Ethnobotany in Annapurna Conservation Area (ACA), Nepal: A Review

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Review

Abstract

Background: Nepal is considered as a biodiversity hotspot with a multi-dimensional social system accompanied by vast amounts of plants and traditional knowledge regarding ethnobotanical practices. There are number of ethnic groups in Nepal whose culture is enriched by ethnobotanical knowledge that has been passed down over generations. Also, ethnobotanical knowledge is diverse in different regions of Nepal. The ethnobotany of Nepal and related archaic knowledge are of great importance to the advancement of local, national and global human society. In this study, we analyze ethnobotany in five districts within Annnapurna Conservation Area, Nepal's largest protected area.

Methods: Information was extracted from relevant publications from the year 1995 to 2021 from electronic databases following the PRISMA framework. Those extracted data from thirty-two publications were analyzed systematically.

Results: This study revealed that the temporal research trend has varied significantly and that the number of research in the accessible areas were relatively higher. Despite the high occurrence of research focusing on ethnomedicinal uses, other ethnobotanical research focusing on Non-timber forest products, wild edible foods are still lacking.

Conclusions: Priority should be given to relatively unexplored research topics and lesser explored areas such as wild edible foods and non- timber forest products, and pharmacognosy in the future, so that the research gap will be addressed which ultimately brings out the real potentiality of the ethnobotanical sector of Annapurna Conservation Area.

Keywords: Ethnobotany, Annapurna Conservation Area, Nepal, Review

Background

Since ancient times, the utilization of plants for various human needs represents a long history of the human relationship with environment. The field of ethnobotany is concerned with the systematic, scientific study of the use and management of plant species based on traditional and local knowledge as well as biotic conservation (Martin 2010). This field also demonstrates how the conservation of plants and local knowledge can be achieved through the study of natural and social sciences. The oldest documentation about the medicinal value of plants in the Indian subcontinent is reported in the Rig-Veda, from 4500 BC to 1600 BC (Singh *et al.* 2012). The indigenous

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knowledge of medicinal plants and other useful plants in Nepal has deep roots since ancient times (Kunwar & Bussmann 2008). Francis Buchanan performed the first scientific study of uses of medicinal plants in Nepal. He collected plants from 1802-1821 and was followed by Nathaniel Wallich in 1820-1821 (Rajbhandari 2001). Now ethnobotany is blooming as global society has realized that vast portion of knowledge is contained in traditional and folk culture, which is being lost in the modern age (Balick & Cox 2020).

Nepal lies in the central part of main Himalayan range harboring unique biological diversity and is floristically characterized as being at the crossroads of six floristic regions (Rajbhandary *et al.* 2020). A great deal of geographic diversity and a wide range of climatic and physiographic conditions in Neoal have resulted in 13067 floral species, including 1001 algae, 2467 fungi, 792 lichens, 1213 bryophytes, 580 pteridophytes, 6973 angiosperms and 41 gymnosperms (MOFSC 2018). Among these plant species about 2300 species are considered medicinally and aromatically useful (Kunwar *et al.* 2018, Rokaya *et al.* 2010). Similarly, the richness of medicinal plants in Nepal is inversely proportional to the altitudinal geography (Acharya *et al.* 2009, Rokaya *et al.* 2012). However, the use of such plants increases with increasing altitude. This is due to high trust in traditional herbal remedies and also no choices for poverty and remoteness (Kunwar & Bussmann 2008). In addition, the traditional use of plant species also supports rural livelihood by providing subsistence and income generation (Pyakurel *et al.* 2018).

Despite the significance of the traditional use of such plant species, the utilization regime has undergone significant changes in recent times (Kutal *et al.* 2021), transforming the traditional system and knowledge of plant use in Nepal (Kunwar *et al.* 2014). On the contrary, there is still a vast portion of unexplored and undocumented knowledge about valuable plant species of Nepal that needs to be documented and explored scientifically. Lack of sustainable harvesting and utilization practices has pushed many of Nepal's medicinal plants to the verge of extinction. Therefore, sustainable use, management and conservation of ethno botanically valued plants based on traditional botanical knowledge is an urgent necessity of Nepal (Kunwar *et al.* 2013).

As part of the effort to manage, use and conserve the ethnobotanical knowledge, it is critical to understand the trends, scope and nature of research conducted on the field of ethnobotany (Lambert *et al.* 1997). Moreover, there is a need for such periodical reviews of the publication in ethnobotany, as it is one of the prerequisites for enhancing the quality of research (de Albuquerque & Hanazaki 2009). The study attempts to analyze the past research patterns on ethnobotany of the study area while identifying the influencing factors and providing a basis for future research to prioritize target research areas in the light of the significance of ethnobotany, its research and changing current context.

