Floristic Diversity in the Lake Cluster of Pokhara Valley, Central Nepal

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ABSTRACT

Wetlands support exceptionally high biodiversity and provide valuable ecosystem services, yet they are among the most threatened habitats due to anthropogenic activities. Conservation and management planning of wetlands requires, among others, a comprehensive floristic account. In this study, we prepared a checklist of the flowering plants found in the wetlands of the Lake Cluster of Pokhara Valley (LCPV), a Ramsar site of Nepal, located in a rapidly urbanizing capital city of Gandaki Province in Central Nepal. Voucher specimens were collected from the study sites through multiple visits during the monsoon (June-August) and autumn (September-November) seasons. Species were categorized based on their life forms (Raunkiaer's classification) and native distribution range (native, naturalized, invasive). Ethno-botanical uses of the plant species were compiled from the published literature. We identified 230 plant species belonging to 70 families and 177 genera. Asteraceae (25 species), Poaceae (22 species), Fabaceae (18 species), Cyperaceae (16 species), and Lamiaceae (11 species) were species-rich families. Therophytes (30%) were the dominant life form followed by Hemicryptophytes (27%). Among 230 species, 183 species were native and 47 species naturalized; among the naturalized species, 21 species were invasive. Most of the plant species (61%) have medicinal values while others have food (24%) and fodder values (13%).

Keywords: invasive alien species, Ramsar site, Raunkiaer's life form, wetland flora

INTRODUCTION

Wetlands are areas of marsh, fen, peatland, or sea, whether natural or artificial, permanent or temporary, with fresh, brackish, or saltwater that is stagnant or flowing, including areas of marine water not exceeding six meters in depth at low tide (Ramsar Convention Secretariat, 2013). Wetlands are also called nature's supermarkets as they provide diverse goods and services to mankind and kidney of nature as they purify and filter water (Mandal & Mukherjee, 2012). For example, 21ethnic communities out of 101 in Nepal depend on wetland resources for their subsistence (Lamsal *et al.,* 2014). Wetlands are among the most productive life support systems in the world which are also immensely important for mankind as they provide humanity the freshwater supply, food and construction materials, and biodiversity, flood control, groundwater recharge, and climate change mitigation(Halls, 1997, https://www.ramsar.org). Wetlands that are the habitat of threatened species and provide valuable ecosystem services are designated as a Ramsar site under the Ramsar Convention on Wetlands (https://www.ramsar.org/). There are over 2400 Ramsar sites in the world including 10 sites in Nepal. The total area covered by all Ramsar sites in the world exceeds 2.5 million square kilometers (https://www.ramsar.org/about/wetlands-of-international-importance-ramsar-sites). Ramsar sites in Nepal occupy 605.61 square kilometers (MoFE, 2018a).

Wetlands support exceptionally high biodiversity and provide habitats to both water and land organisms (Denny, 1994). Floral diversity constitute a major resource in wetlands. A prerequisite to understanding the ecosystem type and biodiversity pattern of the region is a knowledge of the floral diversity of any region (Singh *et al.,* 2017). Such floristic data will be useful for tracking changes in the pattern of vegetation in the future. In Nepal, the analysis of wetland flora is limited. A specific gap exists for the floristic studies in LCPV. Ethno-botanical studies of plants and plant products are essential for proper management of plant resources, in addition to the flora research (Cunningham, 2001).

Lake Cluster of Pokhara Valley (LCPV) is the most recently declared Ramsar site of Nepal (MoFE, 2018b). The LCPV includes nine lakes located in Pokhara Metropolitan, a rapidly urbanizing city of touristic attraction in Central Nepal. This study was carried out to prepare a checklist of the flowering plants found in the LCPV and analyzes their

taxonomic diversity, life forms, biogeographic status, and ethnobotanical uses. The results of this study are useful for the management and conservation planning of the LCPV.

Study area

The study was carried out in the Lake Cluster of Pokhara Valley (LCPV) which includes nine lakes located within Pokhara Metropolitan City, central Nepal (fig. 1). The Valley is located between 27˚55'-28˚23' N latitude and 83˚48'-84˚11' E longitude, with an area of 133.41 sq. km in Pokhara Metropolitan City (Shrestha & Kshetri, 2008). Pokhara is one of the most popular tourist destinations in Nepal, and a provincial capital of Gandaki Province. Of the nine lakes (table. 1), Phewa, Begnas, Rupa, and Deepang are visited by tourists frequently for natural beauty, fishing, and boating. The lakes and other water bodies are important sources of drinking water, fishery, irrigation, and hydropower (MoFE, 2018b). Besides they provide recreational, religious, spiritual, and inspirational values to local people and tourists.

Table 1. General information on the Lake Cluster of Pokhara Valley (MoFE, 2018b).

SN	Attributes	Phewa	Begnas	Rupa	Dipang	Maidi	Kamal pokhari	Gunde	Neureni	Khaste
1	Ward number	6	31	33	27	28	13	26	26	26
2	Area occupied by water (Km^2)	4.33	3.13	1.11	0.14	0.007	0.013	0.08	0.027	0.13
3	Catchment area (Km^2)	119.39	18.6	26.02	2.39	1.6	1.35	0.61	0.18	2.69
4	Lowest elevation (m asl)	763	647	580	687	672	822	741	742	739

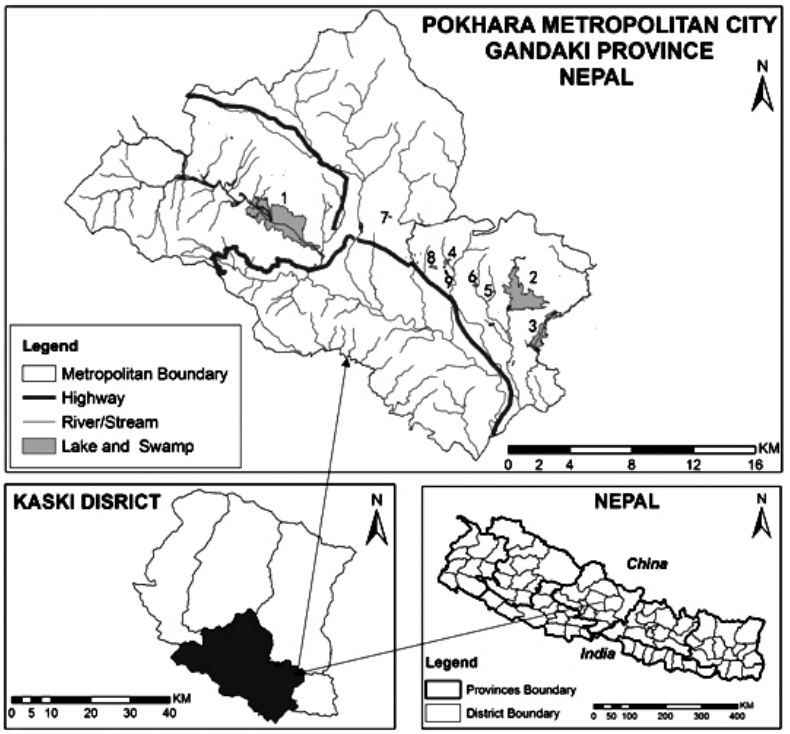

Fig.1. Lake Cluster of Pokhara Valley, Kaski District, Gandaki Province, Nepal. (Numerical values in Pokhara Metropolitan City map represent different lakes: 1. Phewa, 2. Begnas, 3. Rupa, 4. Khaste, 5. Maidi, 6. Deepang, 7. Kamalpokhari, 8. Gunde, 9. Niureni).

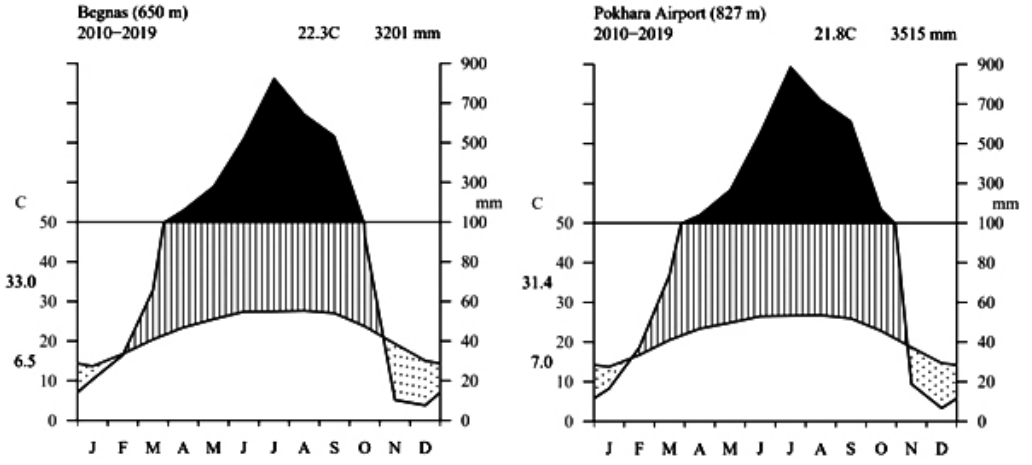

Fig.2. Ombrothermic diagram of the climatic data between2010 to 2019 at Begnas and Pokhara airport.

