped for fodder; plants are planted in eroded areas to check erosion; uses of twinges in mulching or in making green manure are common practices.
Alternanthera sessilis (L) DC Amaranthaceae	Bhringi jhar, Jibre pate	Forest, edges of cultivated field	Tender parts are eaten as vegetables.
Amaranthus spinosus L. Amaranthaceae	Ban lunde, Luran latte	open and sunny places, waste ground	Tender shoots and leaves are consumed as vegetables.
Anaphalis busua (Buch.-Ham. ex D. Don) DC Compositae	Buki phul, Seto ekle ghans	Open areas	Flower head is offered to god and goddess.
Apluda mutica L. Gramineae	Dakle khar	Open places	Plants are used for fodder and for thatching roofs.

Andropogon munroi C.B. Clarke Gramineae	Dakle khar	Rocky places, open areas	Leaves are lopped for fodder; plants are used as hedge.
Artemisia indica Willd Compositae	Titepati	Forest, scrub. Open meadow and agricultural land	Dried shoots are also used as incense during death rites; leaves have insecticidal properties and placed in the mouth of grain bags to protect entrance of moths, bugs and other pests; shoots are used for making compost.
Arundinaria falcate Nees Gramineae	Nigalo	Roadside, edges of cultivated field, open waste land	Young shoots are eaten as vegetables while foliage as fodder; stems are used for making baskets and construction works i.e poles, lining of roof of huts.
Asparagus filicinus. Buch.-Ham. ex D. Don Liliaceae	Kurilo	Shady places	Young shoot is cooked and taken as vegetable.
Bauhinia variegata L. Legumonosae	Koiralo	Forest	Wood is used for house construction and to make house implements; leaves are lopped for fodder; young flowers are cooked as vegetable.
Benthamidia capitata (Wall.) Hara Cornaceae	Dimmar	Forest	Ripe fruits are eaten and are also used for preserved.
Berberis aristata DC Berberidaceae	Chutro, ban chutro	Open hills	Ripe fruits are taken raw; root and stem bark are a source of yellow dye; branches are useful for fields.
Berberis asiatica Roxb. ex DC Berberidaceae	Chutro	Forest, open meadow, trailside	Ripe fruits are eaten fresh; wood is used as firewood and for fencing; root and stem are a source of yellow dye.

Berberis chitria Lindl. Berberidaceae	Chutro	Open meadow or scrub, open areas	Fruits are eaten when they ripe; wood is used as firewood and also for fencing; yellow dye from woody stem is used for dying.
Bidens pilosa L. Compositae	Kaalo kuro, Kurkure	Open waste land	Tender leaves are cooked as vegetables.
Blumea lacera (Burm. F.) DC Compositae	Kurkure	Open meadow and agricultural land	Plant is used to prepare 'madcha', a fermenting cake from which liquor is prepared
Boehmeria rugulosa Wedd. Urticaceae	Dar, githa	Open meadow	Wood is used as timber and raw materials for making good containers while leaves as fodder
Bombax ceiba L. Bombacaceae	Simal	Forest	Wood is used for construction and as raw materials for furniture; stem is used as firewood; floss surrounding seeds is used for stuffing pillow, curtains.
Brassaiopsis hainla (Buch.-Ham ex D. Don) Seem Araliaceae	Hati paila, seto chuletro	Forest, waste land	Leaves are used as fodder
Buddleja asiatica Lour. Loganiaceae	Bhimsen pati	Open sunny place,	Young shoots are offered to god and goddess during religious worships while leaves as fodder; leaves are used as fish poison.
Camellia kissi Wall. Theaceae	Chiyapate, hinguwa	Forest, scrub Moist land	Young leaves are steamed, dried and used as a substitute for tea; flowers are boiled and pickled.