Annapurna Conservation Area (ACA)

The Annapurna Conservation Area (ACA) was established as the largest protected area of Nepal in 1992 with an area of 7629 sq. km of covering five western districts (Kaski, Manang, Mustang, Lamjung and Myagdi)(Khadgi *et al.* 2013). The region is bordered by the dry alpine deserts of Mustang and Tibet (China) in the north, valleys and northern foothills of Pokhara in the south, the Kali Gandaki River in the west, by Marsyandi Valley to east. This conservation area harbors 1,226 floral species, 105 mammals, 518 birds, 40 reptiles and 23 amphibians (Gautam *et al.* 2020, Khakurel *et al.* 2020). Along with rich biological diversity, ACA also presents splendid cultural diversity. This region houses over 120,000 residents of the different ethnical groups with diverse culture and languages such as Gurung, Magar, Thakali and Manage (Baral *et al.* 2008). Natural resources-based livelihood options like agriculture and animal husbandry dominate as the source of living in the region (Nepal *et al.* 2021). However, foreign employment and entrepreneurship have diversified the livelihood options of the region recently (Nyaupane & Thapa 2004). In addition to this, they possess good knowledge of ethnobotanical uses of plants (Khan *et al.* 2013).

Materials and Methods

Literature search and Search strategies

A systematic review of the literature following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (Figure 1) (Moher *et al.* 2010) was conducted. Literature (journal articles, PhD and master's level dissertation) related to ethnobotany published in English language from 1995-2021 was searched using Google Scholar. A combination of the keywords in the search string "allintitle: [Keywords i.e. *medicinal plants, ethnobotanical, ethnobotany, ethnomedicine, traditional use, indigenous knowledge, wild edible plants*] AND [place name i.e. *ACAP, Kaski, Lamjung, Manang, Mustang, Myagdi*]" was used to search the literature, which resulted in 46 articles and 14 citations. Secondly, collected literatures were screened for titles, abstract and duplicates

leading to the removal of 8 articles, and the remaining 38 articles were assessed for eligibility. Based on inclusion and exclusion criteria, 4 articles were further eliminated, resulting in 32 articles for the final systematic review.

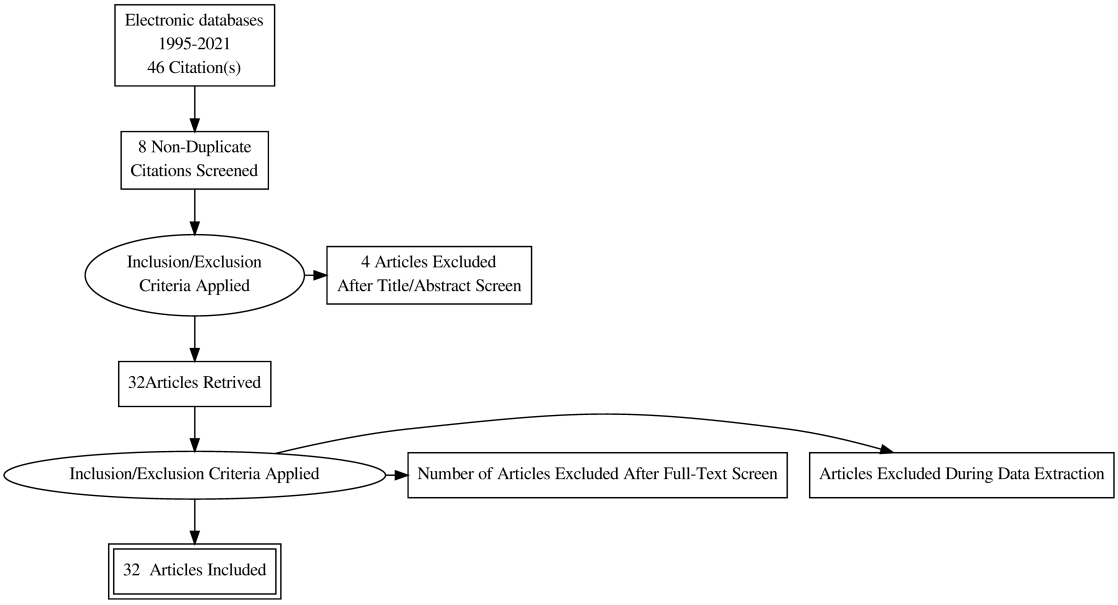

Figure 1. Summary search results and the selection process (PRISMA flow diagram)

Selection Criteria, Data abstraction and analysis

Literatures based on original research meeting the selection criteria (i.e. titles and abstract indicated that the literature was focused on the ethnobotany and traditional use of plants, study area was within the ACA) were included in the review. Literatures were excluded if they were conference proceedings, grey literature.

A spreadsheet of the abstracted dataset was constructed using Ms. Excel, which contained the following information for each literature; year of publication, journal details, author details, research theme, study location, study duration, study techniques, and major uses (Table 1). Furthermore, descriptive statistics were employed to analyze, depict and interpret the results. The map shown in Figure 4. was prepared using QGIS (https://www.qgis.org/). Likewise, a word cloud (Figure 2.) was developed from Wordcloud generator (https://www.wordclouds.com/) based on the keywords of literatures under review.