Pokhara Valley lies in a subtropical region dominated by *Schima-Castanopsis* vegetation, while small patches of the riverine forest dominated by *Acacia catechu, Alnus nepalensis, Pandanus furcatus* are also found in the gorges of Seti and other associated rivers. The minimum temperature was recorded at 6.5ºC at the Begnas weather station and 7ºC at the Pokhara airport. Similarly, the maximum temperature recorded at Begnas was 33ºC and 31.4 ºC at the airport. The mean annual temperatures were 22.3ºC and 21.8ºC, respectively at Begnas andthe airport. Similarly, average annual precipitation was 3201 mm and 3515 mm at Begnas and Pokhara airport respectively (fig. 2). Dry periods are from mid-November to mid-February and the wet periods from mid-February to mid-November. The extreme wet periods extend between March to October and peak in June/July.

METERIALS AND METHODS

Specimen collection and identification

Lakes of LCPV were visited for six times from June 2018 to December 2020, representing two different seasons: monsoon (June-August) and autumn (September-November) because they are the peak flowering seasons of the wetland flora. Voucher specimens of flowering plant species were collected along the shore, inside the lakes, and around the lakes. The free-floating and submerged species growing within the territory of the lakeshore were collected following Haynes (1974). The collected specimens were pressed and dried using newspaper and herbarium pressure. The prepared specimens were identified consulting regional and national floras (Grierson & Long, 1983-2001; Wu *et al.,* 1994-2008; Watson *et al.*, 2011). During the identification process, the collected samples were also cross-checked with the specimens available at the National Herbarium and Plant Laboratories (KATH) and Tribhuvan University Central Herbarium (TUCH). For some doubtful species, expert views were also considered. The nomenclature of the families followed APG-IV (Angiosperm Phylogeny Group, version IV) (Chase *et al*., 2016), while the nomenclature of the genera and species followed Roskov *et al.* (2020). Identified specimens were deposited in TUCH and KATH.

Species categorization and ethnobotanical use

Habits of the species (herb, shrub or tree;annual or perennial) were determined based on field observations of the flora (Grierson & Long, 1983-2001, Wu *et al.*, 1994-2008, Watson *et al*., 2011). The life forms of the identified species were classified following

Raunkiaer's classification as Phanerophytes (Perennating buds from aerial parts more than 2m from the soil surface), Chamaephytes (Perennating buds on aerial parts less than 2m from the soil surface), Hemicryptophytes (Buds at ground level), Cryptophytes (Buds below ground or water), and Therophytes (Plants that survive unfavourable conditions as seeds) (Kent, 2012). The native ranges were extracted from Wu *et al*. (1994-2008) and Plants of the World Online (2020) (http://www.plantsoftheworldonline.org/); for some species with uncertain native range, experts' advice was also solicited. Continents (e.g. Europe, Americas) of the native distribution range of the naturalized alien species were identified. Some of the naturalized alien species were categorized as 'invasive' following the list of invasive alien plants of Nepal by Shrestha (2019). International Union for Conservation of Nature (IUCN) threatened categories were identified for each species (www.iucnredlist.org). The collected plant species were compared with the list of species reported by the Ministry of Forests and environment (MoFE, 2018b) from the LCPV. Ethnobotanical uses of the collected plant species in Nepal were obtained from the following references: Manandhar (2002), Sah *et al* .(2002), Bishokarma *et al.* (2005), Baral & Kurmi (2006), Acharya (2009), Joshi & Joshi (2009), Kunwar *et al.* (2010), Niroula & Singh (2011), Lamsal *et al.* (2014), Kunwar *et al.* (2015), Adhikari *et al.* (2019), Budha-Magar *et al.* (2020), Bhatt & Kunwar, (2020), and Sharma *et al.* (2020). Uses of the plant species were grouped into the following categories: medicines, food, forage, fodder, fiber yielders, rituals plants, fish poisons, timber yielders, fuel-woods, ornamentals, dye yielders, construction materials, green manures, hedge plants, tannin yielders, soaping agents and fermenting agents. Use percent was calculated by dividing the number of times the plant used (e.g. as medicine) by total plant species enumerated (e.g. 216) multiplied by hundred. Due to multiple uses of single plant species, a sum of the percentage values of the different use categories was more than 100%.

RESULTS AND DISCUSSION

Altogether 230 flowering plant species were collected belonging to 177 genera and 70 families from the LCPV (Appendix I). Among them, 168 species were dicots and 62 species monocots. Out of 177 genera, 34 genera had two or more than two species while the rest of others was represented by a single species. Asteraceae (25 species), Poaceae (22 species), Fabaceae (18 species), Cyperaceae (16 species) and Lamiaceae (11 species) were the species-rich families (table 2). Analysis of the floristic composition

of the LCPV revealed Asteraceae and Poaceaeae as the dominant families, which agree with the general floral composition of Nepal (Press *et al.,* 2000). Poaceae was also reported as a dominant family in the wetlands of other parts of Nepal (e.g. Chitwan by Dangol *et al*., 2014). In Nepal, the analysis of wetland flora is limited. Sah *et al.* (2002) reported altogether 401 plant species belonging to 264 genera under 84 families from the Ghodaghodi lake area. Altogether 115 species belonging to 45 families were recorded from the wetland flora of Rupandehi district (Sharma *et al.,* 2019). A total of 108 plant species were recorded from the wetland and periphery of Raja-Rani Tal, Morang (Sharma *et al.,* 2020). Dangol *et al.* (2014) documented 117 plant species belonging to 39 families and 92 generain the area of Rampurghol, Chitwan. Compared to the list of 436 plant species reported in the management plan of the LCPV (MoFE, 2018b), this research revealed the presence of 155 additional plant species suggesting that previous floristic studies of the LCPV are far from complete.Regarding habits, 167 species were herbs, 38 shrubs and 25 trees. Out of the total, 76 were annuals and 154 perennials.

Table 2. Number of species recorded from the Lake Cluster of Pokhara Valley that belong to different families.

S.N.	Family	Number of species
1.	Asteraceae	25
2.	Poaceae	22
3.	Fabaceae	18
4.	Cyperaceae	16
5.	Lamiaceae	11
6.	Polygonaceae, Rubiaceae	8
7.	Malvaceae	6
8.	Acanthaceae, Euphorbiaceae, Moraceae, Orchidaceae	5
9.	Amaranthaceae, Commelinaceae, Rosaceae, Solanaceae, Urticaceae	4
10.	Hypericaceae, Phyllanthaceae,	3
11.	Apocynaceae, Araceae, Boraginaceae, Caryophyllaceae, Convolvulaceae, Dioscoreaceae, Fagaceae, Lauraceae, Linderniaceae, Lythraceae, Melastomataceae, Myrtaceae, Oleaceae, Onagraceae, Oxalidaceae, Plantaginaceae, Pontederiaceae, Primulaceae, Vitaceae	2
12	Remaining 32 families	1

The IUCN red list category of the plant species were attempted to find. Out of the 230 species, 67 plant species were under the Least Concern category and the rest of the others(163 species) were not assessed to any threat category. None of the plants were government protected. However, the ecosystems maintained by these plant species are the habitat of several threatened animal species (MoFE, 2018b).

The majority of the species were native (183 species) while 47 species were naturalized alien species. Out of them, 21 naturalized species were invasive (table 3). Though the flora of LCPV was dominated by the native species, the presence of naturalized species contributing to one-fifth of the total flora recorded during the present study could not be underestimated. Furthermore, globally worst invasive species such as *Eicchornia crassipes, Chromolaena odorata, Lantana camara* and *Mikania micrantha* (Lowe *et al.,* 2000) had already invaded LCPV. The majority of the naturalized species (81%) and all of the invasive alien species were native of the Americas (fig. 3, table 3). The dominance of the American native plant species in the naturalized flora has been also reported at the national level (Bhattarai *et al.,* 2012).

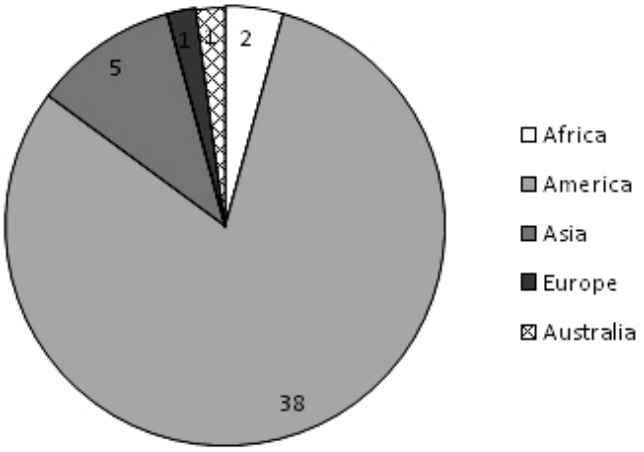

Fig. 3. Number of naturalized species with their place of origin.

Table 3. Floristic diversity of invasive alien plant species in Lake Cluster of Pokhara Valley.RC- Raunkiaers life form classification: He-hemicryptophyte, Ch-Chemaephytes, Th-Therophyte, Cr-Cryptophyte, Ph-Phanerophyte; Uses: Me-Medicine, Fr-forage, Fd-fodder, Gm-green manure.

