

Ethnobotany of *Aconitum naviculare* (Brühl) Stapf in a Trans-Himalayan Landscape of Manang, Central Nepal



A Thesis submitted for the Partial Fulfilment of the Requirements of
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Management (BEM)

Submitted by

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DECLARATION

Thesis entitled “**Ethnobotany of *Aconitum naviculare* (Brühl) Stapf in a Trans-Himalayan Landscape of Manang, Central Nepal**” which is being submitted to the Central Department of Botany, Institute of Science and Technology (IOST), Tribhuvan University, Nepal for the award of requirement of Master’s degree of Science in Biodiversity and Environmental Management (BEM); is a research work carried out by me under the supervision of Assistant Professor Dr. Achyut Tiwari, Central Department of Botany, Tribhuvan University and co-supervised by Prof. Dr. Bharat Babu Shrestha Central Department of Botany, Tribhuvan University, Nepal.

This research is original and has not been submitted earlier in part or full in this or any other form to any university or institute, here or elsewhere, for the award of any degree.

Date: 26 / June / 2023



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Kirtipur, Kathmandu
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RECOMMENDATION

This is to recommend that **Mr. Sandesh Ghimire** has carried out research entitled “**Ethnobotany of *Aconitum naviculare* (Brühl) Stapf in a Trans-Himalayan Landscape of Manang, Central Nepal**” for the award of Master’s degree of Science in **Biodiversity and Environmental Management (BEM)** under our supervision. To our knowledge, this work has not been submitted for any other degree.

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LETTER OF APPROVAL

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ABSTRACT

Indigenous mountain communities utilize their traditional knowledge in plant identification to meet their particular drug needs for a variety of illness. One of such alpine medicinal herbs of the Himalayan landscape is *Aconitum naviculare*, which is rare, yet highly prized in traditional Tibetan medicine. In spite of its high frequency of uses in traditional medicine system and the ethnobotany of this species has been poorly documented. Therefore, the present study focused on documenting traditional knowledge on distribution, harvesting practices, storage, use patterns as well as the local perception on the conservation of *A. naviculare* in two mountain communities (Manang-Nyesyang Rural Municipality and Narpabhumi Rural Municipality) of Manang district central Nepal. Altogether, 65 households were selected by snowball method and information was collected through interview using semi-structured questionnaire during 18th October to 16th December 2022. An additional 11 key informants were interviewed at the same time. The result showed that *A. naviculare* has been in use to treat diseases, such as fever, common cold, cough, high blood pressure, jaundice and diabetes since time immemorial. It is reported that about one gram of dried plant material is boiled with water and the extract is taken orally 1-2 times a day until recovery. The plant is the most frequently used medicinal herb in the study area but it is not in trade. The amount of plant materials owned by the surveyed households was 81 ± 93 gm per household. Among the medicinal plants used by the local communities, *A. naviculare* has the longest history of traditional uses. Although people were conscious about the conservation of this species, livestock or human trampling and changing environmental condition at high mountains were considered as contributing factors for the loss of this plant from the natural habitat. It was found that there is a substantial risk of loss of knowledge on use of this species as young people (< 25 years of age) seldom used this plant and had very limited knowledge about its use. It is emphasized that there is need to improve awareness among young people about the uses and conservation of *A. naviculare* to conserve the existing local knowledge and to upscale its highly effective medicinal use.

Keywords: Tibetan traditional medicine, indigenous people, Himalaya, alpine medicinal plant

ACRONYMS AND ABBREVIATIONS

ACAP	:	Annapurna Conservation Area Project
BC	:	Before Christ
BID	:	bis in die ~ twice a day
CBD	:	Convention on Biological Diversity
CBS	:	Central Bureau of Statistics
CITES	:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DHM	:	Department of Hydrology and Meteorology
DPR	:	Department of Plant Resources
GoN	:	Government of Nepal
IK	:	Indigenous Knowledge
KMTNC	:	King Mahendra Trust for Nature Conservation
LK	:	Local Knowledge
MoFE	:	Ministry of Forests and Environment
MoFSC	:	Ministry of Forests and Soil Conservation
MPs	:	Medicinal Plants
NGOs	:	National Governmental Organizations
NTFPs	:	Non-Timber Forest Products
NTNC	:	The National Trust for Nature Conservation
QGIS	:	Quantum Geographic Information System
TEK	:	Traditional Ecological Knowledge
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
WHO	:	World Health Organization

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CHAPTER - ONE

1. INTRODUCTION

1.1. Background

Ethnobotany deals with the practice of collecting plants and documenting how those plants are used (Davis, 1995). It is the systematic and scientific study of how people use and manage plants, and it shows how the study of natural and social sciences may help preserve indigenous knowledge and plants (Martin, 1995). In the past century, ethnobotany has developed into a scientific field that focuses on the relationship between people and plants through a variety of disciplines, including ecology, pharmacology, public health, and others in addition to the collection and documentation of indigenous uses (Gomez-Beloz, 2002). The need to conserve and utilize plant resources present in tribal communities for socioeconomic development, as well as the quest for potentially new commercial plants, have sparked a sudden increase in interest in ethnobotanical studies in recent years (Kunwar and Bussmann, 2008).

Traditional ecological knowledge (TEK), indigenous knowledge (IK), or local knowledge (LK) refer to the association of peoples' practices, knowledge, values, and beliefs with the use of environmental resources for present as well as future generations (Berkes et al., 2000; Faulstich, 2006; Ochoa and Ladio, 2014). Traditional knowledge is highly important to understand local cultural practices, healing systems, and ways of life in harmony with nature and natural resources (Nakashima and Roue, 2002). The involvement of indigenous population to collect data related to plant could preserve knowledge and resources otherwise that could thereafter be lost forever (Rai, 2009).

The ethnic groups living in many geographical regions rely on wild plants, and each ethnic group has its own repository of knowledge about the plants that grow there for their livelihood (Singh et al., 2012). True importance of indigenous knowledge is being more widely recognized by the statement 'respect, preserve and maintain knowledge, innovation and practices of indigenous and local communities' in Article 8J of Convention on Biological Diversity 1992 (CBD, 1992), which has shifted away from focusing solely on use and relationships in favor of managing and conserving biological diversity (Ghimire et al., 2001).

The basis of traditional ecological knowledge relies on two assumptions: how to mobilize the knowledge and what is its relationship with modern science (Whyte,

2013), which is in opposition to the academic qualification. This knowledge is orally passed from one generation to another and is highly crucial to make local decision for healthcare, agriculture and resource management in rural communities. Indigenous knowledge is valuable for the society and culture as well as for researchers and urban planners working to advance living standards in rural areas (Mundy and Compton, 1991). However, the real importance of indigenous knowledge of contemporary science had been neglected by the glory and promise of modern scientific community and technology (Nakashima and Roue, 2002).

The Trans-Himalayan region is dry and mostly treeless region, but rich in medicinal plants (Rao and Saxena, 1994; Anonymous, 2002). The alpine plants are subjected to a high degree of impacts due to natural and anthropogenic fluctuations (Zhang et al., 2019). Anthropogenic activities such as unsustainable harvesting, human pressure, animal grazing and fire (Niu et al., 2016) with climate change as natural phenomenon have an impact on the population of alpine plants (Schickhoff et al., 2015). Understanding the distribution, production, usage, and trade of medicinal plants in a scientific manner is vital to deal with those phenomena and will aid in management and sustainable growth in the future (Paul et al., 2015). In addition, a key strategy for delivering sustainable healthcare is the preservation and revitalization of traditional medicine knowledge and practice in hundreds of ethnic communities (Lambert et al., 1997).

Indigenous skills that are widely utilized by one community can be used to address the issues of another community in a related ecosystem in a similar region of the world (Warren, 1991). It is a property of non-industrial groups with a history of persistence in resource usage techniques (Warren et al., 1995) that could provide reasonable solutions to design biologically and culturally rich future world (Meilleur, 2002).

The preliminary records of plants used for medicine in Himalayan region were Rigveda before 6,500 years ago (Sing et al., 2012). Later, Atharvaveda (c. 2000–1000 BC), Yajurveda (c. 1200–800 BC) and the Ayurveda (c. 600–100 BC) followed the record (Kunwar and Bussmann, 2008). There are 67 medicinal plants listed in the Rigveda, 82 in the Yajurveda, and 288 in the Atharvaveda (Srikantha Murthy, 2016). Another earliest record of use of plants as medicine were from Sumerian civilization about 5000

years ago, which described 12 drug production techniques that made reference to more than 250 distinct plant species (Kelly, 2009; Petrovska, 2012).

Therapeutic herbs are seen as a major means of health care and an essential component of the culture of more than 80% of the world's population living in developing countries (Bodeker et al., 2005; Qureshi and Ghufuran, 2005). The use of such plants in traditional culture is commonly seen as being related on a long traditional medicine system (Leonti et al., 2003). Over the world, almost 50,000 flowering taxa have been employed for medical purposes (Schippmann et al., 2002). Besides traditional medical uses, global interest is developing towards medicinal plants for modern drug discovery, and most plants in drug discovery are taken from the wild (Barata et al., 2011). Hence, the study of plants and its use value play an important role as a bridge between socio-cultural and the natural sciences (DPR, 2015). Profit can be acquired from study and applied research of medicinal plants used by traditional peoples to counter various diseases (Houghton, 1995) so, in 2009, executive board meeting of WHO planned to publicize the plant medicines in national health system of South-East Asia Region (WHO, 2009).

Medicinal plants in Nepal is considered as a fundamental part of indigenous health care system and have long been collected, used and conserved by aboriginal populations, leading to the economic improvement and wealth of knowledge (Singh et al., 1979; Chaudhary, 1998). About 6500 species of flowering plants (Press et al., 2000; Shrestha and Bajracharya 2019) and over 2300 medicinal plants (Baral and Kurmi, 2006; Kunwar et al., 2018, MoFE, 2018) have been reported to occur in Nepal. About 300 species of medicinal plants are in trade (Pyakurel et al., 2019). Medicinal plants have been exported primarily to neighboring countries India and China (Ghimire et al., 2016; Chapagain, 2020).