Capsella bursa-pastoris (L.) Medik. Cruciferea	Tori ghans, Chamsure jhaar	Open meadow or scrub,	Tender parts are eaten as vegetable.
Castanopsis indica (Roxb.) Miq. Fagaceae	Dhale katus	Forest and scrub	Leaves are used as fodder; wood is used for fuel and home frames, windows, shutters, furniture; cotyledons of the fruit are consumed as well as used to sell in markets
Castanopsis tribuloides (Sm) A. DC Fagaceae	Sano katus, Musure katus	Forest	Dried cotyledons of the fruit are eaten raw or roasted and used to sell in market; wood is used as firewood and for construction purposes i.e. home frames, windows, shutters; leaves are lopped for fodder.
Centella asiatica (L) Urban Umbelliferae	Ghortapre	Moist places	Plant is cooked as vegetable; leaves are used as fodder.
Chenopodium album L. Chenopodiaceae	Bethe saag	cultivated fields, , wastelands	Tender shoots are cooked as vegetable.
Chrysopogon gryllus (L.) Trin. Gramineae	Patapate khar	Waste land, forest, cultivated areas	Plant is used as fodder
Cinnamomum tamala (Buch.-Ham.) Nees & Eberm. Lauraceae	Dalchini, Tejpat	Forest	Bark and leaves are used as spices in curries, meats and vegetable and picked.
Colobrookea oppositifolia Smith Labiatae	Bhogate, Dhusure	Scrub, forest	Plant is lopped for fodder; dried branches are collected for fuel; inflorescence is sold in market for worshiping.

Colquhounia coccinea Wall. Labiatae	Sano tusare	Rocky places	Leaves and flowers are used in incense.
Commelina benghalensis L. Commelinaceae	Ban kane	Moist	Young leaves are eaten as vegetable.
Coriaria nepalensis Wall. Coriariaceae	Machaaino Bhojinsi	Forest	Ripe fruits are eaten fresh; leaves are used to stupefy fish; branches are used for making baskets.
Cynodon dactylon (L.) Pers ***Gramineae***	Dubo	Forest, scrub, open meadow	Shoots are collected for fodder; leaves are used in rituals and religious purposes.
Cyperus rotundus L. ***Cyperaceae***	Kasur, Mothe	Moist places	Tubers are eaten fresh.
Debregeasia longifolia (Burm.f.) Wedd. Urticaceae	Tusare	Bank of stream	Wood is used for fuel; stem bark yields a strong fiber and used for making ropes.
Dendrocalamus hamiltonii Nees ex Arn. ex Munro Gramineae	Tama bans, Chya bans	Forest, waste land, edges of cultivated field	Foliage is used as fodder; young sprouts are used as food; culms are used as beams, poles and as raw materials for mats, baskets etc.; waste are utilized as firewood.
Dendroclamus strictus (Roxb.) Nees Gramineae	Taru bans, Lathi bans	Forest, edges of cultivated field	Foliage is used as fodder; culms are used as water pipes, beams, poles and as raw materials for mats, baskets etc., branches and waste culm materials used as firewood.
Datura stramonium L. Solanaceae	Kalo dhaturo	Waste land, roadside	Leaves are used as green manure.

Diplazium stoliczkae Bedd. Woodsiaceae	Kalo neuro	Forest, pathside	Tender shoots are eaten as delicious vegetable.
Dioscorea bulbifera L. Dioscoreaceae	Githa	Forest	Underground tubers are boiled and eaten.
Dioscorea deltoidea Wall. Ex Griseb. Dioscoreaceae	bhyakur	Moist open places	Tuberous roots are consumed as substitute of food after through boiling or cooking.
Dryopteris cochleata (Ham. ex D. Don.) C. Christesen Dryopteridaceae	Danthe nyuro	Moist places	Tender shoots and fronds are cooked as vegetable.
Drymaria cordata (L.) Willd. ex Roem. & Schult Caryophyllaceae	Abhijaalo	Forest	Tender leaves and shoots are cooked as vegetable.
Duranta repens L. Verbenaceae	Nil kanda	Agricultural land, garden	Plants are grown as a hedgerow
Edgeworthia gardneri (Wall.) Meisn. Thymelaeaceae	Argeli	Forest, scrub	Bark and leaf are used as fish poison; bark is used to prepare Nepali handmade paper
Elaeagnus infundibularis Momiy. Elaeagnaceae	Madilo	Forests	Ripe fruit are eaten fresh; branches are used as fuel.
Engelhardia spicata Lesch. ex Blume Juglandaceae	Mauwa	Forest, scrub, cultivated field	Leaves are valued as green manure; young leaves are used as fish poison