SN	Latin name	Family	Native range	Collection sites	RC	Herb (H)/ Shrub S)	Annual (A)/ Perennialn (P)	Uses	References for uses
1	*Ageratina adenophora* (Spreng.) R.M.King & H.Rob.	Asteraceae	Mexico	Rupa	Ch	H	P	Me	Acharya (2009), Adhikari *et al.* (2019), Budhamagar *et al.* (2020)
2	*Ageratum conyzoides* L.	Asteraceae	Mexico	Kamal pokhari	Th	H	A	Me, Fr	Lamsal *et al.* (2014), Kunwar *et al.* (2010), Bhatt *et al.* (2020)
3	*Ageratum houstonianum* Mill.	Asteraceae	Mexico to Central America	Maidi	Th	H	A	Me	Baral *et al.* (2006), Joshi *et al.* (2009)
4	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	Trinidad to N. Argentina	Phewa	He	H	P		
5	*Amaranthus spinosus* L.	Amaranthaceae	Mexico to Tropical America	Rupa	Th	H	A	Fd, Me, Fr	Manandhar (2002), Joshi *et al.* (2009)
6	*Bidens pilosa* L.	Asteraceae	Tropical & Subtropical America	Khaste	Th	H	A	Fd, Me, Fr	Manandhar (2002), Baral *et al.* (2006), Sharma *et al.* (2020)

7	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Asteraceae	Tropical & Subtropical America	Phewa	Ch	S	P	Me	Baral *et al.* (2006)
8	*Eichhornia crassipes* (Mart.) Solms	Pontederiaceae	S. Tropical America	Phewa	Cr	H	P	Fd, Gm	Joshi *et al.* (2009), Sah *et al.* (2002)
9	*Galinsoga quadriradiata* Ruiz & Pav.	Asteraceae	Mexico to S. Tropical America	Khaste	Th	H	A	Fd	Manandhar (2002),
10	*Ipomoea carnea* subsp. *fistulosa* (Mart. ex Choisy) D.F.Austin	Convolvulaceae	Mexico to S. Tropical America	Phewa	Ch	S	P	He, Me	Manandhar (2002), Baral *et al. (*2006), Kunwar *et al*. (2015)
11	*Lantana camara* L.	Verbenaceae	Mexico to Tropical America	Rupa	Ch	S	P	Fd, Me, He	Manandhar (2002), Kunwar *et al.* (2015)
12	*Mesosphaerum suaveolens* (L.) Kuntze	Lamiaceae	Mexico to Tropical America	Rupa	Th	H	A	Me	Baral *et al.* (2006)
13	*Mikania micrantha* Kunth	Asteraceae	Tropical & Subtropical America	Phewa	He	H	P	Fr	Sharma *et al.* (2020)
14	*Mimosa pudica* L.	Fabaceae	Tropical America	Phewa	He	H	P	Me	Manandhar (2002), Baral *et al.* (2006), Kunwar *et al.* (2010)

15	*Oxalis latifolia* Kunth	Oxalidaceae	Tropical & Subtropical America	Kamal pokhari	Cr	H	P		
16	*Parthenium hysterophorus* L.	Asteraceae	Tropical & Subtropical America	Phewa	Th	H	A		
17	*Pistia stratiotes* L.	Araceae	South America	Phewa	Cr	H	P		
18	*Senna occidentalis* (L.) Link	Fabaceae	Tropical & Subtropical America	Phewa	Th	H	A	Fd, Me	Manandhar (2002), Baral *et al.* (2006)
19	*Senna tora* (L.) Roxb.	Fabaceae	Central America	Phewa	Th	H	A	Fd, Me	Manandhar (2002), Bishwakarma (2005), Baral *et al.* (2006)
20	*Spermacoce alata* Aubl.	Rubiaceae	Colombia to N. South America and W. Brazil	Phewa	He	H	P	Me	
21	*Xanthium strumarium* L.	Asteraceae	N. America, Peru to Brazil and S. South America	Rupa	Th	H	A	Me	Manandhar (2002), Sah *et al.(*2002)

The life form of dominant plant species is one of the basic physiognomic attributes (Beard, 1978), which show the plant-environment interaction, and it helps to understand the micro and macroclimate under which plant species flourish (Khan *et al.,* 2018). The vegetation in our study area ranged from phanerophytes to therophytes with the dominance of therophytes and hemicryptophytes (fig. 4). The hemicryptophytes and cryptophytes constituted the species of the herb. The chamaephytes observed were mainly woody shrub species while the phanerophytes constituted the trees and the associated epiphytes and climbers, growing in the adjoining areas of wetlands. Hydrophytes (a component of Cryptophytes) constituted 10 species; common among them were *Trapa natans, Eichhormia crassispes, Pistia stratiotes, Hydrilla verticillata, Leersia hexandra* and *Ludwigia adscendens*. Such dominancy of hydrophytes was also reported from a study in wetlands of Central Nepal (Burlakoti & Karmacharya, 2004).

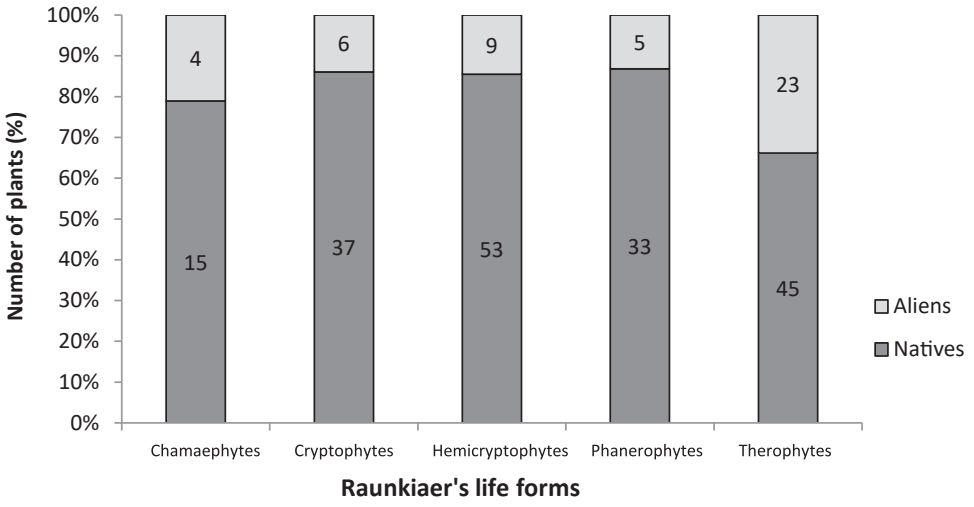

Fig. 4. Percentage of native and naturalized aline plant species in each life form. Values inside the bars represents the number of species.

A review of the previous studies revealed that about 71% (166 species) of the flowering plants recorded in the LCPV have one or moreuse values (table 4). Most of them (59%) were used as medicines, followed by food (25%) and forage and fodder (13%). This suggests that the LCPV provides important provisioning services to the people living in the landscape surrounding the LCPV. A similar type of research was reported by Sah *et al.* (2002) in the Ghodaghodi lake area and Dangol (2014) in Rampur Ghol, Chitwan.

Table 4. Uses of the plant species reported from the LCPV. Uses of the species have been compiled from the previous studies (See Appendix I and II for details).

S.N.	Use category	Number of species	Percentage of species
1.	Medicinal uses	141	61.30
2.	Food value	57	24.78
3.	Fodder and forage	31	13.47
5.	Fiber yielders	8	3.47
6.	Rituals plants	4	1.73
7.	Fish poisons	4	1.73
8.	Timber yielders	3	1.30
9.	Fuelwood	2	0.86
10.	Ornamental plants	2	0.86
11.	Dye yielders	2	0.86
12.	Use in construction	2	0.86
13.	Green manure	1	0.43
14.	Hedge plant	1	0.43
15.	Tannin yielders	1	0.43
16.	Soaping agent	1	0.43
17.	Fermenting agent	1	0.43

This study gives an insight into floral diversityin the LCPV, their biogeography, as well as their uses. Most of the species were native, perennial, and Therophytes. The LCPV provides habitat for several plant species with medicinal values. The presence of several invasive alien plant species, some of them being globally worst, suggests that the wetland habitats of LCPV have been degrading. Management responses to plant invasions, together with other drives of degradation, will help to restore the habitats and ensure the continuous supply of ecosystem services. This will provide both economic as well as conservation benefits.

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REFERENCES

ACHARYA, K P (2009) Utilization and status of plant resources in northern Part of Pokhara Valley, Central Nepal. *Ethnobotanical leaflets* 13:116-122.

ADHIKARI, M; THAPA, R; KUNWAR, R M; DEVKOTA, H P; POUDEL, P (2019) Ethnomedicinal Uses of Plant Resources in the Machhapuchchhre Rural Municipality of Kaski District, Nepal. *Medicines* 6(2), 69. DOI: 10.3390/medicines6020069

BARAL, S R; KURMI, P P (2006) *A compendium of medicinal plants in Nepal.* Rachana Sharma, Kathmandu, Nepal.

BHATT, M D; KUNWAR, R M (2020) Distribution pattern and ethnomedicinal uses of plants in Kanchanpur district, Far-Western Nepal. *Ethnobotany Research and Applications 20*: 1-21.

BHATTARAI, K R, MÅREN, I E, SUBEDI, S C (2014) Biodiversity and invasibility: Distribution patterns of invasive plant species in the Himalayas, Nepal. *Journal of Mountain Science* 11(3): 688-696. DOI: 10.1007/s11629-013-2821-3.

BISHOKARMA, B K; KINSEY, C K; DANGOL, D. R; CHAUDHARY, P (2005) Folk use of plant resource at Madi valley of Chitwan District, Nepal. *Banko Janakari* 15(2): 28-33.