1.2. Rationale

Systematic and dynamic exploration or discovery produces knowledge useful to the long-term preservation of indigenous knowledge, which is recognized by the Convention on Biological Diversity (CBD, 1992). Knowledge and practices of local communities is very useful to maximize benefits to local indigenous people in a sustainable way (GoN/MoFSC, 2014). The local health care system could suffer if population of *Aconitum naviculare* diminishes (Shrestha and Jha, 2010). The study is highly useful in explaining traditional culture and pressure of newly introduced culture

in the society (Pierotti and Wildcat, 2000). *Aconitum naviculare* (Brühl) Stapf was the most preferred medicinal plant in Manang (Shrestha et al., 2007). The *Amchi* of Central Himalaya ranked this plant species as the second most frequently used in traditional healthcare (Ghimire et al., 2021b). About 4–5 kg of *Aconitum naviculare* was used per *Amchi* per year as prescribed by Sowa Rigpa traditional medicine system (Ghimire et al., 2021b). The collection pattern, post-harvest techniques, application procedure and perception of local about conservation of *A. naviculare* is found to be little; hence, we would like to study.

1.3. Objectives

The general objective is ethnobotanical study of *Aconitum naviculare* in Manang district of Nepal.

The specific objectives are to:

- a) Document traditional ecological knowledge on the distribution of *A. naviculare* in Manang district.
- b) Explore traditional practices of harvesting, processing and use patterns of *A. naviculare*.
- c) Analyze community perception and practices of conservation and traditional management of *A. naviculare*.

1.4. Limitations

Present research was conducted only in mountain settlement areas: Manang-Nyesyang and Narpabhumi Rural Municipality of Manang. In terms of time, logistics, and climatic constraints, many difficulties were there. Field visit and data collection for this study was done for only one season. Because different people and NGOs regularly visited this area to gather indigenous knowledge, several villagers were little reluctant to provide information.

CHAPTER - TWO

2. LITERATURE REVIEW

2.1. Ethnobotanical study

Manandhar (1987 and 1994) mentioned wealth of information about medicinal plant from Lamjung and Kaski district of Nepal. He mentioned 66 plant species from Lamjung and 80 plant species from Kaski for the traditional medicinal uses. He mentioned that it is important to document such knowledge because many tribal people of the area hesitated to expose knowledge to outsiders; otherwise, there is risk of chance of loss of knowledge.

Altogether more than 300 useful wild plants were collected in the region of Gyasumdo, Nyesyang and Nar. A number of plants however could not be identified and in other case differences arose concerning the use, so that the inventory reproduces here includes 239 wild plants used in Manang District (77 species from Gyasumdo, 96 species from Nyesyang and 66 from Nar) (Phole, 1999).

Assessment of 42 traded high altitudinal plants was carried out from northwestern Himalayas with one species of CITES Appendix I (*Saussurea costus*) and other four species of CITES Appendix II (*Nardostachys grandiflora*, *Dactylorhiza hatagirea*, *Podophyllum hexandrum*, and *Picrorhiza kurroa*) with above two thirds of the species being traded for rhizomes, roots and bulbs (Ved and Tandon, 1998).

The study of ecological distribution and status of Medicinal and Aromatic Plants in Shey-Phoksundo National Park (SPNP) and buffer zone of Dolpa Nepal discovered 205 species of MAP in total. Of which 40 species were found in lower temperate ecozone (2500–3000 meters), 54 species in lower subalpine ecozone (3500–3500 meters), 63 species in higher subalpine ecozone (3500–4000 meters), and 20 species in alpine ecozone (above 4000 meters) with their abundance and dominance of medical plants (Shrestha et al., 1998).

The goal of the harvesting practices guidelines is to establish standards for making wild plant collections are sustainable. The guidelines included a section on the collection with 14 paragraphs, in addition to other standards for processing, storage, and documentation. Only three of these are concerned with conservation measures. These proposed harvesting practice guidelines place an excessive amount of emphasis on

quality of collection of material and a little on sustainability issues (Harnischfeger, 2000).

Ethnoecological research of buffer zone of Shey-Phoksundo National Park of Dolpo, Nepal focused on perception of people at landscape, plant population and individual level revealed that traditional healers (*Amchi*) have extensive understanding of the biology and ecology of medicinal plants as well as the surrounding environmental factors. People have a unique local system for classifying environmental elements based on structural and biophysical traits, local names, general topography, component types, and biological species that are prized culturally (Ghimire and Aumeeruddy-Thomas, 2002). Likewise, Indigenous people in Trans-Himalayan area of west Nepal have distinguished ecological zones based on types of land use. Folk classification and nomenclature of plants were based on a variety of factors, including the presence or absence of flowers, habitat, habit, morphological structure, function, and property (Rokaya et al., 2005).

Amchi (practitioners of traditional medicine system) of Buddhist tradition in the Trans-Himalayan region adopt Ayurveda, a successor of Tibetan medical system. Some indigenous system of disease treatment such as hot and cold-water bath, Medicine preparation by combining three to 40 ingredients are mentioned by Kala (2005) while studying Health traditions of Buddhist community and role of *Amchi* in Trans-Himalayan region of India. According to him, for the treatment of headache, paralysis, joint inflammation, and arthritis, flower heads of woolly plant species like *Anaphalis* or *Gnaphalium* are burned or heated and applied to certain regions of the body together with animal horns, iron, gold, and silver needles.

In addition to their significance for health care, plants have great sociocultural, symbolic, and economic aspects that support millions of people in the Himalaya through work and revenue. Biological resources including medicinal plants valued in a variety of traditional medical systems, including Ayurveda, Unani, Chinese, and Tibetan, as well as in contemporary allopathic medications. For the development of community-based management systems of MPs/NTFPs in Nepal, which address issues of biodiversity conservation as well as the promotion of local livelihood, the wealth of traditional knowledge systems and experience in community involvement in the management of forests serve as a good foundation (Ghimire, 2008).

In the Nepal Himalaya, Kunwar and Bussmann (2008) conducted ethnobotanical research. Two hundred and sixty four (264) plant species were studied with an emphasis on ethnobotany, ethnomedicine, and the diversity of medicinal plants. Of these, an average of 21-28% were reported for Nepal as being important for ethnobotany and ethnomedicine, and 55% of the region's flora has medicinal potential.

The knowledge of categorization said to have been obtained from Tibetan medicinal practice and direct field observation by agro-pastoralist, which is very beneficial for developing management guidelines (Ghimire and Aumeeruddy-Thomas, 2009). The Plant resources are regarded to be incarnations or symbols of the goods or deities. The relationship between man and trees is based on religion. There is long list of plants that related to Hindu and Buddhist religion (Majupuriya, 2009).

In their study *The Use of Medicinal Plants in the Trans Himalayan Arid Zone of Mustang District, Nepal*, Bhattarai et al. (2010) documented the traditional uses of 121 medicinal plant species, belonging to 49 vascular plant and 2 fungal families, encompassing 92 genera to treat 116 diseases. They provide information on 58 plant species in the Mustang district that were previously unknown for their medical purposes. They also provide evidence that some plant species have several medicinal uses. Typically, plant parts were produced using hot or cold water as the "solvent," though rarely, milk, honey, jiggery, ghee, and oil were used to make medicines.

4Fourty plant species were recorded from high altitude of Ladakh region of Jammu-Kashmir along Lahaul-Spiti in Himachal Pradesh, India. Dorjey et al. (2012) mentioned the use of plants in the form like, powder, juice, and plant extract for treatment of different diseases. According to them, numerous wild plants and their indigenous knowledge are in grave danger of going extinct because of anthropogenic activities such as over-exploitation, accelerated urbanization, and haphazard human activity.

Ethnobotanical knowledge of parasitic and mycoheterotrophic plant species throughout the Central- Eastern Himalayas in Nepal was well represented by Rana and O'Neill (2016). They mentioned that, about 17% of parasitic and 7% of mycoheterotrophic plant species have been identified as having ethnobotanical uses as medicines (41%), fodders (23%), foods (17%), spiritual objects (11%), and materials (8%).

Forest Act 1993 and Forest regulation act 1995 of Nepal regulate the protection of medicinal plants. National Parks and Wildlife Conservation Act, 1973 provide right to

Warden for issuing NTFPs collection license but according to the Forest Act, 2019 the right to issue the license for collecting the Non-Timber Forest Products (NTFPs) is vested with divisional Forest Officer. (Pandey and Pokharel, 2020)

Paste and powder of root of *Aconitum ferox* is said to be used to treat fever, diarrhea, vomiting, indigestion, and stomach problems by the people of Khandadevi and Gokulganga Rural Municipality of Ramechhap District of Nepal. During the study Pradhan et al. (2020) found this species is highly medicinal useful among recorded 139 plants with use value 1.03 and used as pesticides to kill rodents and wild animals also.

Resource Utilization study of Ladakh region in the trans-Himalayas of the Indian Himalayan Region revealed that, the two most prevalent religions, Islam and Buddhism, employed some of the plants, but they were mostly used for therapeutic purposes by cultural that has been passed down orally from one generation to the next. Based on their availability during specific pheno-phases as indicated by the Tibetan traditional calendar, people harvested the plant components. (Haq et al., 2021).

2.2. *Aconitum naviculare* (Brühl) Stapf

Genus *Aconitum* is highly toxic plant with aconite which affect mainly the central nervous system, the heart and gastro intestine (Lin et al., 2004) but about 76 of all aconite species from China and neighboring Asian countries are of highly significance in traditional medicine (Nyirimigabo et al., 2014). According to Ma et al. (2015), among *Aconitum* species used in Tibetan medicine, *A. naviculare* is a plant with low toxicity.

Generally, *A. naviculare* grow on open rocky dry slopes (Shrestha et al., 2006b) but Shreatha and Jha, (2010) found temperature and anthropozoogenic pressure as determining factors for abundance and distribution of this species. They also mentioned some adaptive features (winter perennating bud, shoot and leaf meristem buried inside soil with sufficiently developed tuberous root, globular blue flower, persistent sepals and rapid germination of seed after moistening) in their findings while studying life history and population status of the *Aconitum naviculare*.

Isolation of many compounds from medicinal plants was proved by history of ancient idea, thought, or theory (Gajalakshmi et al., 2011). Gao et al. (2004) collected *Aconitum naviculare* from National Forest Park of Huzhubei Mountain, Qinghai province, China and isolated six diterpenoid alkaloids named as navirine, isoatisine, hordenine, atisine,

hetisinone and delfissinol at first time from the ethanol extract of whole plant. Similarly, three flavonoid glycosides` were isolated from the aqueous extract of the aerial parts of *Aconitum naviculare* collected from upper Manang, Nepal located at elevation of 4100 m asl by Shrestha et al. (2006a).