Eulaliopsis binata (Retz.) C.E.Hubbard Gramineae	Babiyo	Forest	Long needle like leaves are used in making ropes and strings
Euphorbia royleana Boiss. Euphorbiaceae	Siudi	Open dry places	Plant juice is applied to stupefy fish.
Eurya acuminata DC Theaceae	Jhingane	Open and dry places, forest	Leaves are lopped for fodder, while wood as fuel.
Eupatorium adenophorum Spreng Compositae	Banmara	Shrubby and open dry places,	Plants are used as green manure; young shoot is used as fodder.
Ficus bengalensis L. Moraceae	Bar	Roadsides	Leaves are lopped as fodder; ripe receptacles are eaten by village children; plant is planted for a religious purposes; wood is used as poles and for making furniture.
Ficus benjamina L. Moraceae	Sami	Forest	Leaves are used as fodder
Ficus hispida L. f. Moraceae	Khasreto	Roadsides, bushes and thickets	Leaves are lopped for as fodder
Ficus religiosa L. Moraceae	Pipal	Roadsides,	Plant is held sacred by Hindu and Buddhist and worshiped; leaves are used as fodder.
Ficus semicordata Buch.-Ham. ex Sm. Moraceae	Khanyu	Forest,	Leaves are lopped for fodder; ripe figs are edible.

Fimbristylis miliacea (L.) Vahl. Cyperaceae	Jwane jhar	Open places	Leaves are lopped for fodder.
Fragaria nubicola Lindley ex Lacaita Rosaceae	Bhuin ainselu	Forest, open grassland	Fruits are eaten fresh.
Guizotia abyssinica (L.f.) Cass. Compositae	Jhuse til	Open space	Seed oil is used in cooking.
Gaultheria fragrantissima Wall. Ericaceae	Dhasingare	Forest, shady place,	Ripe fruits are eaten without seeds and also prepare local wine from them; leaves are lopped for fodder
Girardinia diversifolia (Link) Friis Urticaceae	Allo	Wasteland and edges of cultivated field	Young tender leaves and inflorescence are cooked as vegetable; fibers are obtained from the stem bark and used to prepare coarse clothes, ropes etc.
Garuga pinnata Roxb. Burseraceae	Dabdabe	Forest	Fruit is eaten fresh or pickled; Wood is utilized for home frames, poles, furniture, firewood, handle of axes and sticks; bark yields a fiber used for rope; leaves are lopped for e fodder.
Hedera nepalensis K. Koch Araliaceae	Dudhilo	Moist	Plant is used as fodder.
Hibiscus sabdariffa L. Malvaceae	Patuwaa	Open places	Young leaves are used as vegetables.

Houttuynia cordata Thunberg Saururaceae	Gande	Moist shady places	Tender parts are consumed as vegetable.
Holboellia latifolia Wall. Lardizabalaceae	Guphala	Shady places	Ripe fruits are eaten fresh.
Hypericum cordifolium Choisy Hypericaceae	Mali phul	Open spaces	Flowers are offered during the religious functions.
Imperata cylindrica (L) P. Beauv. Gramineae	Siru	Weed	Plants are used for thatching roofs and as also fodder.
Indigofera pulchella Roxb. Leguminosae	Raato mirmire	Open dry	Flowers are either pickled or eaten as vegetable.
Inula cappa (Buch.-Ham. Ex D. Don.) DC Compositae	Gaitihare	Forest, scrub	Shoots are used as fodder; Plant is used to make 'marcha', a fermenting cake for which liquor is distilled.
Justicia adhatoda L. Acanthaceae	Asuro	Open	Leaves are mixed with manure to keep harmful insects away from the field; used for making compost.
Kalanchoe spathulata DC Crassulaceae	Ajamaari jhar	Dry sandy places	Leaves have insecticidal properties and are used to keep away insects.
Lagerstroemia parviflora Roxb. Lythraceae	Bot dhaiyaaro	Forest	Wood is used for fuel, agricultural tools and construction while leaves as fodder.