BUDHA-MAGAR, S; BHANDARI, P; GHIMIRE, S K (2020) Ethno-medicinal survey of plants used by Magar (Kham) community, Rolpa district, Western Nepal. *Ethnobotany Research and Applications* 19: 1-29.

CHASE, M W; CHRISTENHUSZ, M J M; FAY, M F; BYNG, J W; JUDD, W S; SOLTIS, D E, ... STEVENS, P F (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181(1): 1-20.

CUNNINGHAM, A B (2001) *Applied ethnobotany: people, wild plant use and conservation.* Earthscan, London, United Kingdom.

DANGOL, D R; GAUTAM, B; OLI, B B (2014) Wetland plants and their local uses: Observations from Rampur Ghol, Chitwan, Nepal. *Journal of Natural History Museum* 28:142-159.

DENNY, P (1994) Biodiversity and wetlands. *Wetlands Ecology and Management*, 3(1): 55-611.

GRIERSON, AJC ; LONG,DG (1983-2001)*Flora of Bhutan*. Royal Botanic Garden, Edinburgh, United Kingdom.

HALLS, A J E (1997) Wetlands, biodiversity and the Ramsar convention: the role of the convention on wetlands in the conservation and wise use of biodiversity. In *Ramsar Convention Bureau*, Gland, Switzerland (Vol. 13).

HAYNES, R R (1984) Techniques for collecting aquatic and marsh plants. *Annals of the Missouri Botanical Garden* 71(1): 229-231.

JOSHI, A R; JOSHI, K (2009) Indigenous Uses of Wetland Plant Diversity of two Valleys (Kathmandu and Pokhara) in Nepal. *Ethnobotany* 21: 11-17

KENT, M (2012) *Vegetation description and data analysis A practical approach*. Wiley Blackwell, A John Wiley & Sons, Ltd, Publication, Oxford, UK

KHAN, W; KHAN, S M; AHMAD, H; ALQARAWI, A A; SHAH, G M; HUSSAIN, M; ABD-ALLAH, E (2018) Life forms, leaf size spectra, regeneration capacity and diversity of plant species grown in the Thandiani forests, district Abbottabad, Khyber Pakhtunkhwa, Pakistan. *Saudi Journal of Biological Sciences* 25(1): 94-100.

KUNWAR, R M; ACHARYA, R P; CHOWDHARY, C L; BUSSMANN, R W (2015) Medicinal plant dynamics in indigenous medicines in far-west Nepal. *Journal of Ethnopharmacology* 163: 210-219.

KUNWAR, R M; BURLAKOTI, C; CHOWDHARY, C L; BUSSMANN, R W (2010) Medicinal plants in far-west Nepal: Indigenous uses and pharmacological validity. *Medicinal and Aromatic Plant Science and Biotechnology* 4(1): 28-42.

LAMSAL, P; PANT, K P; KUMAR, L; ATREYA, K (2014) Diversity, uses, and threats in the Ghodaghodi Lake Complex, a Ramsar site in western lowland Nepal. *ISRN Biodiversity,* Article ID 680102. DOI:10.1155/2014/680102.

LAMSAL, P; PANT, K P; KUMAR, L; ATREYA, K (2014) Sustainable livelihoods through conservation of wetland resources: a case of economic benefits from Ghodaghodi Lake, western Nepal. *Ecology and Society* 20(1): 10. http://dx.doi.org/10.5751/ES-07172-200110.

LOWE, S; BROWNE, M; BOUDJELAS,S; DE POORTER,M (2000)*100 of the world's worst invasive alien species: a selection from the global invasive species database* (Vol. 12). Invasive Species Specialist Group, Auckland, New Zealand.

MANANDHAR, N P (2002) *Plants and people of Nepal.* Timber Press, USA.

MANDAL, S K; MUKHERJEE, A (2012) Diversity of Dicotyledonous plants in Wetlands of Puruliya District, West Bengal. *In* Maiti, G G; Mukherjee, S K (eds). *Multidisciplinary Approaches in Angiosperm Systematics.* University of Kalyani, Kalyani, WB, India; pp 403-9.

MoFE (2018a) *National Ramsar Strategy and Action Plan, Nepal (2018-2024)*. Ministry of Forest and Environment, Government of Nepal, Kathmandu, Nepal..

MoFE (2018b) *Integrated Lake Basin Management Plan of Lake Cluster of Pokhara Valley, Nepal (2018-2023).* Ministry of Forests and Environment, Kathmandu, Nepal.

NIROULA, B; SINGH, K L B (2011) Aquatic plant resources of Betana wetland, Morang, Nepal. *Our Nature 9*(1): 146-155.

PRESS, J R; SHRESTHA, K K; SUTTON, D A (2000) *Annotated checklist of the flowering plants of Nepal*. Natural History Museum Publications, UK (updated online version: http://www.efloras.org/flora_page.aspx?flora_id=110, accessed date. 29 January 2021)

RAMSAR CONVENTION SECRETARIAT (2013) *The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran*, 1971). 6th eddition. Ramsar Convention Secretariat, Gland, Switzerland.

ROSKOV, Y; OWER, G.; ORRELL, T; NICOLSON, D; BAILLY, N; KIRK, P.M; BOURGOIN, T; DEWALT, R.E; DECOCK, W; NIEUKERKEN, E; PENEV, L; EDS. (2020) Species 2000 & ITIS Catalogue of Life, 2020-09-01 Beta. Digital resource at www.catalogueoflife.org/col. Species 2000: Naturalis, Leiden, the Netherlands. ISSN 2405-8858. (accessed date: November 05, 2020).

SAH, J P; SINGH, R L; BHATTA, N (2002) Floristic diversity and use of plants in Ghodaghodi Lake Area, Nepal. *Journal of Natural History Museum* 21*:* 243–266.

SHARMA K; SAUD D S; JOSHI N (2019) Wetland flora of Rupandehi district, Nepal. *Journal of Plant Resources* 17(1): 58-68.

SHARMA, K; SAUD, D S; BHATTARAI,K R; DHAKAL, S; KHADKA, M K (2020) Wetland Plants and their Ethnobotanical Uses in Raja-Rani Tal, Letang, Morang, Nepal *Journal of Plant Resources* 18(1): 135-142.

SHRESTHA, B B; SHRESTHA, U B; SHARMA, K P; THAPA-PARAJULI, R B; DEVKOTA, A; SIWAKOTI, M (2019) Community perception and prioritization of invasive alien plants in Chitwan-Annapurna Landscape, Nepal. *Journal of Environmental Management* 229: 38-47.

SINGH, A; BALODI, K N; NAITHANI, S; SRIVASTAVA, A; SINGH, A; KWON-NDUNG, E H (2017) Vascular plant diversity with special reference to the invasion of alien species on the Doon University Campus, Dehradun, India. *International Journal of Biodiversity and Conservation 9*(3): 56–76. DOI: 10.5897/ijbc2016.1035

WATSON, M F; MKIYAMA, S; IKEDA, H; PENDRY, C; RAJBHANDARI, K R; SHRESTHA, K K eds. (2011) *Flora of Nepal*, Vol. 3. The Royal Botanic Garden Edinburgh, UK.

WU, Z; RAVEN, P H; HONG, D (1994-2008) *Flora of China.* Vol.4,8,11,13,14,16,18, 19,20,22,24,25. Science Press (Beijing) and Missouri Botanical Garden Press, St. Louis, USA.

Appendix 1. Checklist of plant species reported from the Lake Cluster of Pokhara Valley.

SN	Family	Latin name	*IUCN categ*	N/E	D/M	NRR	RC	H/S	A/P	Use value	References for uses	Wetland	Coll. Num.
1	Acanthaceae	*Justicia gendarussa* Burm. f.		N	D	1	He	Sh	P	Me		Phewa	F 131
2	Acanthaceae	*Justicia simplex* D.Don		N	D	1	He	He	P	Me	1, 2	Niureni	140
3	Acanthaceae	*Lepidagathis incurva* Buch.-Ham. ex D.Don		N	D	1	He	He	P	Fd	1, 2	Maidi	M104
4	Acanthaceae	*Strobilanthes atropurpurea* Nees		N	D	1	He	He	P	Me	1, 2	Dipang	92
5	Acanthaceae	*Thunbergia fragrans* Roxb.		N	D	1	He	He	P			Phewa	4
6	Acoraceae	*Acorus calamus* L.	*LC*	N	M	1	Cr	He	P	Me	1, 2, 3, 7, 9, 11, 14	Rupa	R152
7	Amaranthaceae	*Alternanthera philoxeroides* (Mart.) Griseb.		E	D	1	He	He	P			Phewa	152
8	Amaranthaceae	*Alternanthera sessilis* (L.) R.Br. ex DC.	*LC*	E	D	1	He	He	P	Fd, Me, Fr	1, 2, 4, 7, 9, 12, 14, 15	Phewa	70
9	Amaranthaceae	*Amaranthus spinosus* L.		E	D	1	Th	He	A	Fd, Me, Fr	1, 4	Rupa	R124
10	Amaranthaceae	*Dysphania ambrosioides* (L.) Mosyakin & Clemants		E	D	1	He	He	P	Fd, Me	1, 2	Niureni	N 267
11	Amaryllidaceae	*Crinum amoenum* Ker Gawl. ex Roxb.		N	M	1	Cr	He	P	Me	1, 2	Phewa	153
12	Apiaceae	*Centella asiatica* (L.) Urb.	*LC*	N	D	1	He	He	P	Me, Fd	1, 4, 5, 6, 7, 9, 12, 14	Phewa	154
13	Apocynaceae	*Cryptolepis buchananii* Schult. ex Roem. & Schult.		N	D	1	Ph	Sh	P	Me, Fo, Fi	1, 2	Gunde	G117
14	Apocynaceae	*Ichnocarpus frutescens* (L.) W.T.Aiton		N	D	1	Ph	Sh	P	Fd, Me, Fi	1, 2	Maidi	M151
15	Araceae	*Colocasia fallax* Schott	*LC*	N	M	1	Cr	He	P			Rupa	R229