Two diterpenoid alkaloids, navirine B, and navirine C, along with four acid were isolated from the aerial parts of same species of Manang, Nepal (4100 m. asl.) by Dall'Acqua et al. (2008). Correspondingly, Cao et al. (2008), assayed *A. naviculare* located at altitude of 4100-5000 m in China used for Chinese traditional medicine for alkaloids. They found two C20-diterpenoid alkaloids named naviculine A and naviculine B. Both alkaloids were also analyzed for anti-HIV-1 activity but woefully both compounds did not show any bioactivities. He et al. (2017) carried out similar work and isolated three biditerpenoid alkaloids, (navicularines A–C) and three diterpenoid alkaloids (chellespontine, hetisine, and heteratisine) from the species collected from Lhasa, an autonomous region of China. They found only navicularine B exhibiting some cytotoxic activities in-vitro among isolated six compounds against five human cancer cells (cervix cancer, liver cancer, lung cancer, breast cancer and colon cancer).

The way of making medicine by the people of 13 villages of Manang District of Central Nepal to cure fever and jaundice using *Aconitum naviulare* is mentioned by Bhattarai et al. (2006) as half pons of powder from dried whole plant is mixed with two spoon of Chauri ghee and taken two times a day. In that study, *A. naviculare* is said to be one out of documented 91 medicinally valued plant species. Addition to fever, Pandey (2006) mentioned that *Aconitum naviculare* is used to recover disorder in gall bladder, food poisoning along various communicable diseases in Upper Mustang of Nepal as traditional Tibetan therapy system.

Bhattarai et al. (2010) carried out comparable study in Mustang District of Nepal. He found this species used by people for fever, headache, bile and liver diseases using similar process. Doctors in Nepal say not to use oil in food when people get suffered from fever, but above mentioned method of using this medicine with ghee is very interesting (Bhattarai et al., 2010).

Yak herders of Mustang District of Nepal were found using *A. naviculare* to cure health disorders like fever and jaundice. People take mixture of about 15 g of decoction of

whole plant and a cup of hot water BID after meal (Acharya and Kafle, 2015). In addition, Sherpa et al. (2019) studied traditional *Amchi* practices among indigenous Communities of Nepal. They found indigenous communities of Nubri and Kutang valleys of Gorkha district of Nepal use root of this species as a remedy to defeat the poison effects as well as to eliminate fever.

2.3 Research gaps

Most of the researchers have worked on isolation of compounds from *A. naviculare*. It is important to address the medicinal merits and demerits from isolated compounds as it has been found to be minimal. Similar to this, some researchers have noted this species as a therapeutic plant while conducting research in a particular area or culture, but they have infrequently conducted an ethnomedical study with this species alone. Further ethnomedicinal research is required with this species. Nobody has conducted an ethnobotanical study of this particular species' therapeutic usefulness. Ethnobotany of *A. naviculare* must be discussed, with a focus on ethnomedicine.

CHAPTER - THREE

3. MATERIALS AND METHODS

3.1. Study area

3.1.1. Physiognomy and ecology

Geographically, Manang district extends from 28° 27' to 28° 54' N latitude and 83° 40' to 84° 34' E longitude covering an area of 2246 sq. km. The district is bordered on the east by Gorkha and Lamjung districts, the west by Myagdi and Mustang districts, the north by Mustang district, and the south by Lamjung and Kaski districts. Tāl, which has elevation of 1680 m, is the lowest point and Mt. Manaslu with elevation 8163 m is the highest elevation point of the Manang district (CBS, 2015).

Manang, located at the north-central region of Nepal has greatest Trans-Himalayan tract, which is drained by the main waterways of Marsyangdi River. Ecologically, Manang district is classified into three regions: Nyesyang, Nar-Phu, and Gyasumdo. There is a forest of pine and fir with little summer rainfall in the Nyesyang valley. The Nar-Phu valley experiences far less wind than neighboring areas. There are no trees found over 3900 m. Snow typically starts falling in Nyesyang and Nar-Phu at the end of December and lasts into February. Sometimes snow starts falling early, while other times snow lasts until March (Gurung, 1976; Negi, 1994).

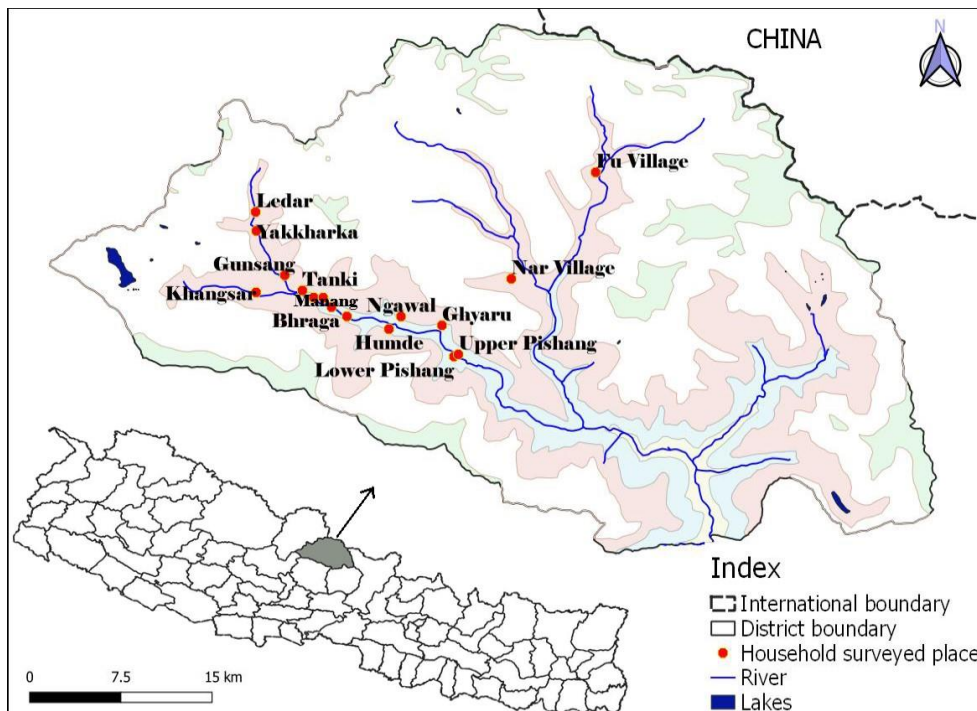


Figure 1: Map of the study area

The study area covers two rural municipalities, viz. Manang-Nyesyang and Narpabhumi. The study was conducted on 11 sites (Pishang, Ghyaru, Ngawal, Humde, Bhraga, Manang, Tanki Manang, Khangsar, Gungsang, Yakkharka and Ledar) starts from Pishang (3214 m) to Ledar (4237 m) lying between 28.614427° to 28.73884° N latitude and 84.147866° to 83.97308° E longitude of Manang-Nyesyang and Nar (4205 m) and Phu (4072 m) lying between 28.681323° to 28.772987° N latitude and 84.198388° to 84.272751° E longitude of Narpabhumi (Figure 1).

3.1.2. Climate

As Manang consists of four climatic zones, viz. temperate, subalpine, alpine, and tundra, it has cold to extreme cold climatic conditions (Paudel et al., 2021). The mean annual precipitation of Manang over years 1971 – 2012 was 800 – 1000 mm in upper belt and 1000 – 1600 mm in lower belt with daily extreme precipitation variation of 100 – 150 mm. Over the years 1971 – 2012, the mean maximum air temperature of Manang was 0 – 4°C and mean minimum air temperature was –8 to –4°C with daily extreme minimum temperature variation of –20°C to –15°C and daily extreme maximum temperature variation less than 15°C in higher belt and 16 – 20°C in lower belt (DHM, 2015).

3.1.3. Vegetation

Manang, a district to the main Himalayan axis falls under the arid or Trans-Himalayan vegetation zone. Due to the towering mountains blocking the southwest monsoons, this area gets relatively little rain (Stainton, 1972; Negi, 1994). Three different vegetation zone falls in the district, viz. upper temperate, subalpine and alpine vegetation zone (Jackson, 1994).

Vegetation types found in the Manang include *Abies-Quercus-Tsuga* forest (*Abies* species, *Quercus* species and *Tsuga dumosa*), *Pinus-Abies* Forest, *Abies spectabilis* forest, *Juniperus recurva* forest, *Juniperus indica* forest, *Betula-Rhododendron* forest. In similar way, *Caragana* (*Caragana sukiensis*, *C. gerardiana* and *C. versicolor*) scrub, *Hippophae tibetana* scrub, *Rhododendron* scrub and *Juniperus* scrub are shrubs found in Manang (Figure 2) (MoFE, 2021).

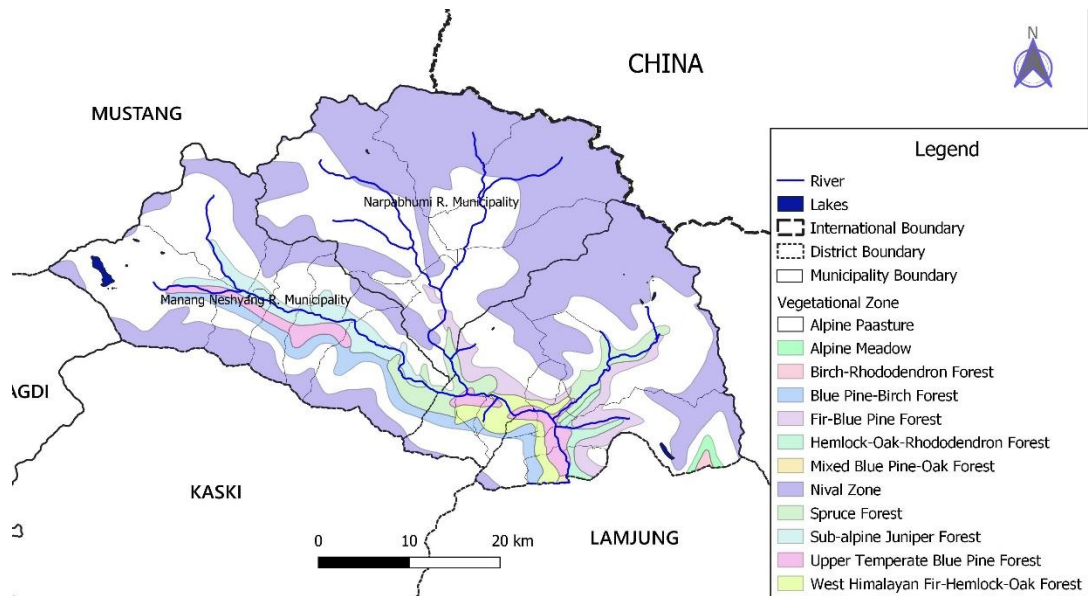


Figure 2: Map of Manang showing different vegetational zones

Manang is rich in valuable medicinal herbs, such as sugandhawal (*Valeriana jatamansi*), pashanved (*Bergenia* sp.), chiraito (*Swertia* sp.), jatamasi (*Nardostachys jatamansi*), padamchal (*Rheum australe*) and panchaule (*Dactylorhiza hatagirea*). Poisonous useful plants such as atis (*Aconitum* sp.), Satuwa (*Paris poliphylla*) are also found in this region (Pohle, 1990). Altogether, 91 species of ethnomedicinal plants (Bhattarai et al., 2006), 16 species used as fence and fuelwood (Bhattarai et al., 2007), 20 rituals and religious plant species (Bhattarai et al., 2008) and 41 wild edible plant species (Bhattarai et al., 2009) were documented from Manang.