Lindera pulcherrima (Nees) Benth. ex Hook. f. Lauraceae	Phusuro	Forest	Ripe fruits are eaten without seeds; wood is utilized for fuel while leaves fodder.
Litsea monopetala (Roxb.) Pers. Lauraceae	Kutmiro	Forest	Leaves are used as fodder; branches are used for fuel.
Lycopodium japonicum Thunb. ex A. Murray Lycopodiaceae	Nagbeli	Forest	Plants are used for decoration of gates during the function.
Lyonia ovalifolia (Wall.) Drude Ericaceae	Angeri	Forest,	Wood is used as fuel, timber and raw materials for carpentry, while leaves are used as fodder; leaves are also used as insect repellent; young leaves are used for fish poisoning.
Macaranga pustulata King ex Hook. f. Euphorbiaceae	Banare	Open areas	Leaves are used as plate for wrapping for foodstuffs; wood is used for fuel; leaves are lopped for fodder.
Maclura cochinchinensis (Lour.) Corner Moraceae	Amali, Damaru	Forest	Ripe fruits are eaten fresh.
Mangifera indica L Anacardiaceae	Aamp	Forests, Cultivated areas	Ripe fruit is eaten; wood is used as raw materials for construction.
Mahonia napaulensis DC Berberidaceae	Jamanemandro	Forest	Ripe fruits are eaten raw; bark yields a dye.
Melia azedarach L. Meliaceae	Bakaino	Cultivated field, scrub, forest	Leaves are used as fodder; wood is used for fuelwood, and construction i.e. doors, frames, bed and to make the handles of agricultural tools;

			dried fruits, stem, bark and leaves are largely employed to protect woolen fabrics from insect attacks; fruits are used as fish poison.
Michelia kisopa Buch.-Ham ex DC Magnoliaceae	Seto champ	Forest	Wood is used as timber and fuelwood while leaves as fodder.
Maesa chisia Buch-Ham ex D. Don Myrsinaceae	Bilaune	Shady places	Plant is lopped for fodder; root and bark are used as fish poison; twigs are used as fuel; bark, root and leaves are used as insecticides.
Mimosa rubicaulis Lam. Leguminosae	Areri kanda	Forest, scrub, open place,	Plant is used as fodder.
Myrica esculenta Buch.-Ham ex D. Don. Myricaceae	Kaphal	Forest, cultivated fields	Ripe fruits are eaten as well as used to sell in markets; wood is used for fuel; leaves are lopped for fodder; bark decoction is used for stupefying fish.
Myrsine capitellata Wall Myrsinaceae	Bakal pate Phalane kath	Forest and scrub	Leaves are gathered for fodder; ripe fruit is edible.
Myrsine semiserrata Wall. Myrsinaceae	Phalame	Forest, open hill	Wood and twigs are used as fuel and for construction; leaves are used as fodder.
Nephrolepis cordifolia (L.) K. Presl Nephrolepidaceae	Panisaro, Pani amala	Shady places	Fleshy root tubers are eaten by village children.