16	Araceae	*Pistia stratiotes* L.	*LC*	E	M	2	Cr	He	P			Phewa	P114
17	Asteraceae	*Acmella paniculata* (Wall. ex DC.) R.K.Jansen	*LC*	N	D	1	Th	He	A			Kamal pokhari	115
18	Asteraceae	*Adenostemma lavenia* (L.) Kuntze		N	D	1	He	He	P			Phewa	15
19	Asteraceae	*Ageratina adenophora* (Spreng.) R.M.King & H.Rob.		E	D	1	Ch	He	P	Me	2, 4, 5, 7, 11	Rupa	R21
20	Asteraceae	*Ageratum conyzoides* L.		E	D	1	Th	He	A	Me, Fr	1, 2, 4, 6, 8, 12	Kamal pokhari	65
21	Asteraceae	*Ageratum houstonianum* Mill.		E	D	1	Th	He	A	Me	2, 4	Maidi	M10
22	Asteraceae	*Bidens bipinnata* L.		N	D		Th	He	A	Fd, Me	1, 13	Phewa	25
23	Asteraceae	*Bidens pilosa* L.		E	D	1	Th	He	A	Fd, Me, Fr	1, 2, 15	Khaste	K123
24	Asteraceae	*Chromolaena odorata* (L.) R.M.King & H.Rob.		E	D	1	Ch	Sh	P	Me	2	Phewa	P225
25	Asteraceae	*Crassocephalum crepidioides* (Benth.) S.Moore		E	D	1	Th	He	A	Me	1, 2	Phewa	P137
26	Asteraceae	*Cyanthillium cinereum* (L.) H.Rob		N	D	1	Th	He	A	Me		Khaste	98
27	Asteraceae	*Duhaldea cappa* (Buch.-Ham. ex D.Don) Pruski & Anderb.		N	D	1	Ch	Sh	P	Me	1	Maidi	M103
28	Asteraceae	*Eclipta prostrata* (L.) L.	*LC*	E	D	1	Th	He	A	Fd, Me, Fr	1, 2, 4, 6, 7, 12, 13, 15	Phewa	P138
29	Asteraceae	*Elephantopus scaber* L.		N	D	1	He	He	P	Me, Fa	1, 2, 13, 15	Khaste	26
30	Asteraceae	*Emilia sonchifolia* (L.) DC.		N	D	1	Th	He	A	Me, Fd, Fa	1, 15	Gunde	107
31	Asteraceae	*Erigeron canadensis* L.		E	D	1	Th	He	A			Phewa	159
32	Asteraceae	*Eschenbachia japonica* (Thunb.) J.Kost.		N	D	1	Th	He	A			Niureni	164
33	Asteraceae	*Mikania micrantha* Kunth		E	D	1	He	He	P	Fr	15	Phewa	P200

34	Asteraceae	*Parthenium hysterophorus* L.		E	D	1	Th	He	A			Phewa	P 4
35	Asteraceae	*Pseudognaphalium affine* (D.Don) Anderb.		N	D	1	Th	He	A			Dipang	417
36	Asteraceae	*Sonchus arvensis* L.		E	D	1	Th	He	A	Me, Fd	1, 2	Gunde	81
37	Asteraceae	*Sonchus asper* (L.) Hill		N	D	1	Th	He	A	Fd, Me, Fr	1, 2	Phewa	161
38	Asteraceae	*Sonchus oleraceus* L.		E	D	1	Th	He	A	Fd	1	Phewa	P102
39	Asteraceae	*Synedrella nodiflora* (L.) Gaertn.		E	D	1	Th	He	A	Me	1, 2	Phewa	P104
40	Asteraceae	*Tridax procumbens* L.		E	D	1	Th	He	A	Me	1, 2	Gunde	278
41	Asteraceae	*Xanthium strumarium* L.		E	D	1	Th	He	A	Me	1, 9	Rupa	R124
42	Balsaminaceae	*Impatiens insignis* DC.		N	D	1	Th	He	A	Fr	1	Phewa	162
43	Bignoniaceae	*Oroxylum indicum* (L.) Kurz		N	D	1	Ph	Tr	P	Me, Ri	1, 2, 3, 13	Begnas	B 231
44	Boraginaceae	*Cynoglossum zeylanicum* (Vahl) Thunb. ex Lehm.		N	D	1	He	Sh	P			Gunde	105
45	Boraginaceae	*Cynoglossum wallichii* G. Don		N	D	1	Th	He	A			Khaste	27
46	Brassicaceae	*Nasturtium officinale*W.T.Aiton	*LC*	E	D	1	Cr	He	P	Fd	1	Kamal pokhari	163
47	Caryophyllaceae	*Drymaria cordata* (L.) Willd. ex Roem. & Schult.		E	D	1	Th	He	A	Fd, Me	1, 2	Rupa	K153
48	Caryophyllaceae	*Stellaria media* (L.) Vill.		N	D	1	He	He	P	Fd, Me	1, 2	Kamal pokhari	166
49	Ceratophyllaceae	*Ceratophyllum muricatum* Cham.		N	D	1	Cr	He	P			Phewa	30
50	Commelinaceae	*Commelina paludosa* Blume		N	M	1	Cr	He	P	Fd, Me	1, 2	Kamal pokhari	103 Kamal
51	Commelinaceae	*Cyanotis vaga* (Lour.) Schult. & Schult.f.		N	M	1	Cr	He	P			Niureni	N139
52	Commelinaceae	*Floscopa scandens* Lour.	*LC*	N	M	1	Cr	He	P	Me, Fr	1, 2, 4, 5, 14	Gunde	23

53	Commelinaceae	*Murdannia nudiflora* (L.) Brenan		N	M	1	Th	He	A	Fd, Me	1, 2, 9, 12	Begnas	B145
54	Convolvulaceae	*Ipomoea carnea* subsp. *fistulosa* (Mart. ex Choisy) D.F.Austin		E	D	1	Ch	He	P	He, Me	1, 2, 13, 14	Phewa	101
55	Convolvulaceae	*Ipomoea purpurea* (L.) Roth		E	D	1	Th	He	A			Niureni	168
56	Costaceae	*Hellenia speciosa* (J.Köenig) S.R.Dutta	*LC*	N	M	1	He	He	P	Fd, Me	1, 2, 3	Rupa	R128
57	Cucurbitaceae	*Solena heterophylla* Lour.		N	D	1	He	He	P	Fd, Me, Fo	1, 2	Khaste	K100
58	Cyperaceae	*Actinoscirpus grossus* (L.f.) Goetgh. & D.A.Simpson	*LC*	N	M	1	Cr	He	P	Me, Fi	2	Rupa	7
59	Cyperaceae	*Carex cruciata* Wahlenb.		N	M	1	Cr	He	P			Phewa	169
60	Cyperaceae	*Cyperus albescens* (Steud.) Larridon & Govaerts		N	M	1	Th	He	A			Phewa	F151
61	Cyperaceae	*Cyperus brevifolius* (Rottb.) Hassk.	*LC*	N	M	1	Cr	He	P	Fr	9, 12	Phewa	47
62	Cyperaceae	*Cyperus compressus* L.	*LC*	N	M	1	Th	He	A	Me, Fr	2, 12, 14	Maidi	M205
63	Cyperaceae	*Cyperus corymbosus* Palla		N	M	1	Th	He	A			Phewa	21
64	Cyperaceae	*Cyperus cyperoides* (L.)Kuntze	*LC*	N	M	1	Cr	He	P	Me	1, 2	Phewa	P123
65	Cyperaceae	*Cyperus iria* L.	*LC*	N	M	1	Th	He	A	Fr, Me	2, 9, 12	Maidi	M214
66	Cyperaceae	*Cyperus platystylis* R.Br.		N	M	1	Th	He	A			Kamal pokhari	26
67	Cyperaceae	*Eleocharis congesta* D.Don	*LC*	N	M	1	Th	He	A			Khaste	18
68	Cyperaceae	*Fimbristylis dichotoma* (L.) Vahl	*LC*	N	M	1	Cr	He	P	Fo, Me	1, 2, 9, 12, 14, 15	Khaste	K116
69	Cyperaceae	*Schoenoplectiella juncoides* (Roxb.) Lye		N	M	1	Cr	He	P	Fi, Fo	1, 4	Phewa	16 phewa
70	Cyperaceae	*Schoenoplectiella lateriflora* (J.F.Gmel.) Lye		N	M	1	Th	He	A			Khaste	K101