Table 1 Table representing major variables considered in the review

Variables	Description
Publication types	Journal articles(Original research papers, short communications, review articles), PhD and master's level dissertation
Year	Calendar Year (AD) from 1995-2021
Journal details	Scimago Journal Ranking
Author details	Gender of the lead author
Research theme	Ethnomedicine, Domestic use, Cultural/Religious use
Study location	Districts of Nepal covered by ACA
Study duration	1 year, multiple year
Study season	1 season, multi-season
Methods of data collection	Individual interview, Group discussion, Focal group discussion, Key Informant Interview, Field visit, Rural Appraisal
Data analysis	Descriptive statistics, Ethnobotanical indices, Inferential statistics
Plants records and identification	Herbarium Voucher specimen, Photographs
Life form	Herb, Shrub, Trees
Plant parts	Underground parts, Aerial parts

Results and Discussion

Publishing journal, authors and affiliations

Among the 32 published works (Supplementary Material S1) selected from the ACA region, 84.67% (n=27) were journal articles followed by Master's level theses (9.38%, n=3) and book chapters (6.25%, n=2). Out of 27 journal articles, the highest number (n=15) were published in the journal of international coverage with only eight journals ranked in Scimago Journal ranking. These results agree with results of (Paudel *et al.* 2020) which reported that most of the research published in Nepal end up in unranked national journals although these rankings do not always serve as proxies of quality research (Mañana-Rodríguez 2015, Moustafa 2014). Analyzing the authorship from the gender perspective, only 2 literature had female lead authors which contrasted vastly with the number of published literature lead-authored by male researchers (n=30). This can be attributed to lower number of females involved in research in Nepal. Lower involvement of females in such research may be due to; Gender disparities in education and employment, Stereotypes and cultural environments, Gender bias in hiring and promotion, and Women's disproportionate domestic and caring labor (Schiebinger 2010). Likewise, based on the affiliation of the authors, only 37.5 % of the selected literature had one or more authors of foreign origin. This entails the proportionately lower foreign collaboration in the research of ethnobotany in the ACA area.

Figure 2. Word cloud developed on https://www.wordclouds.com/. All the words depicted in the word cloud are Keywords used in the literature under review. Larger the size of the word more they have appeared in the studies.

Methods and duration of data collection

Among the studies considered, more than two folds (n=21, 65.62%) of studies employed two or more methods to collect data. Individual interviews (n=22) were the most frequently used methods of data collection followed by field visits (n=17) and group discussions (n=12) (Figure 3). Most of the studies under review employed, combined individual interviews with some form of field visit including forest walk, transect survey and vegetation sampling. The combined methods of ethnobotanical data collection (individual interviews and field visit) have led to the improved understanding of traditional and medicinal use of plants (Popović *et al.* 2016) as they collect both cultural and botanical data (Gerique 2006).

Similarly, the number of publications using purposive sampling techniques was the highest (n= 26, 81.25%). The frequent use of purposive sampling in the studies is justified, as the majority of the knowledge regarding

ethnobotanical applications is limited to a small group of respondents (Tongco 2007). Moreover, it is already known that, ethnobotanical knowledge is differentiated by gender, age and occupation (Pfeiffer & Butz 2005). The general population tend to have limited knowledge, while specialist such as shamans, healers, doctors or herbalists hold specialized knowledge and comprehension about ethnobotanical system (Weckerle *et al.* 2018). Depending on the scope of the study, sampling strategies may differ and research focusing on more specialized knowledge tend to have purposive sampling (Bernard 2011, Newing *et al.* 2011).

In addition to this, 71.87% of the literature under review collected herbarium or photographic records for the identification of plants and among them, plant identification in the field (n=18, 78.26%) was a frequently used method. The collection process of a voucher specimen (i.e., herbarium) or photographic record is crucial as it allows correct identification and enables knowledge of the plant and its uses to be understood by reference to the global floral archive (Nesbitt 2014). Ecology, cultivation, and uses of plants in other cultures along with chemical and medicinal properties, can be taken as some examples of reference using the global floral archive (Bennett & Balick 2014).