3.1.4. Demographic / ethnic composition

Manang is among the least populated districts of Nepal. The total population is 5658, which occupies only 0.02% of total population of Nepal (NPHC, 2021). According to final report of National Population and Housing Census 2021, there are 3,192 males and 2,466 females in this district (Table 1).

Out of 19 ethnic communities of Manang district, the main ethnic groups of Manang-Nyesyang and Narphumi are Gurung, Ghale and Bhote (CBS, 2014). Gurung and Ghale are culturally oriented partly towards Tibetan Buddhists tradition and partly Nepali Buddhist or Hinduism. The Lama or Bhote are firmly rooted in the religious tradition of Buddhism and cultural tradition of Tibet. They are Tibetan immigrants who come to the area during late 19th and early 20th century (Gurung, 1976)

Table 1: Demographic information of study area (NPHC, 2021)

S.N.	Demographic features	Manang-Nyesyang Rural Municipality	Narpabhumi Rural Municipality
1.	Number of household	548	125
2.	Number of family	558	125
3.	Total population	1584	398
4.	Total male population	818	170
5.	Total female population	766	228

3.1.5. Socioeconomic conditions

The upper Manang valley has abundant pasture (Pohle, 1990). Thus, the people of Manang belong especially an agro-pastoral community. The major source of income and livelihood of ethnic people (Gurung and Bhote) were farming of livestock, such as yak, sheep, cattle and goat and its products either consumed directly or exchanged for money (Ale, 2000). In present days, only a few households are involved in yak farming, majority have shifted towards business and tourism as a major economic activity due to the increasing number of tourists in the area. There are many hotels, lodges, and other businesses related to tourism today (Chapagain, 2016).

Local people were initially involved on local and regional trade during 1970s and was extended to national and international level by 2000 (Chapagain, 2016). Until the early 1960s, Manang was reported as the main corridor of salt and wool trade route. People started to engage in international trade (in Hong Kong, Thailand, etc.) after the end of salt trade and presently after 1980, tourism is one of the sources of earning to sustain livelihood (Chhetri, 2014).

During the field survey, it is found that the population, who also engage in small-scale commerce, grows barley and potatoes. Availability of transportation facilities and introduction of new technology people are involved in growing new vegetables like cucumber, tomato, radish, cauliflower, and cabbage in polyhouse. Because of the harsh winter weather, people move from upward to low valley during December to winter quarters with their herd. From there, some individuals, mostly young people, traveled out to the south to trade yak products, wool, dried cheese, spices (jimbu), and a few

medicinal herbs. In present time, apple farming is also growing and becoming secondary livelihood earning of study area.

3.1.6. Conservation practice

Manang is a part of Annapurna Conservation Area Project (ACAP). ACAP look after the resources of the area and safeguard the quality of life of people (NTNC, 2021). The ACAP was founded to lessen issues with environmental deterioration in the Annapurna region and to raise the standard of living there by active involvement of the community at all development stages, including planning, implementation, and evaluation (KMTNC, 1997).

To minimize the soil erosion and crop damage Manang people have been using different plant species. Some villagers no longer gather furniture and fuelwood from the nearby forest as they did in the past; instead, they now gather from the neighboring community. This is a good illustration of conservation and forest management awareness (Bhattarai et al., 2007). The collection of medicinal plants such as yarsagumba is required the permission from ACAP in this area. No one are allowed to kill wild animals or trade, and transport their products. If s/he is found to have done so, he will be dealt with according to the rules. This rule is helping to protect the area (NTNC, 2021).

3.2. Study species

Aconitum naviculare (Brühl) Stapf (syn. *Aconitum ferox* var. *navicularis* Brühl) is a small perennial herb having 5-30 cm height with upright or erect stem. Roots are white, fusiform or tuberous. Leaves are mostly basal, rounded and, palmately divided into 3-5 entire or toothed lobes. Flowers 1 – 4; sepal boat shaped hairy, white or blue-violet with darker veins. Petals recurved; head 0.3 – 0.5 cm. Fruit are five follicled, 1 – 1.2 cm long enclosed by sepals. Flower bloom between July to September and fruiting begins in october (Lama et al., 2001; Ohba et al., 2008; Dall'Acqua, 2011; Ghimire, et al., 2014).

3.2.1 Habitat and distribution

Aconitum naviculare grows in the subalpine to subartic, open and dry rocky slopes, shrubland, juniperous scrub and meadows (Roskov et al., 2023). Out of 28 species of *Aconitum* found in Nepal (Shrestha et al., 2022), the native range of *Aconitum naviculare* is Himalaya to southern part of Tibetan plateau. It is distributed in Bhutan, north India (Sikkim), Southern part of Tibetan plateau and Nepal (Lama et al., 2001;

Ghimire et al., 2014; Roskov et al., 2023). It is endemic to Himalaya (Ghimire et al., 2014; DPR, 2016), distributed in dry south facing slopes of Central Nepal between 4090-4650 m asl with sclerophyllous and thorny alpine scrubland (Shrestha and Jha, 2009). The elevation ranges of the species is between 3000 to 4900 m in Sikkim (Agnihotri et al., 2015) and 4200 to 4900m in Nepal and Tibet (Lama et al., 2001; Cou et al., 2008; Ghimire et al., 2021b).



Figure 3: *Aconitum naviculare* (Ledar, Manang; October 19, 2022 © Bharat Babu Shrestha)

3.2.2 Traditional uses

Among the *Aconitum* species, *A. naviculre* is a plant species with low toxicity (Ma et al., 2015). It is used with other herbs to treat health problems, such as bile fever, headache, poisoning, fever due to poisoning, and infections. (Lama et al., 2001). Flower, leaves, stem and tuber of the plant are used to treat arthritis, cough, food poisoning, general poisoning, infectious diseases, intestinal pains, and skin infection by detoxifying it (Ghimire et al., 2021a). This plant ranks as the second most frequently utilized in traditional medicine by the *Amchi* of central Himalaya (Ghimire et al., 2021b). According to the Sowa Rigpa traditional medical system's recommendations, 4-5 kg of *Aconitum naviculare* were utilized per *Amchi* per year (Ghimire et al., 2021b).

3.3. Data collection

Primary data were collected by applied ethnobotanical approaches mentioned by Martin (1995) and Cunningham (2001), such as map reading, household survey and key informant interviews and direct field observations.

3.3.1. Ethical consideration

Prior to undertaking research, the objectives of the study were discussed with respective authorities, and permission to conduct research was obtained from Department of National Parks and Wildlife Conservation, Babarmahal Kathmandu and Annapurna Conservation Area Project (ACAP), Headquarters, Pokhara (Appendix I). In the villages, prior informed consent (PIC) was obtained by discussing the objectives of the study with the respondents (Martin, 1995). The objectives and methods of the study, the benefits and risks associated with the study, and the method of data store and evaluation were explained to the respondents before collecting data.

3.3.2. Map reading

Political map and topographic map were collected from the Department of Survey of the Government of Nepal. A political map was used to describe boundaries and major villages. Topographic map was used to show elevation, vegetation cover, boundaries, and the configuration of an area's natural and manmade physical characteristics (topography). Google map was used to collect information about collection site of different villages.

3.3.3 Household survey

3.3.3.1 Selection of interviewees

Interviewees were selected using exponential non-discriminative snowball sampling. This method uses a geometric chain sampling sequence, where locating a single suitable participant is the first step in creating a sample population. This participant then goes on to refer more possible research subjects, and so on, until enough respondents for a study is found (Kolaczyk, 2009; Chan, 2020). When performing qualitative research with a population that is difficult to identify, this sampling strategy might be employed extensively. Due to the fact that referrals are from reliable sources, finding subjects is simple and quick. Some people are reluctant to volunteer for research projects because they do not want their identities to be made public. In this circumstance, snowball

sampling is helpful since they seek references from acquaintances (Biemacki and Waldorf, 1981). Therefore, we use this method for sampling.

3.3.3.2 Semi-structured interview

Field survey was carried out using semi-structured interview method. A set of questions (Appendix II) were prepared before going to the field and other questions were raised during the interview depending on the responses of the respondents. Interviews were taken during 18th October to 1st November 2022 to 53 informants of Manang-Nyesyang Rural Municipality. They were interviewed in their own villages. Additionally, 12 informants of Narpabhumi Rural Municipality were interviewed during 12th to 16th December 2022 in Kathmandu (Nagarjun Municipality – 2, Raniban and Nagarjun Municipality – 4, Sitapaila). Local people were interviewed mainly about their concern and knowledge of *Aconitum naviculare* on use, ecology and habitat, collection sites, collection process and quantity, knowledge transformation, trade status, conservation status and available quantity stock for use.

3.3.4 Key informant interview

A total of 11 key informants (one traditional healer, one school teacher, five Conservation Area Management Committee members of Annapurna Conservation Area Project and four local government members) were interviewed during the same time (18th October to 1st November 2022) using exponential non-discriminative snowball sampling method. Specimen display and semi structured interview were conducted (Appendix III) for key informants. Key informants' interview was more focused on management and conservation practice of the species.

3.4. Data analysis

A compiled set of data had been prepared using the perception and knowledge of local people towards location, collection site, harvest time, harvest amount, use for, use process and dose of *Aconitum naviculare*. The data were evaluated semi-qualitatively in descriptive methods such as tabulation, pie charts, bar graphs, figures, and maps. Free source software R-studio was used to analyze significant difference between the ages of respondents who were involved in collection through Welch Two Sample t-test. Similar way, open source QGIS software was used to analyze information through maps after mentioning the distribution and mapping the resource.