71	Cyperaceae	*Schoenoplectiella mucronata* (L.) J.Jung & H.K.Choi	*LC*	N	M	1	Cr	He	P	Fi, Fo	1, 4, 14	Rupa	R198
72	Cyperaceae	*Scleria biflora* Roxb.	*LC*	N	M	1	Cr	He	P	Fo	1, 2	Khaste	K102
73	Cyperaceae	*Scleria levis* Retz.		N	M	1	Cr	He	P			Khaste	K109
74	Dioscoreaceae	*Dioscorea bulbifera* L		N	D	1	He	He	P	Fd, Me	1, 2	Rupa	R103
75	Dioscoreaceae	*Dioscorea pubera* Blume		N	D	1	He	He	P			Niureni	182
76	Dipterocarpaceae	*Shorea robusta* Gaertn.	*LC*	N	D	1	Ph	Tr	P	Me, Ti, Tag	1, 2, 13	Maidi	I91
77	Eriocaulaceae	*Eriocaulon nepalense* Prescott ex Bong.	*LC*	N	M	1	Th	He	A	Me	1	Phewa	P226
78	Euphorbiaceae	*Alchornea mollis* (Benth.) Müll.Arg.		N	D	1	Ch	Sh	P			Maidi	M124
79	Euphorbiaceae	*Euphorbia hirta* L.		N	D	1	Th	He	A	Me	2	Phewa	185
80	Euphorbiaceae	*Euphorbia pulcherrima* Willd. ex Klotzsch	*LC*	N	D	1	Ch	Sh	P	Me, Or	1	Rupa	R104
81	Euphorbiaceae	*Falconeria insignis* Royle		N	D	1	Ph	Tr	P	Me, Fp	1, 2	Begnas	B24
82	Euphorbiaceae	*Macaranga denticulata* (Blume) Müll.Arg.	*LC*	N	D	1	Ph	Tr	P	Me, Fo	1, 2	Phewa	184
83	Fabaceae	*Aeschynomene indica* L.	*LC*	N	D	1	He	Sh	P	Me	2	Gunde	G68
84	Fabaceae	*Bauhinia purpurea* L	*Lc*	N	D	1	Ph	Tr	P	Fo, Cm, Fd, Fr, Me	1,2	Rupa	R61
85	Fabaceae	*Chamaecrista leschenaultiana* (DC.) O.Deg.		N	D	1	He	He	P			Phewa	41
86	Fabaceae	*Chamaecrista rotundifolia* (Pers.) Greene		E	D	1	He	He	P			Phewa	46
87	Fabaceae	*Crotalaria alata* D.Ddon		N	D	1	He	Sh	P	Me	1	Khaste	187
88	Fabaceae	*Crotalaria pallida* Aiton		N	D	1	He	Sh	P			Dipang	93

89	Fabaceae	*Crotalaria sessiliflora* L.		N	D	1	He	Sh	P	Me	1, 2	Gunde	192
90	Fabaceae	*Desmodium concinnum* DC.		N	D	1	He	He	P	Me	1, 2	Phewa	P121
91	Fabaceae	*Desmodium heterocarpon* (L.) DC.		N	D	1	Th	He	A	Me	1, 2	Phewa	56
92	Fabaceae	*Desmodium laxiflorum* DC.		N	D	1	Th	He	A	Fo	1, 2	Phewa	194
93	Fabaceae	*Desmodium multiflorum* DC		N	D	1	Ch	He	P	Me	1, 2	Gunde	197
94	Fabaceae	*Dunbaria glandulosa* (Dalzell & A.Gibson) Prain		N	D	1	Th	He	A			Maidi	201
95	Fabaceae	*Indigofera atropurpurea* Hornem.		N	D	3	Ph	Sh	P			Rupa	311
96	Fabaceae	*Mimosa pudica* L.	*LC*	E	D	1	He	He	P	Me	1, 2, 8, 12, 15	Phewa	19
97	Fabaceae	*Mimosa rubicaulis* Lam.		N	D	1	Ch	Sh	P	Me	1, 2	Phewa	F150
98	Fabaceae	*Senna occidentalis* (L.) Link		E	D	1	Th	Sh	A	Fd, Me	1, 2	Phewa	P 2
99	Fabaceae	*Senna tora* (L.) Roxb.		E	D	1	Th	Sh	A	Fd, Me	1, 3, 8, 12	Phewa	P213
100	Fabaceae	*Stylosanthes hamata* (L.) Taub.		E	D	1	Th	He	A			Phewa	42
101	Fagaceae	*Castanopsis indica* (J.Roxb. ex Lindl.) A.DC.	*LC*	N	D	1	Ph	Tr	P	Me, Fd, Fw, Fo	1, 5	Maidi	M201
102	Fagaceae	*Quercus lanata* Sm.	*LC*	N	D	1	Ph	Tr	P	Fd, Me, Fo, Fw	1, 2	Rupa	204
103	Gesneriaceae	*Aeschynanthus parviflorus* (D.Don) Spreng.		E	D	1	Ph	He	P	Me	1, 2	Niureni	123
104	Hydrocharitaceae	*Hydrilla verticillata* (L.f.) Royle	*LC*	N	M	1	Cr	He	P	Me, Gm, Fr, Fd	1, 2, 4, 6	Niureni	N140
105	Hypericaceae	*Hypericum japonicum* Thunb.		N	D	1	He	He	P	Me	1, 2	Khaste	211

106	Hypericaceae	*Hypericum podocarpoides* N.Robson		N	D	1	Ch	Tr	P	Me	1	Begnas	B23
107	Hypericaceae	*Hypericum uralum* Buch.-Ham. ex D. Don		N	D	1	Ch	He	P	Me, Fo	1, 2	Maidi	89
108	Juncaceae	*Juncus prismatocarpus* R.Br.	*LC*	N	M	1	Cr	He	P			Gunde	G125
109	Lamiaceae	*Clerodendrum bracteatum* Wall. ex Walp.		N	D	1	Ch	Sh	P			Rupa	R121
110	Lamiaceae	*Anisomeles indica* Kuntze		N	D	1	He	He	P	Me	1, 2	Phewa	27
111	Lamiaceae	*Colebrookea oppositifolia* Sm.		N	D	1	Ph	Sh	P	Me	2, 9	Kamal pokhari	62
112	Lamiaceae	*Melissa axillaris* (Benth.) Bakh.f.		N	D	1	He	He	P	Me	2	Phewa	60
113	Lamiaceae	*Mesosphaerum suaveolens* (L.) Kuntze		E	D	1	Th	He	A	Me	2	Rupa	235
114	Lamiaceae	*Ocimum gratissimum* L.		N	D	1	Th	He	A	Me	2	Niureni	N177
115	Lamiaceae	*Ocimum tenuiflorum* L.		N	D	1	Th	He	A	Me, Ri	1, 2	Kamal pokhari	K126
116	Lamiaceae	*Platostoma coloratum* (D.Don) A.J.Paton		N	D	1	He	He	P	Fd, Me	1, 2	Maidi	87
117	Lamiaceae	*Plectranthus mollis* (Aiton) Spreng.		N	D	1	He	He	P	Me	1, 2	Gunde	238
118	Lamiaceae	*Pogostemon auricularius* (L.) Hassk.		N	D	1	He	He	P			Gunde	105
119	Lamiaceae	*Scutellaria discolor* Colebr.		N	D	1	He	He	P	Me	1, 2	Gunde	74
120	Lauraceae	*Cinnamomum verum* J.S.Presl		N	D	1	Ph	Tr	P			Rupa	R125
121	Lauraceae	*Litsea monopetala* (Roxb.) Pers.	*LC*	N	D	1	Ph	Tr	P	Fo, Me	1, 2	Rupa	R211
122	Lentibulariaceae	*Utricularia australis* R.Br.	*LC*	N	D	1	Cr	He	P			Maidi	251
123	Linaceae	*Reinwardtia indica* Dumort.		N	D	1	Ch	Sh	P	Me	1, 2	Kamal pokhari	K136
124	Linderniaceae	*Torenia asiatica* L.		N	D	1	Th	He	A	Me	2	Kamal pokhari	268