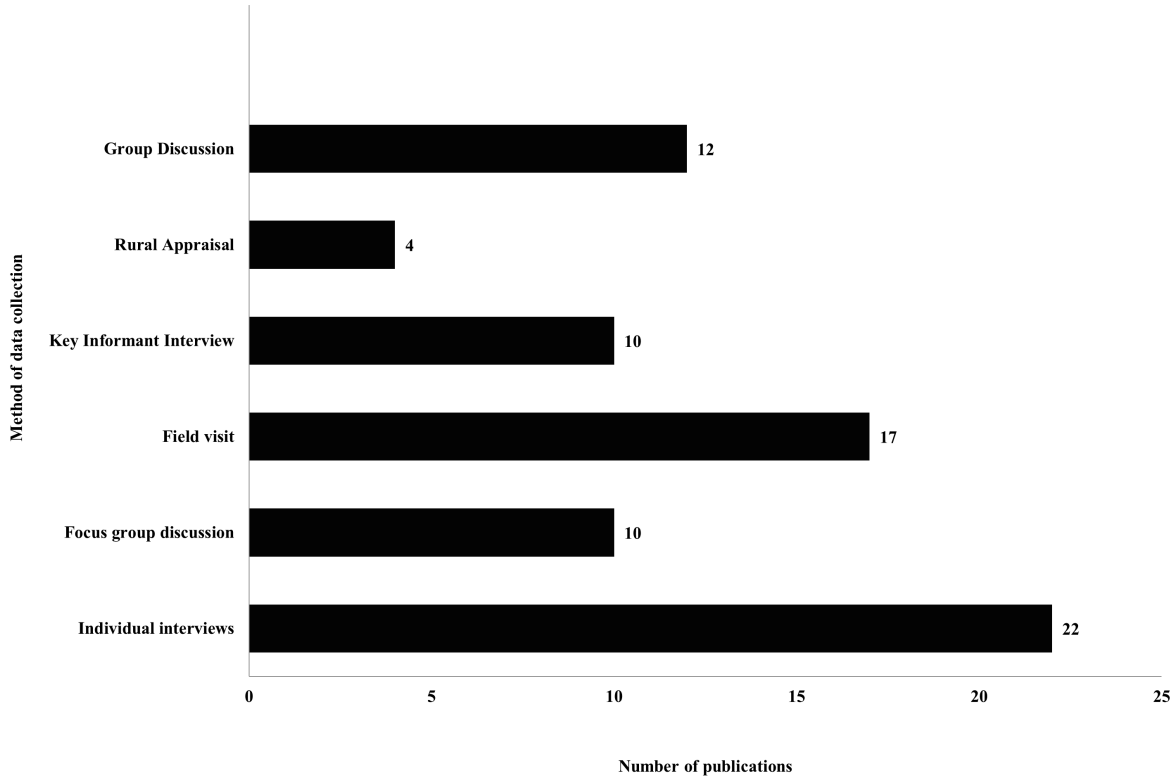

Figure 3. Number of publications using different methods for data collection

Most of the studies (n=22, 68.75%) used descriptive statistical tools for the analysis of data, with limited number of studies (n=8, 25%) used quantitative and ethnobotanical indices like Use Value (UV) and Relative Frequency of Citation (RFC) (Rana *et al.* 2015). Ethnobotanical indices are frequently relied upon as proxy for the identification drugs and remedies and to prioritize the high valued plants (Heinrich *et al.* 2009). However, the cultural value and importance of plants in general, cannot be summed up by such indices (Leonti 2022).

Moreover, a significant portion of the research (n=19, 29.37%) was concluded within 1 year in a single season. However, the availability of plants varies with the season (Scheiner & Rey-Benayas 1994) altering the pattern of use. An ideal ethnobotanical research would last more than a year, for dealing with floral, agronomical and socio-cultural cycle. As there may be seasonal differences in use practices, availability of plant and markets which may affect the way respondent scrutinize these topics. In order to capture this variation fieldwork and interviews should be repeated (Weckerle *et al.* 2018). Considering the importance of statistically and scientifically valid research, the use of quantitative ecological indices and ethnobotanical indices should be prioritized along with the promotion of multiyear and multi-seasonal studies.

Temporal snapshot of the studies

The number of studies focusing primarily on the ethnobotany of the ACA region conducted over the years has fluctuated dramatically. Despite the downwards trends of publications from 2010 onwards until 2018, with the abrupt change in the year 2015, the recent trend seems to be in a progressive direction (Figure 4). The progress in ethnobotanical research from last decade of the 20th century to beginning to 21st century clearly depicts the growing interest of researchers. The identical pattern of change over century has also been recorded in other investigations around the world, indicating the progress in the number of articles published in ethnobotany (Giovannini *et al.* 2016, Liu *et al.* 2016, Yeung *et al.* 2020). This growth in number of research throughout the world including ACA, indicated the interest of the scientific community in ethnobotanical studies, and leading to increased data documentation and strengthening modern pharmacology by through exploration, isolation and testing of plant derived natural compounds. (Fakchich & Elachouri 2021)

Further, the relatively smaller number of publications at the beginning of the 2000s might be due to curbed research efforts in the extended political insurgency in Nepal extending from 1995 to 2004. However, the research efforts have been restored since then with a sudden decline in 2015 due to devastating earthquake (Gautam 2017). Similar patterns were observed in all the field of biological sciences (Kandel *et al.* 2021). Based on the review of it is safe to conclude that, despite the fluctuating number it is safe to conclude that scientific interest in ethnobotanical research is growing in the ACA, with increased number of researchers, academic institutions, better access to information and availability of transportation services.