CHAPTER – FOUR

4. RESULTS

4.1. Ecological knowledge of local communities

All respondents of the survey reported that *Aconitum naviculare* is found on south-west facing slopes. They also reported that bluish-white or purple flowers and rounded leaves with toothed lobes are its major distinguishing characteristics. Fifty-three respondents named *Aconitum naviculare* locally as ‘Pongkar’, followed by ‘Ponkarpa’ (11 respondents), ‘Ponkarma’ (8 respondents) and Bhonkar (4 respondents) (Figure 4).

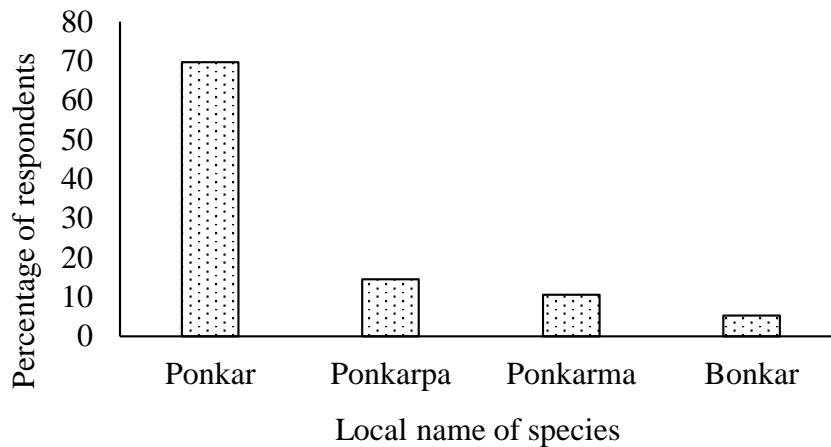


Figure 4: Local name of *A. naviculare* given by the local people in Manang

Eighty three percent of the respondents mentioned that *A. naviculare* grows on scrublands. Only a few respondents (5%) reported that the species also grow on grassland. Nearly 12% said that the plant grows on both shrubland and grassland (Figure 5)

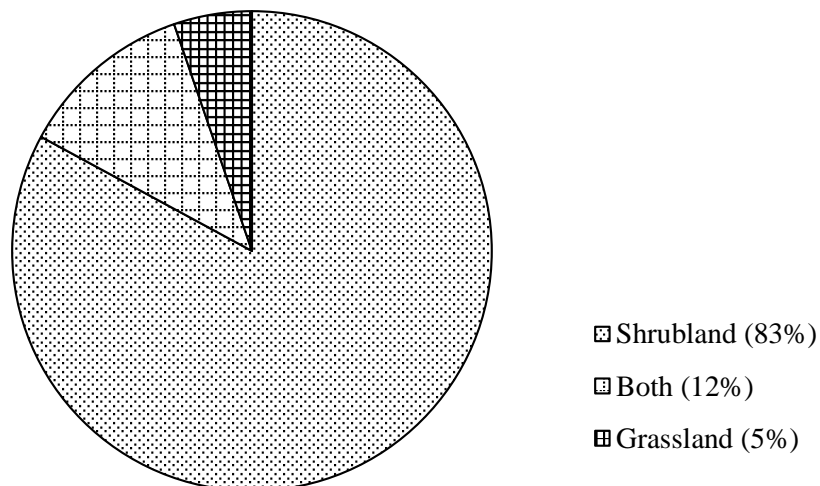


Figure 5: Habitat of *Aconitum naviculare* according to local knowledge

According to the knowledge of the people interviewed during the study and the data compiled later using Microsoft Excel, *Aconitum naviculare* begins to germinate in April and starts to grow more in May and June. After growing, it sets about to bud from the end of June or the beginning of July and starts blooming well in August. Its flowers are fully matured in August/September and fruiting starts during the end of September and October (Figure 6).

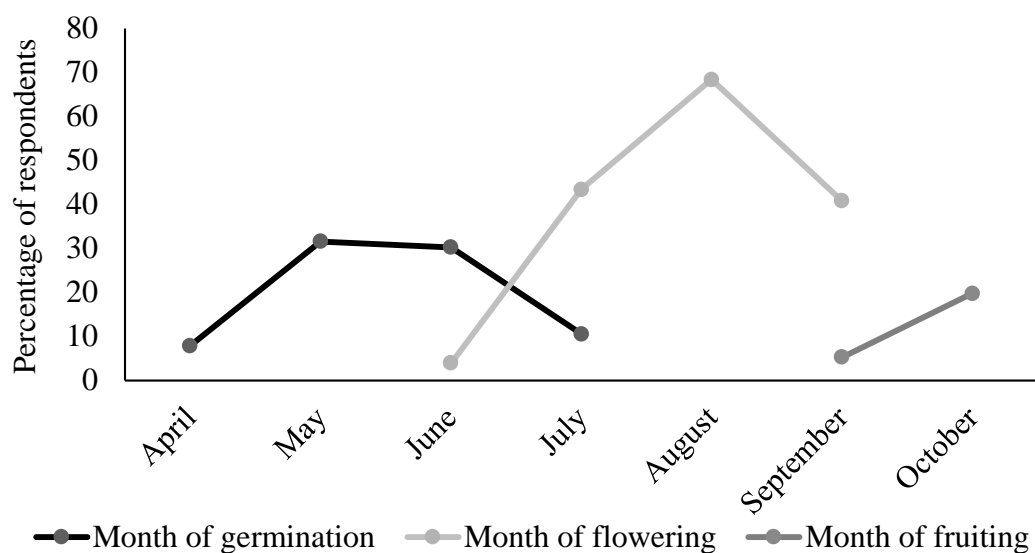


Figure 6: Phenology of *Aconitum naviculare* based on traditional knowledge

4.2. Distribution and collection

Information of household survey and then direct field inspection revealed that, *Aconitum naviculare* was found in the places from 4146 m ('Ghorkeyang' above Ghyaru) to 4416 m (near throng Phedi) of Manang-Nyesyang Rural Municipality and 3835 m ('Jyagometa' near Nar village) to 4629 m ('Thatong' above Phu village) of Narpabhumi Rural Municipality. *Aconitum naviculare* was reported to be found at eight places (Ghyorkang, Koncho, Ice Lake, Manang Pang, Alke above Shreekharka, above Yakkharka, above Ledar and near Throng Phedi) in Manang-Nyesyang Rural Municipality and 11 places (near Kangla Phedi, Jyagometa, Lephe, Hemchong, Dhamla, Chongche, Kurusangpo, Bakhal, Ngoru, Salde, Sangache, Kulung, and Thatong) in Narpabhumi Rural Municipality (Figure 7).

People of Nar, Phu, Ghyaru, Ngawal, and Khangsar villages collected *A. naviculare* from nearby places of their own. However, the collection sites for the people of Mungji, Bhraga, Manang, and Tanki manang were found to be above Yakkharka and Ledar area.

The species was not found in Pishang and Humde area; therefore, people of these two settlements obtained *A. naviculare* from people of other settlements. For example, people of Pishang often received it from people of Nar, Phu and Ghyaru, while the people of Humde received it from people of Manang (Figure 7).

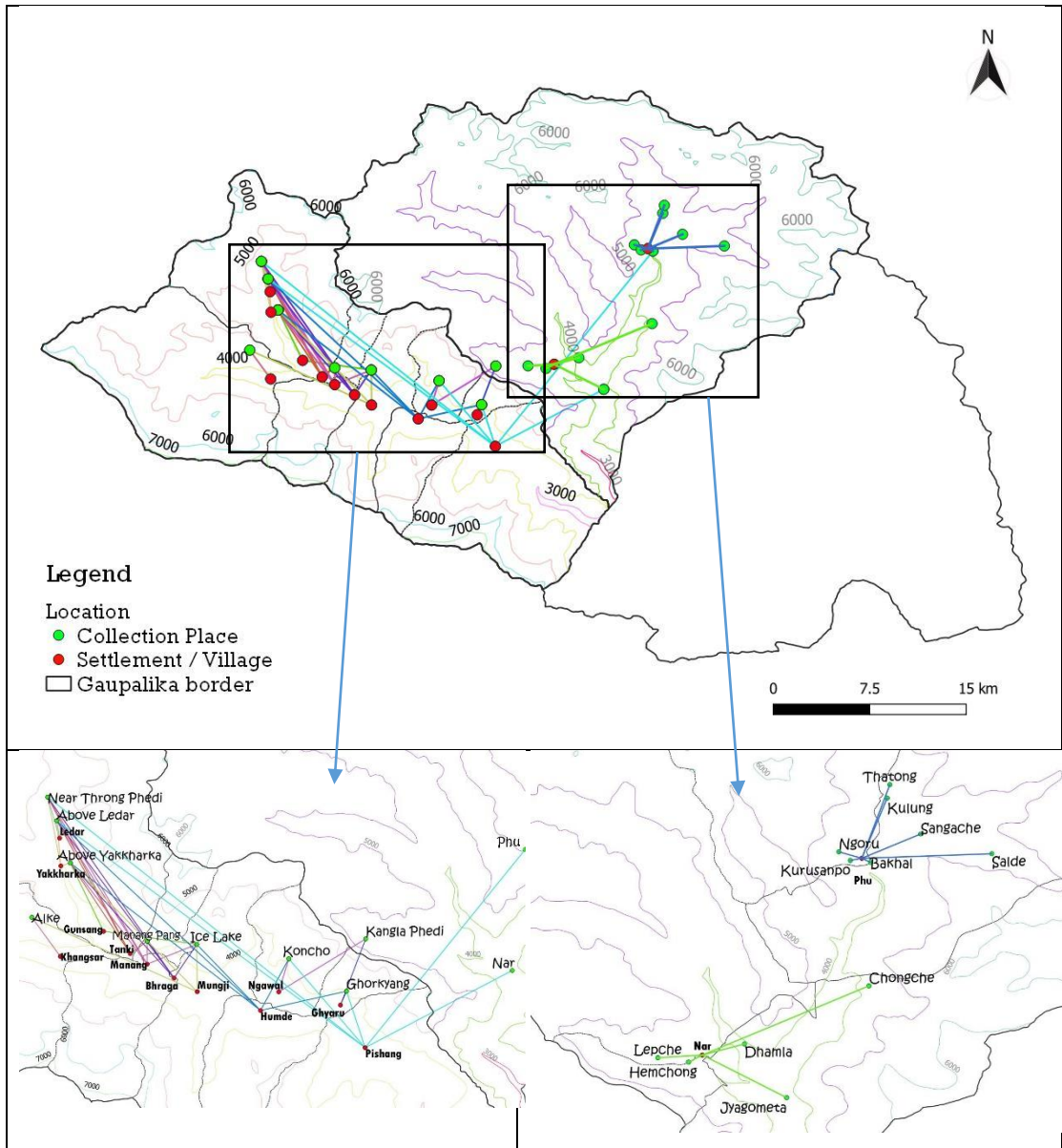


Figure 7: Map of Manang District showing surveyed villages with respective collection places

The mean age of the respondents was 52 years (range 23 to 83). Welch Two Sample t-test revealed that there was significant difference between the age of respondents who were involved in collection and those not involved ($p = 1.99 \times 10^{-5}$). Results demonstrated that not all aged people were involved in collection. On average, age of

people involved in collection were reported to be 46 ± 12 year and age of people who did not involve in collection were reported to be 61 ± 14 year (Figure 8).