125	Linderniaceae	*Bonnaya ciliata* (Colsm.) Spreng.		N	D	1	Th	He	A	Me, Fd	2, 14	Khaste	109
126	Lythraceae	*Cuphea procumbens* Ortega		E	D	1	He	He	P	Fo	1	Phewa	9
127	Lythraceae	*Woodfordia fruticosa* (L.) Kurz	*LC*	N	D	1	Ph	Sh	P	Me	2, 9	Begnas	403
128	Magnoliaceae	*Magnolia champaca* (L.) Baill. ex Pierre	*LC*	N	D	1	Ph	Tr	P	Me, Ti, Dy	1, 2	Maidi	267
129	Malvaceae	*Abelmoschus manihot* (L) Medik		N	D	1	Th	Sh	A	Me		Gunde	G133
130	Malvaceae	*Hibiscus rosa-sinensis* L		E	D	1	Ph	Sh	P	Me Fo	1	Khaste	K69
131	Malvaceae	*Sida acuta* Burm.f.		N	D	1	He	Sh	P	Me, Fi	1, 2	Kamal pokhari	280
132	Malvaceae	*Sida rhombifolia* L.		N	D	1	He	He	P	Me, Fi	1, 2	Kamal pokhari	281
133	Malvaceae	*Triumfetta rhomboidea* Jacq.		N	D	1	He	He	P	Me, Fd	1, 2	Niureni	34
134	Malvaceae	*Urena lobata* L.	*LC*	N	D	1	He	Sh	P	Me, Fi, Ta, Fr	1, 2, 15	Khaste	106
135	Melastomataceae	*Osbeckia nepalensis* Hook.		N	D	1	He	Sh	P	Me, Fd	1, 2	Phewa	31
136	Melastomataceae	*Osbeckia stellata* Buch.-Ham. ex D.Don		N	D	1	He	Sh	P	Me, Fd	1, 2	Phewa	32
137	Meliaceae	*Toona ciliata* M.Roem.	*LC*	N	D	1	Ph	Tr	P	Me, Ti	1, 2, 5	Begnas	B23
138	Menispermiaceae	*Cissampelos pareira* L.		N	D	1	Ph	He	P	Me, Fi	1, 2, 7, 13	Maidi	M207
139	Menyanthaceae	*Nymphoides indica* (L.) Kuntze	*LC*	N	M	1	Cr	He	P			Phewa	22
140	Moraceae	*Ficus benjamina* L	*Lc*	N	D	1	Ph	Tr	P	Me	1	Phewa	P67
141	Moraceae	*Ficus racemosa* L.	*LC*	N	D	1	Ph	Tr	P	Fd, Fw, Fo	1, 2	Maidi	M205
142	Moraceae	*Ficus religiosa* L		N	D	1	Ph	Tr	P	Me, Fd	1,2; 1	Phewa	P81
143	Moraceae	*Ficus sarmentosa* Buch.-Ham. ex Sm.		N	D	1	Ph	Tr	P	Fd, Fo	1, 2	Phewa	P140

144	Moraceae	*Ficus semicordata* Buch.-Ham. ex Sm.	*Lc*	N	D	1	Ph	Tr	P	Me, Fo, Fd	1,2;1;1	Rupa	R70
145	Myricaceae	*Morella esculenta* (Buch.-Ham. ex D.Don) I.M.Turner		N	D	1	Ph	Tr	P	Me, Fd	1, 2, 5, 13	Begnas	B23
146	Myrtaceae	*Melaleuca citrina* (Curtis) Dum. Cours.		E	D	1	Ph	Tr	P	Fo	1	Khaste	K67
147	Myrtaceae	*Syzygium cumini* (L.) Skeels	*LC*	N	D	1	Ph	Tr	P	Me, Ta, Dy	1, 2	Rupa	284
148	Nelumbonaceae	*Nelumbo nucifera* Gaertn.		N	M	1	Cr	He	P	Fd, Me, Ri	1, 2, 4, 6, 9	Kamal pokhari	288
149	Nymphaeaceae	*Nymphaea rubra* Roxb. ex Salisb.	*LC*	N	M	1	Cr	He	P	Me	2	Phewa	P122
150	Oleaceae	*Fraxinus floribunda* Wall.	*LC*	N	D	1	Ph	Tr	P	Me	1, 2	Rupa	291
151	Oleaceae	*Jasminum multiflorum* Andrews		N	D	1	Ch	He	P	Me, Or, Ri	1, 2	Deepang	15
152	Onagraceae	*Ludwigia adscendens* (L.) H.Hara	*LC*	N	D	1	He	He	P	Me	1, 2	Maidi	297
153	Onagraceae	*Ludwigia hyssopifolia* (G.Don) Exell	*LC*	E	D	1	Ch	He	P	Me	2	Kamal pokhari	32
154	Orchidaceae	*Apostasia wallichii* R.Br.		N	M	1	He	He	P			Dipang	D151
155	Orchidaceae	*Bulbophyllum affine* Wall. ex Lindl.		N	M	1	Ph	He	P			Maidi	147 M
156	Orchidaceae	*Bulbophyllum careyanum*(Hook.) Spreng.		N	M	1	Ph	He	P			Maidi	302
157	Orchidaceae	*Rhynchostylis retusa* (L.) Blume		N	M	1	Ph	He	P	Me	1, 2	Maidi	303
158	Orchidaceae	*Zeuxine strateumatica* (L.) Schltr.	*LC*	N	M	1	Cr	He	P			Maidi	211 Maidi
159	Orobanchaceae	*Lindenbergia indica* Vatke	*LC*	N	D	1	He	He	p	Me	1, 2	Phewa	25
160	Oxalidaceae	*Oxalis corniculata* L.		E	D	1	Th	He	A	Fd, Me	1, 2, 4, 6, 8, 12	Phewa	303

161	Oxalidaceae	*Oxalis latifolia* Kunth		E	D	1	Th	He	A			Kamal pokhari	K134
162	Pentaphyllaceae	*Eurya cerasifolia* (D.Don) Kobuski		N	D	1	Ph	Tr	P	Fd	1	Rupa lake	R63
163	Phyllanthaceae	*Phyllanthus emblica* L	*LC*	N	D	1	Ph	Tr	P	Me		Begnas	B31
164	Phyllanthaceae	*Phyllanthus urinaria* L.		N	D	1	He	He	P	Me	2, 12	phewa	304
165	Phyllanthaceae	*Phyllanthus virgatus* G.Forst		N	D	1	He	Sh	P			Rupa	312
166	Plantaginaceae	*Limnophila chinensis* (Osbeck) Merr.	*LC*	N	D	1	Th	He	A			Kamal pokhari	61
167	Plantaginaceae	*Limnophila sessiliflora* Blume	*LC*	N	D	1	Th	He	A			Phewa	P124
168	Poaceae	*Arthraxon hispidus* (Thunb.) Makino		N	M	1	Cr	He	P			Phewa	48
169	Poaceae	*Brachiaria villosa* (Lam.) A.Camus		N	M	1	Cr	He	P			Phewa	P123
170	Poaceae	*Cenchrus purpureus* (Schumach.) Morrone	*LC*	E	M	1	Cr	He	P			Khaste	96
171	Poaceae	*Cymbopogon pendulus* (Nees ex Steud.) W.Watson		N	M	1	Cr	He	P			Rupa	314
172	Poceae	*Cynodon dactylon* (L.) Pers.		N	M	1	He	He	P	Me	1,2	Phewa	P83
173	Poaceae	*Digitaria ciliaris* (Retz.) Koeler		N	M	1	Cr	He	P	Fo	1	Phewa	325
174	Poaceae	*Eleusine indica* (L.) Gaertn.	*LC*	N	M	1	Th	He	A	Me	2, 12	Kamal pokhari	323
175	Poaceae	*Eragrostis atrovirens* (Desf.) Trin. ex Steud.	*LC*	N	M	1	Th	He	A			Gunde	327
176	Poaceae	*Eragrostis tenella* (L.) P.Beauv. ex Roem. & Schult.		N	M	1	Th	He	A	Fr	1, 12	Gunde	G120
177	Poaceae	*Eragrostis unioloides* (Retz.) Nees ex Steud.	*LC*	N	M	1	Th	He	A	Fr	1	Gunde	G121
178	Poaceae	*Imperata cylindrica* (L.) P.Beauv.		N	M	1	Cr	He	P	Me	1, 2, 12	Dipang	D 153
179	Poaceae	*Leersia hexandra* Sw.	*LC*	E	M	4	Cr	He	P	Me, Fr	1, 2, 4, 14	phewa	330

180	Poaceae	*Microstegium fasciculatum* (L.) Henrard		N	M	1	Th	He	A	Fo	1	Phewa	8
181	Poaceae	*Oryza rufipogon* Griff.	*LC*	N	M	1	Cr	He	P			Phewa	26
182	Poaceae	*Panicum miliaceum* L.		N	M	1	Th	He	A	Fr	1	Phewa	57
183	Poaceae	*Paspalum dilatatum* Poir.		E	M	1	Cr	He	P	Fr	9	Phewa	45
184	Poaceae	*Paspalum scrobiculatum* L.	*LC*	N	M	1	Th	He	A	Fr, Me	1, 2, 9	Phewa	P103
185	Poaceae	*Sacciolepis indica* (L.) Chase	*LC*	N	M	1	Th	He	A	Fr	1	Khaste	97
186	Poaceae	*Setaria pumila* (Poir.) Roem. & Schult.		N	M	1	Cr	He	P	Fr	1, 12, 15	Khaste	K 113
187	Poaceae	*Sporobolus fertilis* (Steud.) Clayton		N	M	1	Cr	He	P			Phewa	23
188	Poaceae	*Themeda triandra* Forssk.		N	M	1	Cr	He	P			Niureni	N220
189	Poaceae	*Thysanolaena latifolia* (Roxb. ex Hornem.) Honda		N	M	1	He	Sh	P	Me, Fo, Fi	2; 1	Dipang	D76
190	Polygalaceae	*Salomonia cantoniensis* Lour.		N	D	1	Th	He	A	Me	1, 2	Khaste	346
191	Polygonaceae	*Persicaria barbata* (L.) H.Hara	*LC*	N	D	1	He	He	P	Fd, Me, Fp	1, 4, 6, 9	Phewa	21
192	Polygonaceae	*Persicaria capitata* (Buch.-Ham. ex D.Don) H.Gross		N	D	1	Cr	He	P	Me, Fo	1, 2	Rupa	216
193	Polygonaceae	*Persicaria hydropiper* (L.) Spach	*LC*	N	D	1	Th	He	A	Me, Fp	1, 2, 4, 9, 14, 15	Phewa	57
194	Polygonaceae	*Persicaria lapathifolia* (L.) Delarbre	*LC*	N	D	1	Th	He	A			Phewa	21
195	Polygonaceae	*Persicaria perfoliata* (L.) H.Gross		N	D	1	Th	He	A	Fd, Me, Fr	1, 2	Kamal pokhari	72
196	Polygonaceae	*Persicaria posumbu* (Buch.-Ham. ex D.Don) H.Gross		N	D	1	Th	He	A			Maidi	M112
197	Polygonaceae	*Polygonum plebejum* R.Br.		N	D	4	Th	He	A	Fd, Me	1, 2	Kamal pokhari	31