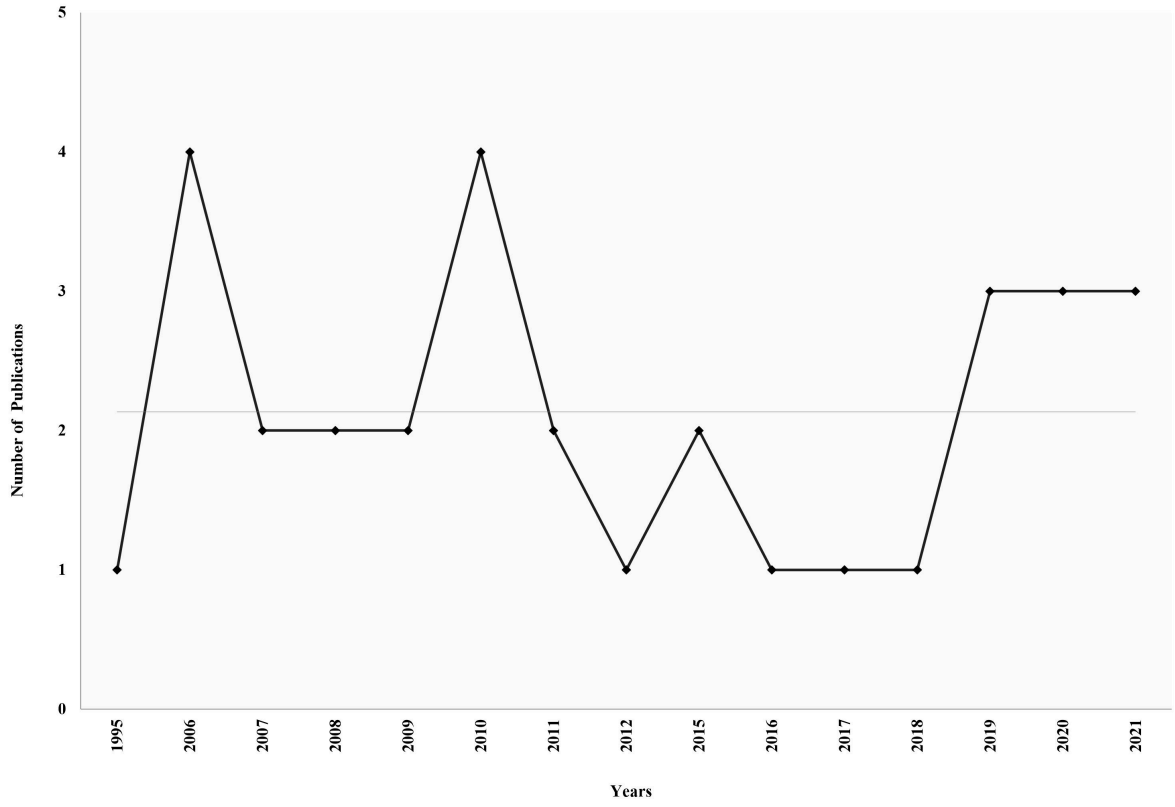

Figure 4. Number of publication on ethnobotany of ACA region from the year 1995-2021. This figure shows the fluctuating pattern.

Research effort: spatial snapshot

Analysis of geographic position of the literatures included in this review depicts that, the distribution of research across the area of ACA is skewed geographically (Figure 5). The highest number of the studies were undertaken in Kaski district (n=16, 50%) followed by Mustang (n=6, 18.75%), Lamjung (n=5, 15.62%). The district with the least number of research was Myagdi. The uneven distribution of research effort in the ethnobotany of ACA region may be due to harsh terrain, inaccessibility, and limited availability. Geography, altitudinal gradient, distance and accessibility are the intrinsic factors that alter the pattern of collection and use of plants (Orme *et al.* 2005, Slaton 2015, Thomas *et al.* 2009). These factors in turn affect research efforts as use is patterned by geo-spatial features

(Souza *et al.* 2018). Moreover, due to easier accessibility, Kaski, Makawanpur, Parbat, Ilam, Kathmandu districts were frequently researched resulting in high number of ethnobotanical publications (Kunwar *et al.* 2022).
Areas with altitude between 1000 and 2500m from the mean sea level have the higher species richness of Plants with ethnobotanical importance, (Rokaya *et al.* 2012), while higher altitude areas have low diversity of ethnobotanically important plants (Subedi *et al.* 2015). Kaski district is also the hotspot for use of ethnomedicinal plants with plant distribution associated with areas of protected area. Whereas the rough terrain, and alternating hills and valleys of other districts may have limited the access to plant resources thereby resulting in underreporting of plants uses (Kunwar *et al.* 2022), leading to less number of researches. This pattern of distribution and use of such species may be another reason for skewed distribution of research across ACA.