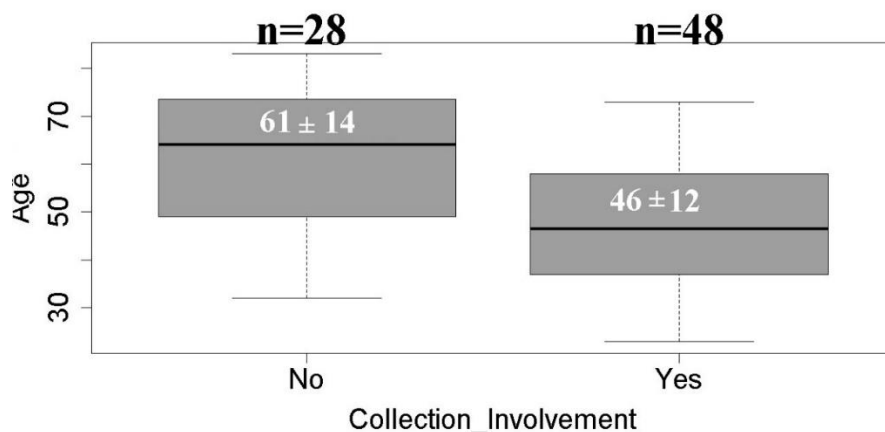


Figure 8: Age of interviewed respondents involved in collection

Variation in estimated quantity collected in one season with different households is shown in Figure 9. The average estimated quantity collected in one season by a household was found to be high in Manang village (186 g), Phu village (165 g) and Yakkharka-Ledar (126 g). It was relatively low in Pishang (13 g) and Munjgi-Bhraka (66 g). People of Humde were found not involved in collection. Therefore, average estimated quantity collected in one season by people of Humde village was considered zero.

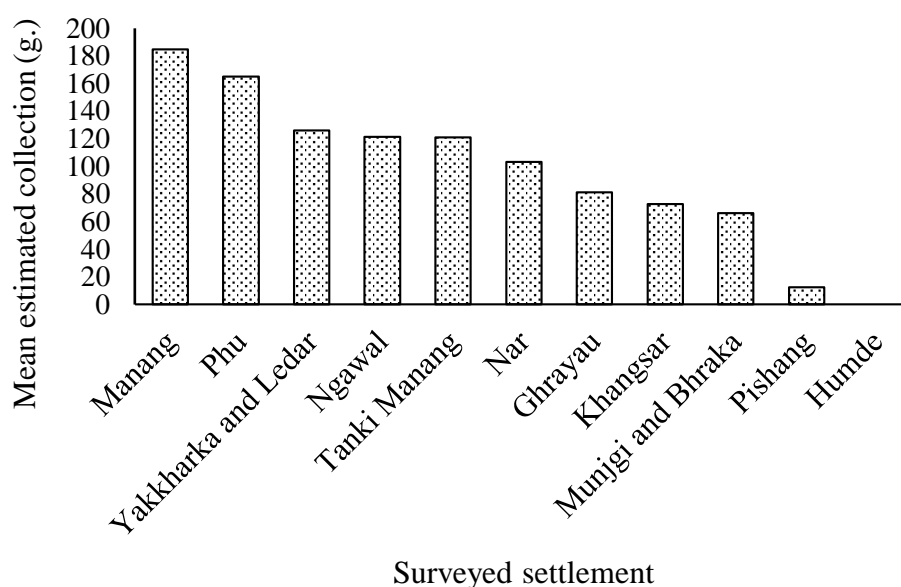


Figure 9: Average estimated quantity (air dried mass) per household collected in one season by a people in different studied villages in Manang

According to the respondents, flowering period was the best collection time of *Aconitum naviculare*. Highest percentage of respondents (67%) reported that they have been collecting the plant during August (Figure 10), which is the peak flowering season of *Aconitum naviculare*. Some respondents (11%) also collected the plant during July. Hand picking was found to be customary practice for collection of above ground parts. Most people collected and used above ground parts of the plant. Few people (4%) were found collecting roots (tuber) by uprooting with the help of whip.

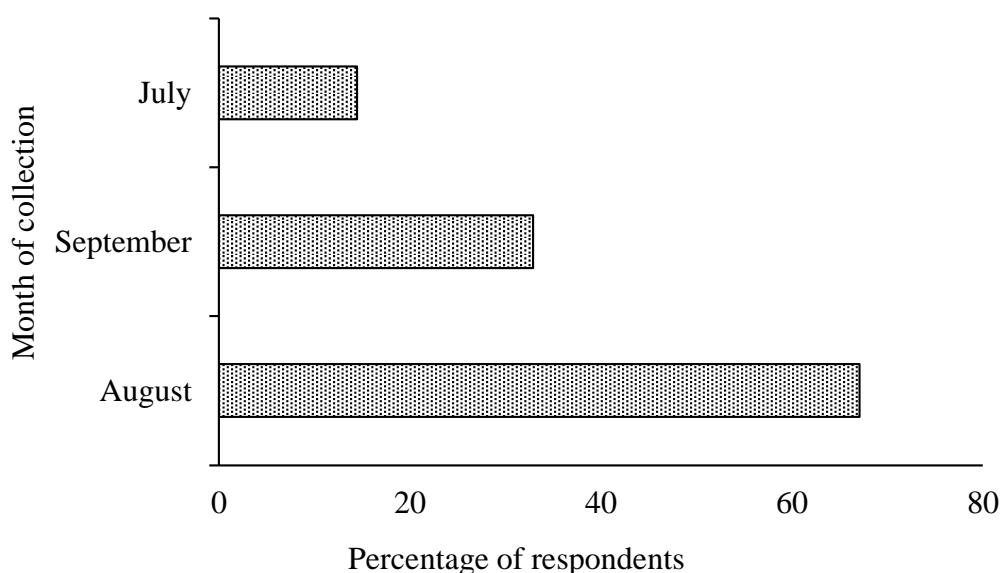


Figure 10: Percentage of respondents collecting *Aconitum naviculare* during different months

4.3. Post-harvest processing and storage

Peoples of Manang to whom we interviewed were found using two drying methods before storage after picking and bringing the plant parts: sun drying and shade drying. More than half (52%) of the respondents said that shade drying method is better than sun drying method preferred by only 48% respondents (Figure 11). Five storing processes were recorded. Most people were found storing in plastic bags. People who followed shade drying method preferred storing by making bundle and hanging. Other methods of storing included wrapping inside cotton bag and keeping inside glass or plastic jar (Figure 12).

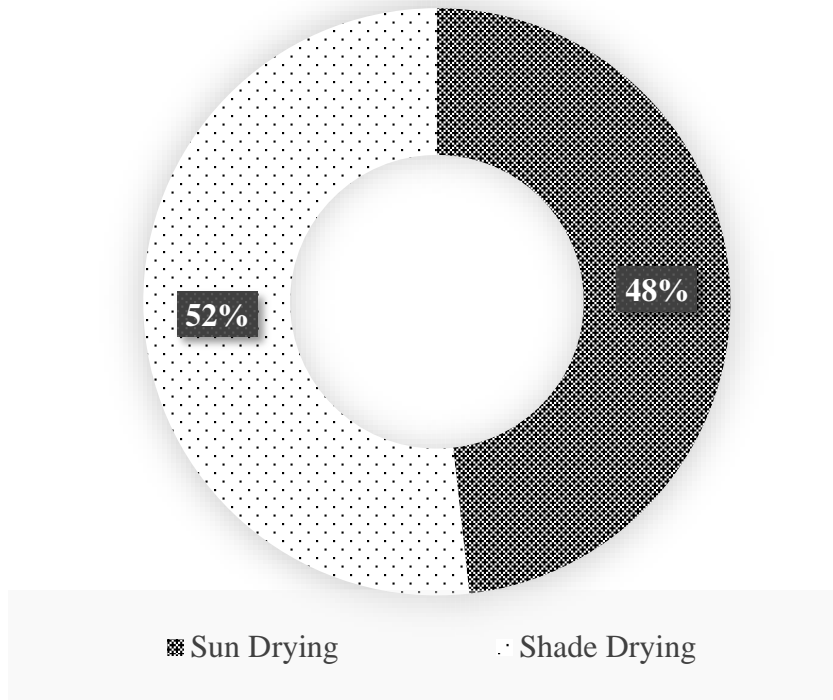


Figure 11: Drying methods preferred by people interviewed

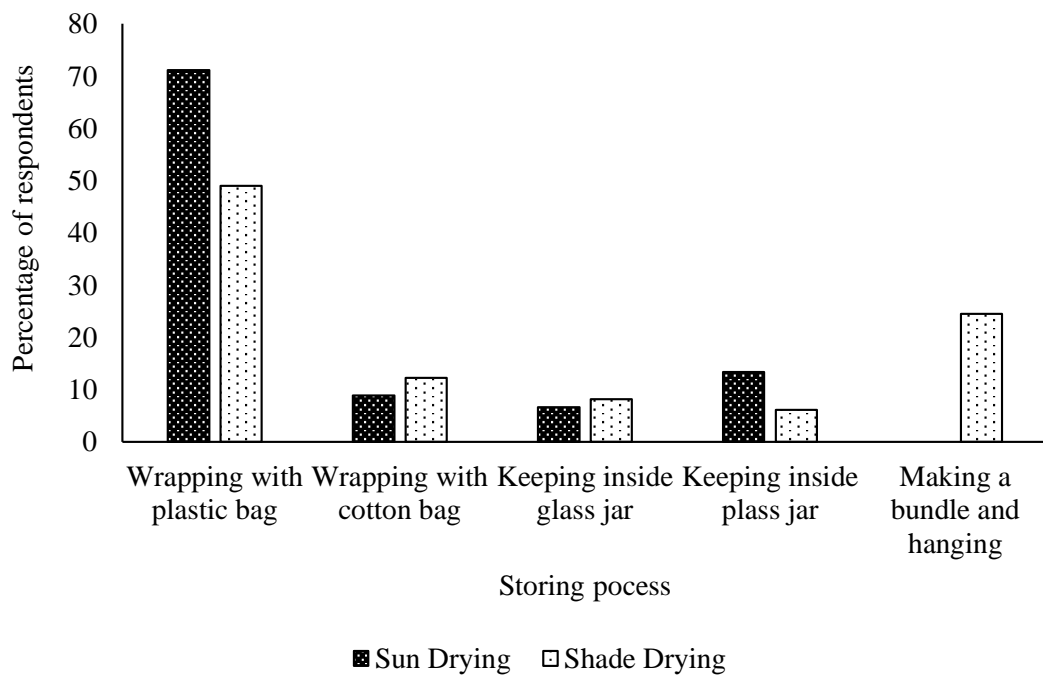


Figure 12: Storing processes preferred by respondents who follow different drying method

4.4. Ethnobotanical uses of *Aconitum naviculare*

Fever (39%), common cold and cough (30%), and hypertension (17%) were main diseases that were found to be treated by majority of people interviewed in the study area using *Aconitum naviculare*. Additionally, the plant had been also considered useful in the treatment of diabetes (6% of respondents), Jundice (5% of respondents), and poison effect (3% of respondents) (Figure 13). It was found that people used *A. naviculare* as medicine in four ways (Figure 14).