Osyris wightiana Wall. Ex Wight Santalaceae	Nundhiki	Forest	Young leaves are used as substitute of tea
Oxalis corniculata L. Oxalidaceae	Chari amilo	Waste ground, roadsides, cultivated field,	Leaves are eaten raw; plant is used as fodder.
Persicaria barbata (L) Hara Polygonaceae	Pire Khursani jhar	Riverside, moist place, forest	Tender shoots and leaves are cooked as vegetable; plant is used as fish poison.
Persicaria hydropiper (L.) Spach. Polygonaceae	Pire jhar	Moist places	Crushed plants are thrown in the water course for killing fish; plants are also used as insecticides
Phyllanthus emblica L. Euphorbiaceae	Amala	Forest, scrub	Fruit is eaten fresh or pickled.
Pilea symmeria Wedd. Urticaceae	Gagaleto, Chiple	Crivas of rock in moist places	Tender shoot and leaves are cooked as a vegetable.
Pinus wallichiana A. B. Jackson Pinaceae	Gobre sallo	Forest	Wood is used as fuel wood, timber and raw materials for construction works; needles are used for making compost; resin is used ad raw material for soap, waxes and grease; dark brown dye from the stem is used for coloring cloth, mats .
Pinus roxburghii Sarg. Pinaceae	Rani salla	Forest, dry places	Wood is used as timber, firewood and resin is used as raw material for soap, needles are used for cattle bed; seeds are roasted and eaten.

Plantago major L. Plantaginaceae	Esapgol	Open moist place, roadside,	Tender vegetative parts are eaten as vegetable.
Phragmites karka (Retz.) Trin. ex Steudel Gramineae	Narkat	Roadside, cultivated field,	Leaves and young shoot are used as fodder.
Polystichum squarrosum (D. Don) Fee. Dryopteridaceae	Phusre neuro, thulo neuro	Shady and exposed areas, forest	Tender parts are eaten as vegetable.
Premna barbata Wall. Ex Schaur Verbenaceae	Gineri	Forest, shady places	Plant is lopped for fodder; bark fiber is made into coarse twigs.
Prinsepia utilis Royle Rosaceae	Dhatelo	Dry slopes, shady places, forest	Fruits are eaten by children; plant is used for making fence; oil from seeds are used for lighting; wood is used as firewood.
Prunus cerasoides D. Don Rosaceae	Paiyun, ban paiyun	Forest, open places	Branches are used for making walking sticks; seeds are made into rosaries and necklaces; ripe fruits are edible, plant is lopped for fodder,
Prunus napaulensis (Seringe) Steud. Rosaceae	Jungali aaru, aaru pate	Forest, scrub	Fruits are eaten without seeds; wood is used as firewood and for construction as timber.
Psidium guajane L. Myrtaceae	Amba	Forest, cultivated field	Ripe fruit is eaten raw.
Pyrus pashia Buch.-Ham. Ex D. Don Rosaceae	Mayal	Open shady places, forest	Ripe fruits are edible; leaves and twigs are lopped for fodder; wood is used as fuel and agricultural tools.

Quercus glauca Thunb. Fagaceae	Phalat	Forest	Wood is mainly used for fuel and construction; leaves are used as fodder.
Quercus lanata Sm. Fagaceae	Banjh	Forest	Leaves are used as fodder; wood is used for fuel and as timber for house frames, poles, furniture, agricultural implements.
Quercus semicarpifolia Sm. Fagaceae	Kharsu, Khasru	Forest,	Wood is used as timber and fuel wood; stump is used for making charcoal; leaves are lopped for fodder
Rheum australe D. Don. Polygonaceae	Chulthi amilo, Padamchal	Open slopes, forest	Petals are picked after drying.
Rhododendron arboretum Smith Ericaceae	Laligurans	Forest	Wood is used as firewood and for making charcoal and as timber; wood is also used to prepare household utensils; immature leaves are used as fish poison; leaves are lopped for fodder; flowers are eaten raw by the children; flowers are also offered to god and goddess.
Rhus javanica L. Anacardaceae	Bhaki amilo, dudhe bhalayo, chuk amilo	Forest, open places	Fruits are eaten raw or pickled; plant is used as fodder and fuel.
Ricinus communis L. Euphorbiaceae	Ander, Andi	Wasteland	Crushed leaves and seeds are used as fish poison
Rorippa nasturtium-aquaticum (L) Hayek Cruciferae	Sim saag	Damp places, bank of river	Tender vegetative portions are cooked as vegetable