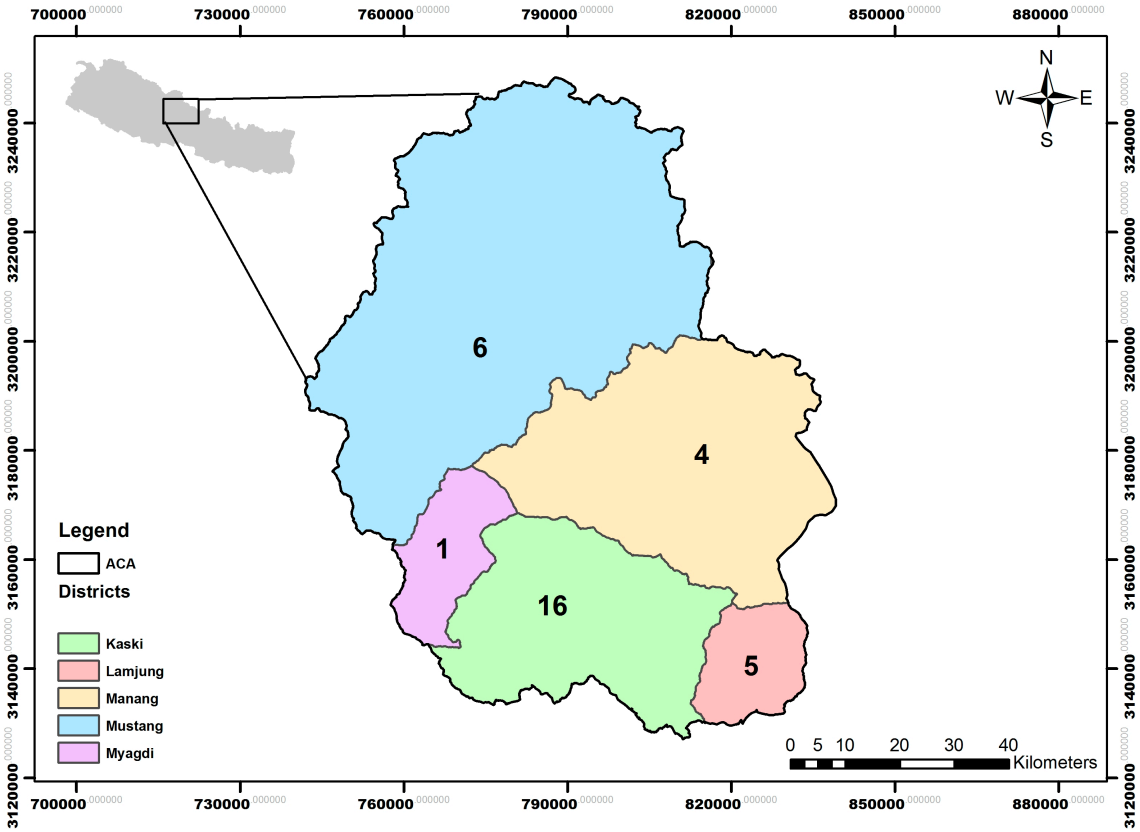

Figure 5. Map depicting number of publications in different districts covered by ACA region. Half of the publications are from Kaski district.

Additionally, resources and infrastructure ultimately influence research efforts, increasing the number of research conducted. The relatively greater number of academic institutions teaching biological and social sciences in Kaski district may be another factor for the skewed pattern of ethnobotanical research in ACA region (Kunwar *et al.* 2022).

Thematic field of the studies

The highest number of studies were focused on the ethnomedicine theme (n=21, 65.62%), followed by domestic use (n=10, 31.25%) and cultural and religious Uses (n=1, 3.1%) of the three themes (Figure 6) of the ethnobotanical research considered. Ethnomedicine was the most studied theme; however, aspects of ethnomedicine such as formulation, and doses were still not documented. Most of the studies we considered focused on exploring the indigenous use of plants as medicine and disease (Bhattarai *et al.* 2006, Bhattarai *et al.* 2010). The higher incidence of research focusing on ethnomedicine was also evident in the national context too (Rajbhanday & Winkler 2015). However, there is a need for studies focusing on in-vitro and in-vivo medicinal activities to provide scientific evidence for the indigenous use of plants by the local people (Khanal *et al.* 2020). The higher incidence of plants used for medicinal purposes in Nepal (Kunwar & Bussmann 2008); greater dependence on traditional plant-based medicines as first choice (Pohle 1990), is likely to have contributed to this pattern of more studies on ethnomedicine theme. Moreover, ethnomedicine is frequently studied as it is a structural component of local medical systems (Kleinman 2020).

Similarly, the ACA region lacked comprehensive studies focusing particularly on the use of Non-timber forest products (Chhetri & Gupta 2007), wild edible plants (Khakurel *et al.* 2021). This paucity of research is likely to negatively affect planning for biodiversity conservation and sustainable use but also help in the preservation of indigenous knowledge and genetic resources. Therefore, studies focusing on relatively unexplored thematic areas of ethnobotanical research are deemed necessary (Bennett & Balick 2014, Scheiner & Rey-Benayas 1994).

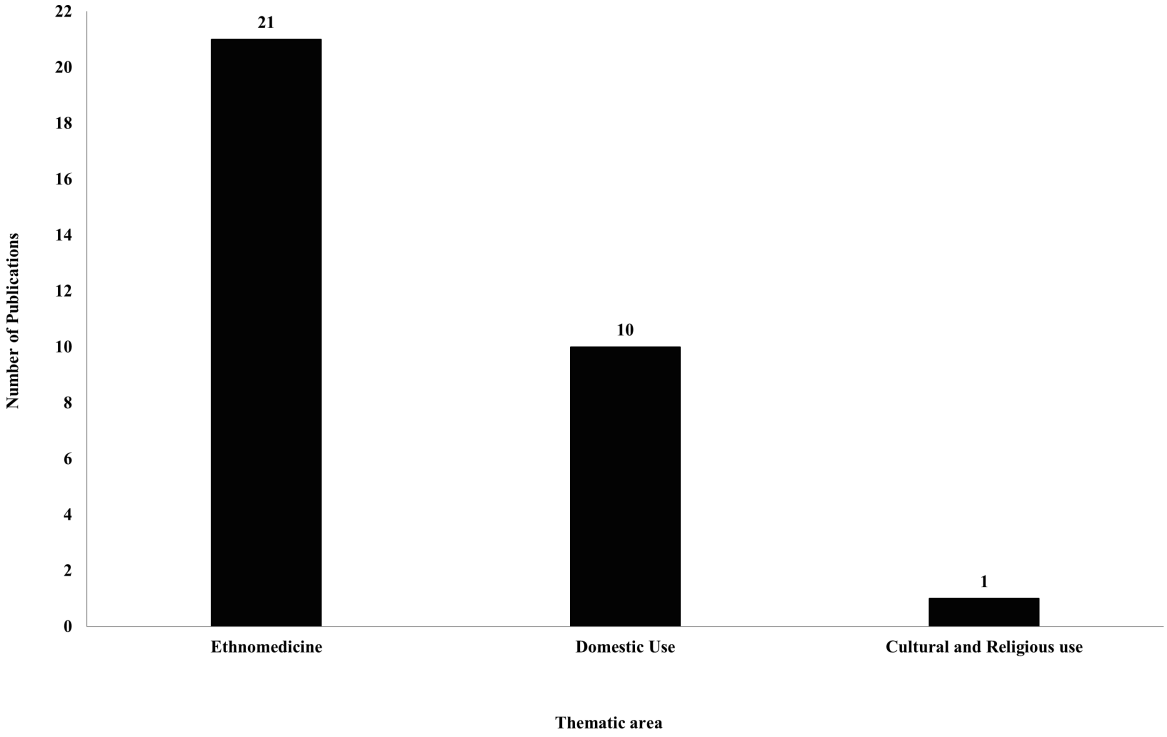

Figure 6. Number of articles based on the thematic area. The highest number of studies belonged to Ethnomedicine.