1. Boiling a small amount (0.83 ± 0.53 g) aboveground part of *A. naviculare* in water for 5 – 10 minutes and then drinking it after making the water lukewarm.
2. Boiling a small amount (0.83 ± 0.53 g) aboveground part of *A. naviculare* in water for 5 – 10 minutes adding some additives (kutki, yeli, and ghee) and then drinking it after making the water lukewarm.
3. Soaking a small amount aboveground part of *A. naviculare* in water for 5 – 10 minutes and drinking the water.
4. Directly taking a small amount of powdered *A. naviculare* leaves or stem and then drinking lukewarm water.

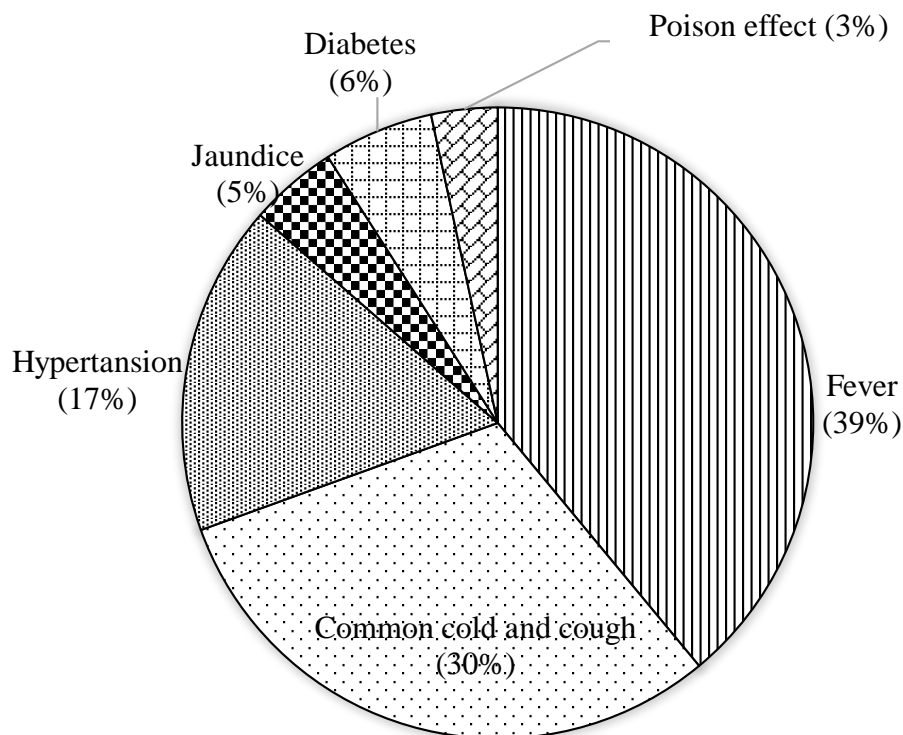


Figure 13: Diseases treated using *Aconitum naviculare* by the respondents (figures in percentage indicate percentage of respondents who use plant for particular ailments)

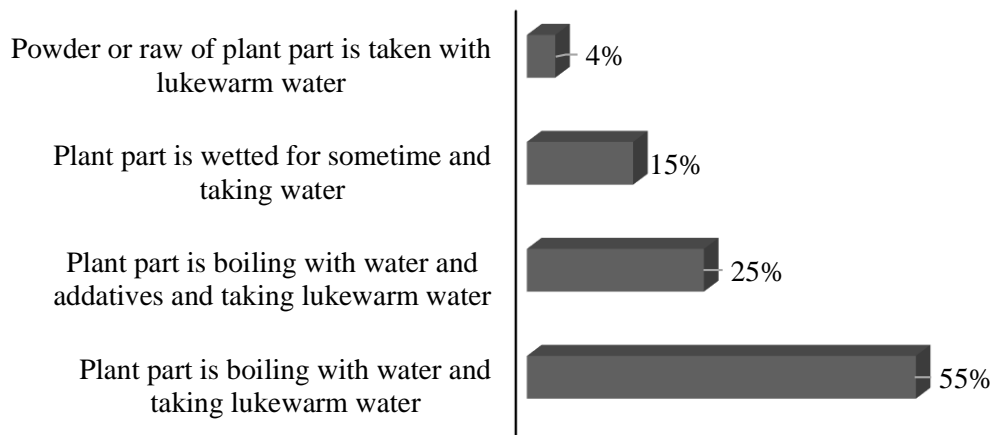


Figure 14: Methods of preparation of medicine (figure in percentage indicate percentage of respondents who prefer different method of medicine preparation)

All the informants who used it by soaking or boiling said that they drink only a glass of decoction 1-2 times a day. People who consume its powder took one teaspoon a day with a glass of lukewarm water. In most cases, the plant had been consumed only for two to three days. The informants said that if people used more than that, body would become weak due to low blood pressure, diarrhea. Vomiting and sever kidney problems may be caused as it has high bitterness (Figure 15).

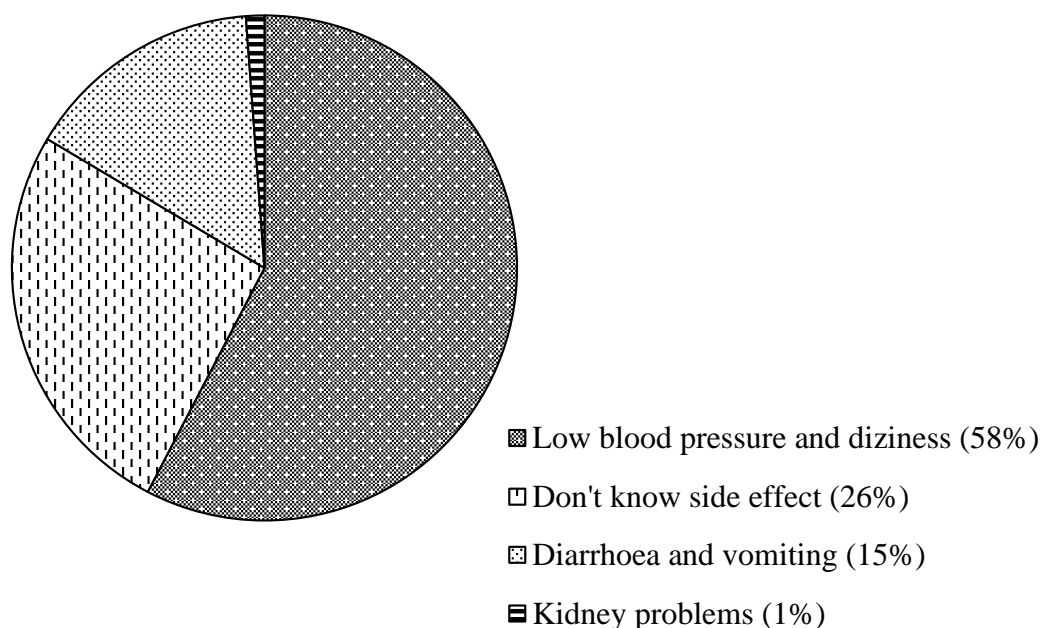


Figure 15: Side effects of *Aconitum naviculare* (figure in bracket indicate the percentage of respondents who told about respective side effect)

When quantifying the amount used at a time, it was found that 41% informants used 0.51 to 1.00 g at a time. Similarly, 26% of people were found using both below 0.50 g as well as 1.01g to 1.50g. Few people (3%) reported using more than 1.51 g at a time (Figure 16). The mean quantity used for one dose is calculated as 0.83 ± 0.53 g.

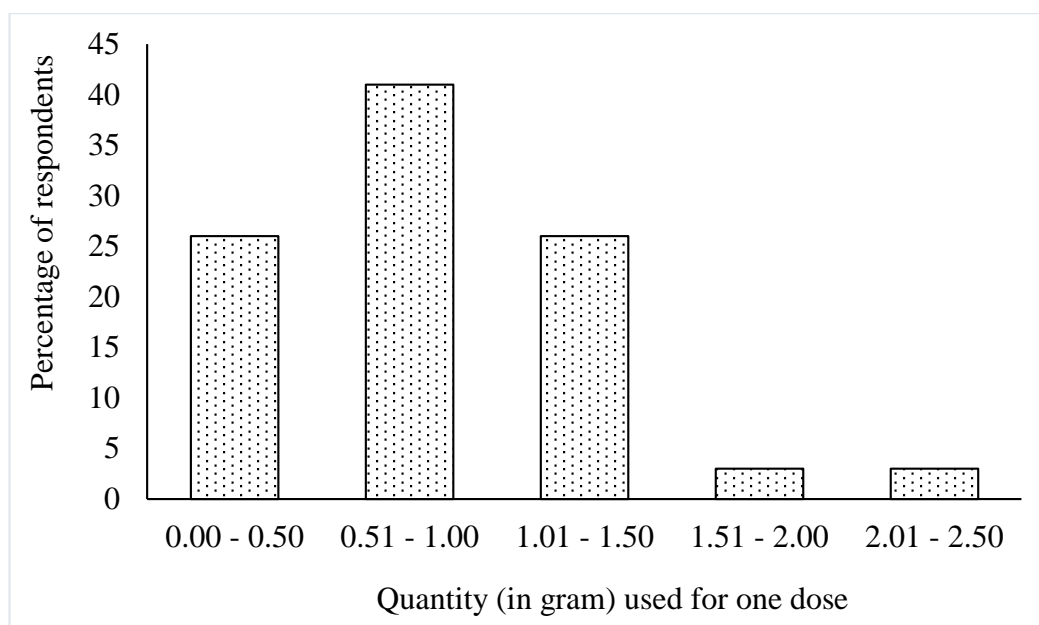


Figure 16: Quantity of aboveground part used for one dose

Out of 76 interviews (65 household survey interview and 11 key informants' interview), 41 informants had the stored stock of *A. naviculare* in their home. Weighing the stored stock, we found a minimum of 3 g to a maximum of 400 g with mean of $80.64 \text{ g} \pm 93.14$ g stock per household. Among the 11 settlements (9 wards in Manang-Nyesyang Rural Municipality and 2 villages in Narpabhumi Rural Municipality), the most stock keeping households were found in Bhraka where 88% of the households showed stock while the least stock keeping households were found in Humde where only 20% of the households showed stock quantity. Similarly, 78% households of Manang, 67% households of Nar, 63% households of Phu, 60% households of Ghyaru, 57% households of Ngawal, 50% households of Tanki Manang, 38% households of Khangsar, 36% households of Yakkhark-Ledar, and 33% of households Pisang were found to have quantity of dried aboveground parts (Figure 17).