Rubia manjith Roxb. Ex Fleming Rubiaceae	Majitho	Forest	Root and stem are used for red dye.
Rubus ellipticus Smith Rosaceae	Ainselu	Open place	Ripe fruits are eaten fresh and sold in the markets.
Rubus foliolosus D. Don. Rosaceae	Kalo ainselu	Forest, open place	Ripe fruits are eaten.
Rubus paniculatus Smith Rosaceae	Kalo ainselu, Bhalu ainselu	Exposed shady place, forest, scrub	Ripe fruits are eaten raw.
Rumex nepalensis Spreng. Polygonaceae	Halhale	Wasteland, roadsides, scrub	tender leaves and shoots are eaten as vegetable.
Salix babylonica L. Salicaceae	Bains, Tissi	Riverside, forest	Leaves are used as fodder; wood is used as fuel wood; plants are planted to conserve the river bank.
Sarcococca hookeriana Baillon Buxaceae	Chilekath	Forest, scrub	Leaves are used as fodder while wood as firewood and timber.
Sambucus adnata Wall. Ex DC. Sambucaceae	Moti phul	Open places	Flowers are offered to god and goddess.
Saurauia napaulensis DC Saurauiaceae	Gogane	Open places	Leaves and twigs are lopped for fodder; ripe fruits are edible.

Schima wallichii (DC.) Korth. Theaceae	Chilaune	Forest, Open places	Wood is used as firewood and for carpentry; leaves are lopped for fodder and making compost; bark is used for dyeing; pounded bark and fruits are employed to stupefy fish.
Scurrula elata (Edgeworth) Danser Loranthaceae	Ainjero	Forest	Ripe fruits are eaten,
Scutellaria repens Buch. – Ham. ex D. Don Labiatae	Chaarpate	Open areas, rock crevices	Tender shoots and leaves are cooked as vegetable.
Setaria pallidefusca (Schumach.) Stapf. & C.E. Hubbard Gramineae	Golphuki	Open rocky soil	Leaves are used as fodder.
Shorea robusta Gaertn. Dipterocarpaceae	Sal, Agarth	Forest	Roasted seeds are eaten; wood is utilized as timber and firewood; leaves are lopped for fodder and also used as leaves plate for wrapping.
Smilax aspera L. Liliaceae	Syal daino	Forest, moist places	Tender shoots and leaves are cooked as vegetable.
Solanum nigrum L. Solanaceae	Jungali bihi, Kaalo bihi	open place, wasteland,	Ripe fruits are eaten by village children.
Sonchus oleraceus L. Compositae	Dudhe kandaa	Forest, moist places	Young vegetative parts are eaten as vegetable
Stellaria monosperma Buch.-Ham. ex D. Don Carryophyllaceae	Jethmadhu	Moist shady places, forest	Tender shoots and leaves are cooked as a vegetable

Symplocos sumuntia Buch-Ham ex D. Don Symplocaceae	Hakulal	Forest	wood is used to make handles of tools and agricultural implements, and as timber, fuel; leaves are lopped for fodder.
Symplocos theifolia D. Don Symplocaceae	Ghole, Hakulal	Forest	Branches are used as raw material to prepare household utensils and as fuel.
Syzygium cumini (L) Skeels Myrtaceae	Jamun	Open places	Ripe fruits are eaten fresh and sold in market.; wood is utilized for furniture, handles of agricultural implements, tools, household utensils, fuel wood
Talauma hodgsonii Hook f. & Thoms. Magnoliaceae	Bhalu kath	Forest	Leaves are lopped for fodder; wood is used for handle of Khukuri (Nepalese knife) and as fuelwood
Terminalia alata Heyne ex Roth Combretaceae	Asnaa, Saaj	Forest	Plants are used as fodder; wood is used as timber, fuelwood and for making charcoal
Terminalia bellirica (Gaertn,) Roxb. Combretaceae	Barro	Forest	Kernals of the fruits are edible; bark used for dye; leaves are lopped for fodder; wood as fuel wood and timber for construction and agricultural implements.
Terminalia chebula Retzius Combritaceae	Harro	Forest	Kernels of the fruits are edible; wood is used for construction, agricultural implements, furniture, and other domestic purpose; leaves are lopped for fodder.
Thysanolaena maxima (Roxb.) Kuntze Gramineae	Amreso	Forest, cultivated area, open rocky places	Inflorescence is used for brooms and sell in market.