Use pattern of plants

The analysis of the publications that described the plant's uses (n=18) revealed that the most frequently used life form was herb (n=12, 66.67%), followed by shrub. The relative abundance of the herb in the study region rather than other life forms, and their high effectiveness in curing of different ailments (Luitel *et al.* 2014, Singh *et al.* 2012, Uprety *et al.* 2010) are likely to make the herb, the most used life form. Relatively easier collection, storage, transportation of herbs than other life forms may be another reason for their frequent use (Shrestha & Dhillion 2003). Herbs also harbor the higher amounts of secondary metabolites for their life strategies and can be easily cultivated than other forms, this may have also contributed to their higher use (Bekalo *et al.* 2009, Stepp & Moerman 2001).

Similarly, aerial parts of plants (n=12, 66.67%) were frequently used in comparison to underground parts (n=6, 33.33%). This is because leaves, and other aerial parts contain a higher concentration of biologically active substances, because they play greater role in the defense system of plants (Malla *et al.* 2015, Srithi *et al.* 2009, Umair *et al.* 2019). The identification of the most used part may assist in determining prospects and bioactivities (Adhikari *et al.* 2019). Hence, our findings indicated the relatively higher use of aerial parts and herb life forms in the ACA region, which is in coherence with ecological apparency hypothesis.

Conclusion

This review indicated that the majority of the articles that were analyzed, , focused on the ethnomedicinal research in ACA region, concluding that, ACA region is one of the most resourceful area of Nepal for medicinal herbs and archaic ethnobotanical knowledge. Likewise, most of these studies carried out to date are traditional, only documenting the knowledge and inventory of the resources, there is an urgent need for studies focusing on applied

and conservation ethnobotany. Moreover, from a gender perspective, there is a dire need to improve the number of female researchers involved in studies with different interventions.

Similarly, the spatial coverage of ethnobotanical research in the ACA seems skewed; this indicates a necessity of promoting research in locations, that are under-represented and unexplored. Although the temporal trend of ethnobotanical research has fluctuated, there has been a progressive rise in numberof studies in present days, which need to be sustained. This review underscored the need for research highlighting the relation between pharmacognosy and ethnobotany in the region. The use of ethnobotanical and ecological indices coupled with in-vitro and in-vivo phytochemical analysis could be effective in generating scientific evidence for the indigenous use of plants.

Taking into consideration the plant diversity, ecological importance, and economic potential of the region. Ethnobotany can be a new dimension of sustainable economy of the ACA with effective conservation measures and sustainable utilization of plant species. Furthermore, the outcome of this review could be helpful to the researcher, conservation practitioners as well as policy and decision-makers for developing a proactive and strategic course of action in the future.

Declarations

List of abbreviations: ACA: Annapurna Conservation Area, PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses, NTFPs : Non-Timber Forest Products
Ethics approval: None needed because it is review article
Consent for publication: Not applicable
***Availability of data and materials*:** Data presented in figures and table will be provided upon request. The list of literature under review are provided under supplementary material.
Competing interests: The authors declare that there is no conflict of interest.
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Authors´ contributions: AP: Conceptualization, data collection and analysis, writing the first draft of the manuscript, SG: Conceptualization, data collection and analysis, writing the first draft of the manuscript. JB: Conceptualization, writing the first draft of the manuscript and final revision. All authors read, agreed and approved for the submission of this manuscript.

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Appendix 1 - Publications considered