198	Polygonaceae	*Koenigia campanulata* (Hook.fil.) T.M. Schust. & Reveal		N	D	1	He	He	P	Fd	1, 2	Niureni	95
199	Pontederiaceae	*Eichhornia crassipes* (Mart.) Solms		E	M	1	Cr	He	P	Fd, Gm	4, 9	Phewa	31
200	Pontederiaceae	*Pontederia hastata* L.		N	M	1	Cr	He	P	Fd, Me	1, 2, 14	Gunde	122
201	Potamogetonaceae	*Potamogetoncrispus* L		N	M	1	Cr	He	P			Kamal pokhari	355
202	Primulaceae	*Maesa macrophylla* Wall. ex Roxb.		N	D	1	Ph	Sh	P	Me	1, 2	Rupa	R162
203	Primulaceae	*Maesa chisia* D Don		N	D	1	Ch	Sh	P	Me, Fd, Fi	1	Maidi	M83
204	Ranunculaceae	*Ranunculus sceleratus* L.	*LC*	N	D		Th	Th	A	Fd, Me	1, 2, 4, 6, 9	Kamal pokhari	28
205	Rosaceae	*Rubus ellipticus* Sm.	*LC*	N	D	1	Ch	Sh	P	Fd, Me, Fo	1, 2	Phewa	366
206	Rosaceae	*Rubus kumaonensis* Balakr.		N	D	1	Ch	Sh	P			Maidi	M119
207	Rosaceae	*Potentilla indica* (Andr.) Wolf		N	D	1	He	He	P	Fd, Me	1, 2	Maidi	M120
208	Rosaceae	*Pyracantha crenulata* (D.Don) M.Roem.		N	D	1	Ch	Sh	P	Md; Fo	1,2	Rupa	R64
209	Rubiaceae	*Dimetia scandens* (Roxb.) R.J.Wang		N	D	1	He	He	P	Me, Fo	1, 2	Begnas	B25
210	Rubiaceae	*Exallage auricularia* (L.) Bremek.		N	D	1	He	He	P			Gunde	G231
211	Rubiaceae	*Galium aparine* L.		N	D	1	Th	He	A	Me	1, 2	Phewa	130
212	Rubiaceae	*Knoxia sumatrensis* (Retz.) DC.		N	D	1	He	He	P			Phewa	367
213	Rubiaceae	*Mussaenda frondosa* L.		N	D	1	Ch	Sh	P	Me	1	Maidi	M84
214	Rubiaceae	*Oldenlandia corymbosa* L.	*LC*	N	D	1	Th	He	A			Rupa	R167
215	Rubiaceae	*Scleromitrion verticillatum* (L.) R.J.Wang		N	D	1	He	He	P			Khaste	206
216	Rubiaceae	*Spermacoce alata* Aubl.		E	D	1	He	He	P	Me	10	Phewa	40

217	Solanaceae	*Datura metel* L.		E	D	1	Ph	Sh	P	Me	1, 2	Dipang	D227
218	Solanaceae	*Solanum nigrum* L.		N	D	1	He	He	P	Fd, Me	1, 2, 13	Phewa	29
219	Solanaceae	*Solanum torvum* Sw.		E	D	1	Ch	Sh	P	Fd, Me	1, 2	Phewa	57
220	Solanaceae	*Solanum virginianum* L.		N	D	1	He	Sh	P	Me	1	Kamalpokhari	K81
221	Theaceae	*Schima wallichii* (DC.) Korth.	*LC*	N	D	1	Ph	Tr	P	Me, Cn	1, 2, 5	Maidi	M200
222	Trapaceae	*Trapa natans* L.	*LC*	N	D	1	Cr	He	P	Me	2	Maidi	385
223	Urticaceae	*Boehmeria virgata* (G.Forst.) Guill.	*LC*	E	D	1	Ch	He	P	Me, Fi	1, 2	Phewa	14
224	Urticaceae	*Gonostegia hirta* (Blume ex Hassk.) Miq.		N	D	1	He	He	P	Fd, Me, Sa	1, 2, 7	Maidi	386
225	Urticaceae	*Pilea scripta* (Buch.-Ham. ex D.Don) Wedd.		N	D	1	He	He	P			Gunde	41
226	Urticaceae	*Pouzolzia zeylanica* (L.) Benn. & R.Br.		N	D	1	He	He	P	Fd, Me	1, 2	Kamal pokhari	105
227	Verbenaceae	*Lantana camara* L.		E	D	1	Ph	Sh	P	Fd, Me, He	1, 13	Rupa	R120
228	Vitaceae	*Cissus javana* DC.		N	D	1	Ph	He	P	Me, Fr	1, 2	Rupa	R127
229	Vitaceae	*Leea asiatica* (L.) Ridsdale		N	D	1	Ch	He	P	Fr		Rupa	R136
230	Zingiberaceae	*Hedychium ellipticum* Buch.-Ham. ex Sm.		N	M	1	He	He	P			Rupa	397

Abbreviations: N/E-Native exotic; RC-Raunkiear's classification, *i.e.* Ph-Phanerophyte, Ch-Chamaephyte, Cr-Cryptophyte, He-Hemicryptophyte, Th-Therophyte; H/S/T-Herb, shrub or tree; A/P-Annual/Perennial. Native range referece (NRR): 1 (POWO, www.plantsoftheworldonline.org/), 2 (Weeds of Australia, www.weeds.org.au), 3(www.eflora.org), 4(GRIIS, www.griis.org); Redlist categories are *LC* (Least concerned); D/M-Dicots & Monocots; IUCN categ-IUCN threatened categoriers.

Appendix II

Code	References
1	MANANDHAR, N P (2002) *Plants and people of Nepal*. Timber press.
2	BARAL, S R; KURMI, P P(2006)*A compendium of medicinal plants in Nepal*. Kathmandu, Nepal: Rachana Sharma.
3	BISHOKARMA, B K; KINSEY, C K, DANGOL, D R; CHAUDHARY, P (2005) Folk use of plant resource at Madi valley of Chitwan District, Nepal. *Banko Janakari* 15(2):28-33.
4	JOSHI, A R; JOSHI, K (2009) Indigenous Uses of Wetland Plant Diversity of two Valleys (Kathmandu and Pokhara) in Nepal. *Ethnobotany* 21: 11-17
5	ACHARYA, KP(2009) Utilization and status of plant resources in northern Part of Pokhara Valley, Central Nepal. *Ethnobotanical leaflets* 2009(1): 13.
6	LAMSAL, P; PANT, K P; KUMAR, L; ATREYA, K (2014)Diversity, uses, and threats in the Ghodaghodi Lake Complex, a Ramsar site in western lowland Nepal. ISRN Biodiversity, 2014.
7	ADHIKARI, M; THAPA, R; KUNWAR, R M; DEVKOTA, H P; POUDEL, P (2019) Ethnomedicinal Uses of Plant Resources in the Machhapuchchhre Rural Municipality of Kaski District, Nepal. *Medicines* 6(2): 69.
8	KUNWAR, R M; BURLAKOTI, C; CHOWDHARY, C L; BUSSMANN, R W(2010) Medicinal plants in farwest Nepal: Indigenous uses and pharmacological validity. *Med Aromat Plant Sci Biotechnol* 4(1): 28-42.
9	SAH, J P; SINGH, R L; BHATTA, N (2002) Floristic diversity and use of plants in Ghodaghodi lake area.*Nepal. J Nat Hist Mus* 21(1-4): 243-66.
10	CONSERVA, L M; JESU COSTA FERREIRA, J (2012) Borreria and Spermacoce species (Rubiaceae): A review of their ethnomedicinal properties, chemical constituents, and biological activities. *Pharmacognosy reviews* 6(11): 46.

11	BUDHA-MAGAR, S; BHANDARI, P; GHIMIRE, S K (2020) Ethno-medicinal survey of plants used by Magar (Kham) community, Rolpa district, Western Nepal. *Ethnobotany Research and Applications*, 19:1-29.
12	BHATT, M. D; KUNWAR, R. M. (2020). Distribution pattern and ethnomedicinal uses of plants in Kanchanpur district, Far-Western Nepal. *Ethnobotany Research and Applications* 20:1-21.
13	KUNWAR, R M; ACHARYA, R P; CHOWDHARY, C L; BUSSMANN, R W (2015) Medicinal plant dynamics in indigenous medicines in farwest Nepal. *Journal of Ethnopharmacology* 163: 210-219.
14	NIROULA, B; SINGH, K L B (2011) Aquatic plant resources of Betana wetland, Morang, Nepal. *Our Nature*, 9(1): 146-155.
15	SHARMA, K; SAUD, D S; BHATTARAI K R; DHAKAL, S; KHADKA, M K (2020) Wetland Plants and their Ethnobotanical Uses in Raja-Rani Tal, Letang, Morang, Nepal. *J. Pl. Res. 18(1):135-142*