Trichilia connaroides (Wight & Arn.) Bentvelzen Meliaceae	Aankha taruwa		Wood is used for fuel.
Urena lobata L. Malvaceae	Nalu kuro	Weed	Bark provides a good fiber for making ropes and twine
Urtica dioica L. Urticaceae	Sisnu	Scrub, wasteland, roadside	Young leafy parts are collected in the time of scarcity and are cooked as vegetable; stem fiber is used to make ropes
Vitex negundo L. Verbenaceae	Simali	Forest	Branches are used as toothbrushes, branches are made into brooms.
Woodfordia fruticosa (L) Kurz Lythraceae	Dhaero, Amar phul	Forest, dry places	Flowers have red dye which is used for dyeing the clothes; plants are used for fuel
Zanthoxylum acanthopodium DC Rutaceae	Jangali Timur, Bhote timur,	Forest, rocky places	Dried fruits with seeds are used for flavoring foodstuffs , fresh fruits are picked.
Zanthoxylum armatum DC Rutaceae	Timur, Bhale Timur	Forest	Fresh fruits are pickled and used as spices in vegetable and pickles; paste of the fruit is mixed with water and spread on vegetables as an insecticides; fresh bark is used as fish poison.
Zizyphus mauritiana Lam. Rhamnaceae	Hadebayer	Scrub, dry land, open areas	Fruits are eaten fresh and also dried for selling; wood is used to make handles of tools and agricultural implements, and as fuel; leaves are lopped for fodder.

Inventory and Documentation of the useful species with Indigenous knowledge and Practices

The ecosystems of the watershed are rich in biodiversity with various useful species due to its environmental characteristics of the Kali Gandaki watershed. Moreover, the people of the studied villages have also developed unique indigenous knowledge related to the uses of plant resources due to constant association with the forests and agricultural ecosystems. During the present study, it was also recorded that some plants are not only utilize to cure diseases, but also use for the fulfillment of domestic needs of the people. For example, juice of leaves is drunk twice a day for five consecutive days to treat bronchitis (Joshi and Joshi, 2000), whereas leaves of same species are mixed with manure to keep harmful insects away from the field. These existing valuable information are needed to be documented before lost or disappeared. As there is absent of the documentation system in this areas, priority should be given to develop a system to document the valuable ethnobotanical species, their habitats, uses, and knowledge and practices relating to the uses of plants. It is strongly recommended that major thrust should also be given to a chemical screening of the species.

Income generation, and People participation

Plant resources are the major sources of income in the watershed. The local people used to collect and sell non-wood forest products to the traders and in market. Though the exact data on trade of the parts of the useful plants is not available, the existing local information indicate that every year large amount of drugs, and other plant-based raw materials are exported from this watershed. The already exporting species and other potential useful species can be scientifically cultivated and managed in the studied areas. It is obvious that the success and sustainability of the management activities depend upon the involvement of the local people. Emphasis should be given to initiate a special program for raising people's awareness as well as or the domestication, conservation and sustainable management of species.

Resource depletion and conservation aspects

At present, various activities related to land use change are under implementation near the Mirmi village and in the bank of Kali Gandaki and Adhi Khola rivers.. Some of plants such as *Berberis* sp., *Melia azederach* ,*Terminalia bellirica, Terminalia chebula* are already in the list of threatened species of Nepal (HMG/MFSC, 2002; Manandhar, 2002; Joshi and Joshi, 2005)**.** When questioned about the changing status of plants of the kali gandaki watershed, the respondents listed some useful species such as *Portulaca oleraceae, Potentilla flugens, Zanthoxylum armatum,*which had also declined in abundance during the last decade. Hence, efforts should be directed to investigate the status of the useful species and their habitats and to initiate the conservation of plants and habitats.

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