Title of publication	Year	Publication type	Name of Journal	Study location	Study duration	Study techniques
Traditional botanical knowledge (TBK) on the use of medicinal plants in Sikles area, Nepal	2015	Journal	Asian Journal of Plant Science and research	Kaski	within 1 year	Individual Interviews, FGD
Ethnobotany of wild Junipers (*Juniperus* species) in Manang district, Central Nepal	2006	Journal	Scientific World	Manang	more than 1 year	Individual Interviews
Folklore medicinal plants used against typhoid and fever in Lwangghalel, Kaski District, Central Nepal	2020	Journal	Journal of Plant Resources	Kaski	within 1 year	Individual Interviews, FGD, GD, Field Visit
Survey on medicinal plants used for anti-diabetic activity in Kaski District, Nepal	2018	Journal	Journal of Health and Allied Science	Kaski	within 1 year	Individual Interviews
Traditional knowledge of processing and use of the Himalayan giant nettle (*Girardinia diversifolia* (Link) Friis) among the Gurungs of Sikles, Nepal	2012	Journal	Ethnobotany Research and Applications	Kaski	more than 1 year	Individual Interviews, KII
Medicinal plant knowledge of the Panchase region in the Middle Hills of the Nepalese Himalayas	2011	Journal	Ban ko Janakari	Kaski	within 1 year	Individual Interviews, GD, Field Visit
Assessment of phytochemical, antioxidant and antimicrobial activities of some medicinal plants from Kaski District of Nepal	2020	Journal	American Journal of Plant Science	Kaski	within 1 year	Field Visit
Indigenous knowledge on medicinal plants in Mid-Hills of Nepal: Ac ase study of Sikles area Kaski district	2008	Book Chapter/book	NA	Kaski	within 1 year	FGD, KII, Rural Appraisal
The role of non-timber forest products (NTFPS) in the livelihood of rural people in protected areas	2017	Thesis	NA	Lamjung	within 1 year	Individual Interviews, KII, FGD, Rural Appraisal, Field Visit
Non-timber Forest Product and its Impacts on Livelihood in the Middle Hill: A Case of Lamjung district, Nepal	2019	Journal	Journal of Geography and Geology	Lamjung	within 1 year	Field Visit, FDG, KII
Ecological study of medicinal plant *Paris polyphylla* in Ghandruk VDC, Kaskli, Nepal	2009	Thesis	NA	Kaski	within 1 year	Field Visit
Trend analysis and purpose of use of some important plant and animal species of Ghandruk VDC, Nepal	2010	Journal	Our Nature	Kaski	more than 1 year	Individual Interviews, KII, FGD
Ecological status of prioritized non-timber forest products in Machhapuchhre Rural Muncipality of Annapurna Conservation Area, Nepal	2015	Thesis	NA	Kaski	within 1 year	Field Visit, Individual Interviews, KII, FGD
Some native medicinal plants of Western Gurung	2010	Book Chapter/book	NA	Kaski	within 1 year	Individual Interviews
Traditional medicinal lants used by tribals of Lamjung District, Nepal	2008	Journal	International Journal of Crude Drug Research	Lamjung	more than 1 year	Individual Interviews
Ethnomedicinal plants used by the people of Manang district, Central Nepal	2006	Journal	Journal of Ethnobiology and Ethnomedincine	Manang	more than 1 year	Individual Interviews, Field Visit

Ethnomedicinal uses of plant resources in the Machhapuchchhre rural municipality of Kaski district, Nepal	2019	Journal	Medicines	Kaski	within 1 year	Individual Interviews, Field Visit, FGD, KII
Ethnomedicine in Himalaya: a case study from Dolpa, Humla, Jumla and Mustang dIstricts of Nepal	2006	Journal	Journal of Ethnobiology and Ethnomedincine	Mustang *	within 1 year	Individual Interviews, GD, Rural Appraisal
An Inventory of some herbal drugs of Myagdi district, Nepal	1995	Journal	Economic Botany	Myagdi	more than 1 year	Individual Interviews
A survey of Non-timber Forest Products (NTFPs) in Upper Mustang	2007	Journal	Scientific World	Mustang	more than 1 year	Field Visit, Rural Appraisal
Role of indigenous peoples in sustainable forest management: A case study from Gurung Community in Lamjung District of Nepal	2021	Journal	International Journal of Research and Analysis in Humanities	Lamjung	more than 1 year	Individual Interviews, FGD
Folklore medicinal plants used against typhoid and fever in Lwangghalel, Kaski District, Central Nepal	2020	Journal	Journal of plant resources	Kaski	within 1 year	GD, FGD
Traditional knowledge on medicinal plants used for the treatment of livestock diseases in Sardikhola VDC, Kaski, Nepal	2010	Journal	Journal of Medicinal Plants Research	Kaski	within 1 year	KII
Use of medicinal plants in traditional Tibetan therapy system in Upper Mustang, Nepal	2006	Journal	Our Nature	Mustang	within 1 year	KII
The use of medicinal plants in the trans Himalayan arid zone of Mustang district, Nepal	2010	Journal	Journal of Ethnobiology and Ethnomedicine	Mustang	more than 1 year	Individual Interviews, Field Visit
Plants used as fence and fuelwood in Manang district, Central Nepal	2007	Journal	Scientific World	Manang	more than 1 year	Individual Interviews, Field Visit
The use of plants for fencing and fuelwood in Mustang District, Trans-Himalayas, Nepal	2009	Journal	Scientific World	Mustang	more than 1 year	Individual Interviews, Field Visit
An assessment of ethnomedicinal use, chemical constituent analysis and bioactivity evaluation on high altitude medicinal plant *Delphinium brunonianum* of Manang District	2011	Journal	Nepal Journal of Science and Technology	Manang	more than 1 year	Field Visit, Lab
Ecological status and diversity indices of Panchaule (*Dactylorhiza hatagirea*) and its associates in Lete village of Mustang district, Nepal	2016	Journal	Banko Jankari	Mustang	within 1 year	Field Visit
Contributions of non-timber forest products to people in mountain ecosystems and impacts of recent climate change	2021	Journal	Ecosystems and people	Kaski	within 1 year	Individual Interviews
Non-timber forest product and its impacts on livelihood in the Middle Hill: A case of Lamjung district, Nepal	2019	Journal	Journal of Geography and Geology	Lamjung	more than 1 year	Individual Interviews, Field Visit, FGD, KII
Foods from the wild: Local knowledge, use pattern and distribution in Western Nepal	2021	Journal	PLOS One	Kaski	within 1 year	Individual Interviews, Field Visit, FDG