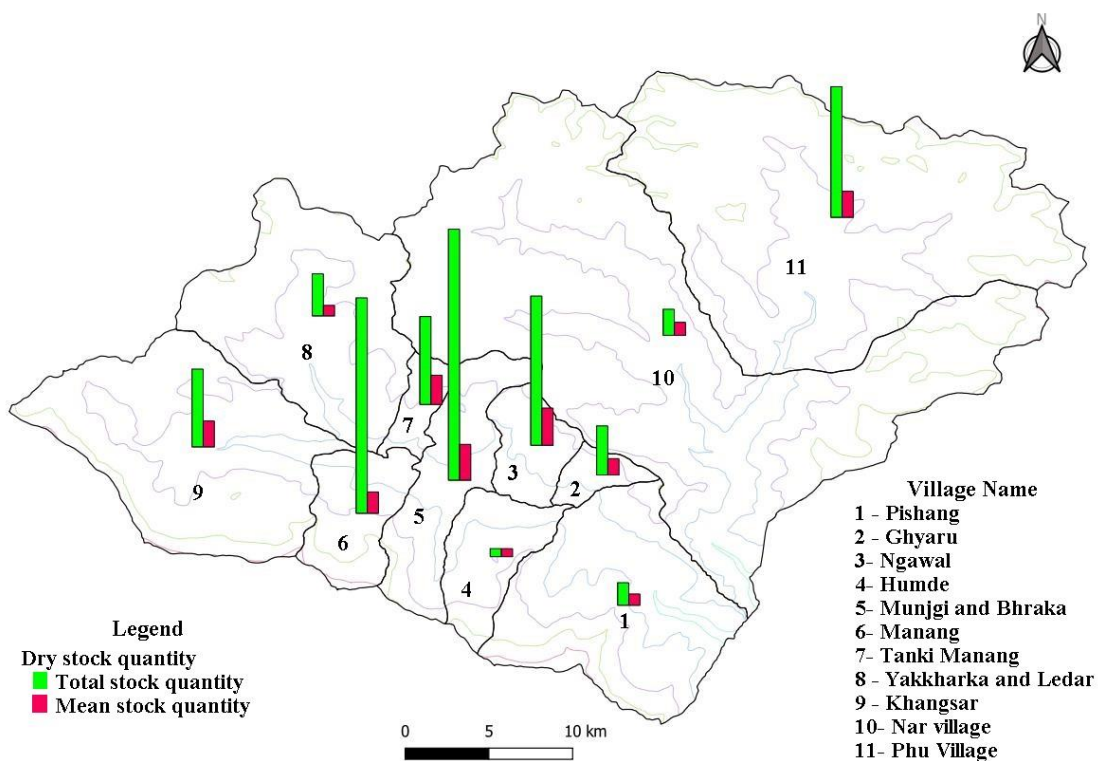


Figure 17: Stock quantity (gram) of *Aconitum naviculare* in surveyed settlements

A total of 3306 g of *A. naviculare* was weighted during the survey. The largest stock was found in Munjgi and Bhraka (783 g), followed by 672 g in Manang village and 476 g in Ngawal. In addition, the least stock was found in Nar (81 g), Pisang (70 g), and Humde (25 g) villages, respectively.

Among the medicinal plants available in the study area and traditional knowledge based on those available plants, 95% of respondents accept that, *A. naviculare* is frequently and highly used medicinal plants. About 80 % of the informants mentioned that the villagers who migrated from Manang to other districts of Nepal such as Kathmandu and Chitwan still used this medicinal plant by asking from their family members and relatives of Manang.

The study also had provided the opportunity to interview 103 years old Doli Gurung of Pishang village (Figure 18). He said that he has been using this medicinal herb since his childhood. According to Doli Gurung, his parents also used it from a young age. In similar way, among the respondents, 92% of the people who participated in the interview admitted that they acquired the knowledge of using Ponkar plant from their parents. In addition, it can be inferred that the knowledge of the use of *A. naviculare*

has been successively transferred from generation to generation. Therefore, it can be argued that the use of *A. naviculare* is the oldest knowledge of herbal plant uses in Manang villages.



Figure 18: Interviewing with the oldest respondent (Doli Gurung) of Pishang (27th October, 2022)

4.5. Conservation practice and transfer of knowledge

All respondents stated that Annapurna Conservation Area Project (ACAP) aims to conserve the natural resources of this area but no action plan, policy, rules and regulations have been made for the collection, use, protection and trade of *A. naviulare*. Based on the topic of conservation of this plant, all the respondents were asked about its need of conservation in natural habitat, need of conservation by planting own land and allow trading. Many respondents indicated that it is better to conserve it in natural habitat as much as possible and by cultivating in their own fields. It was found that 89% of the respondents said that it should be conserved and only 11% said that there is no need of conservation efforts. The majority (83%) of the respondents said that it should be cultivated if possible but 17% of respondents believed that there is no need of cultivation as the plant can be easily collected from its natural habitat (Figure 19).

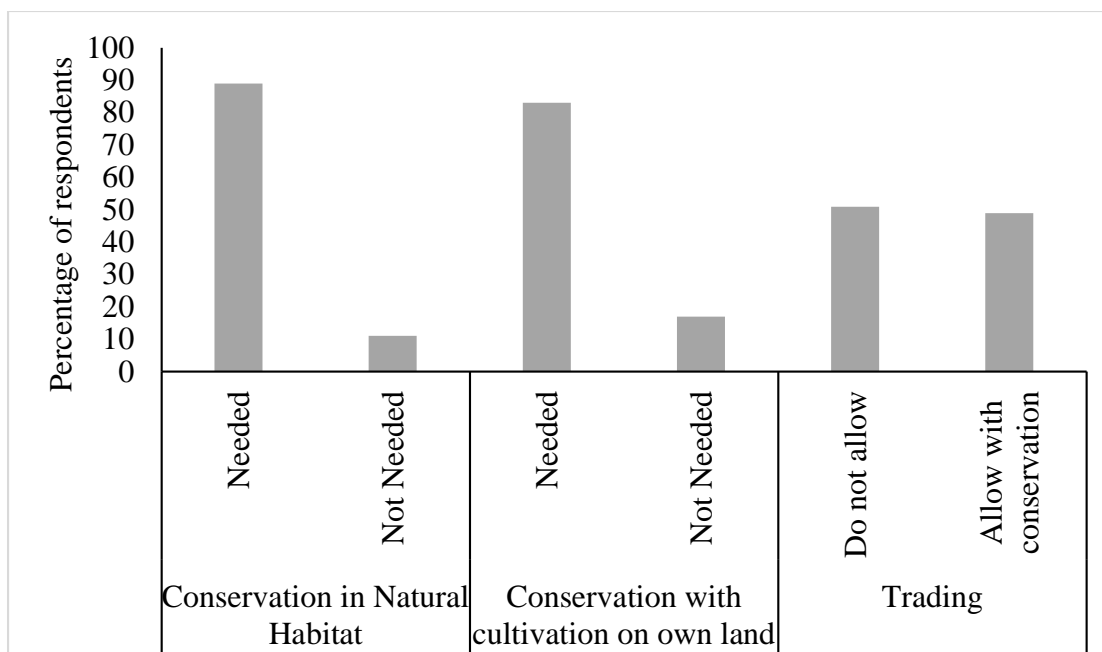


Figure 19: Perception of people about conservation of *Aconitum naviculare*

There was no trade of this plant species from Manang. Respondents who chose the statement ‘no trading’ and ‘allow trading with conservation’ were 51% and 49% respectively (Figure 19). The people who said ‘not to trade and if trade is allowed it may cease to exist’ were mostly from the old age group and the people who wanted trading with conservation were mostly found to be from the adult age group. It was noted that relatives and neighbors easily give this medicinal herb stored in their homes to others without any cost. It has also been noted that people sometimes give this plant as a gift to their relatives. From the present scenario, it is understandable that there is a good sense of belonging with people and less likely to decline with respect to use. If it is commercialized it may cease to exist.

Out of 76 respondents, four respondents of Ngawal and Ghyaru were found trying cultivation of rhizome bringing from natural habitat to their own land. All four respondents accepted that the plant germinated and flowering occurred successfully. None of respondents voiced about fruiting from the rhizome-transplanted plants (Table 2).

Table 2: Details of cultivation of rhizome by respondents of different settlement.

Village of Respondents	Quantity of Cultivation	Cultivation Month/Year	Findings During Cultivation
Ngawal	4 roots	September, 2021	All roots germinate successfully, flowering bloomed but no seed occurred
Ngawal	4 roots	August, 2019	tried to cultivate inside plastic tunnel and found that root transplantation can be good as all roots are germinate
Ngawal	6 roots	July, 2016	All roots germinate successfully, flowering bloomed but no seed occurred
Ghyaru	12 roots	August, 2018	10 roots germinate successfully, flowering bloomed but no seed occurred

The majority of the respondents (83%) said that they use the plant. When asked whether you have informed about the use of this plant to their children, 86% said they did and 14% said they did not. Two-thirds (66%) of the informants accepted that their children or siblings had seen dried materials of *A. naviculare*, but when asked whether their next generation used it, only 53% admitted that they did. Similarly, 37% of the respondents told that their children or siblings had seen the plant in the natural habitat (Figure 20).

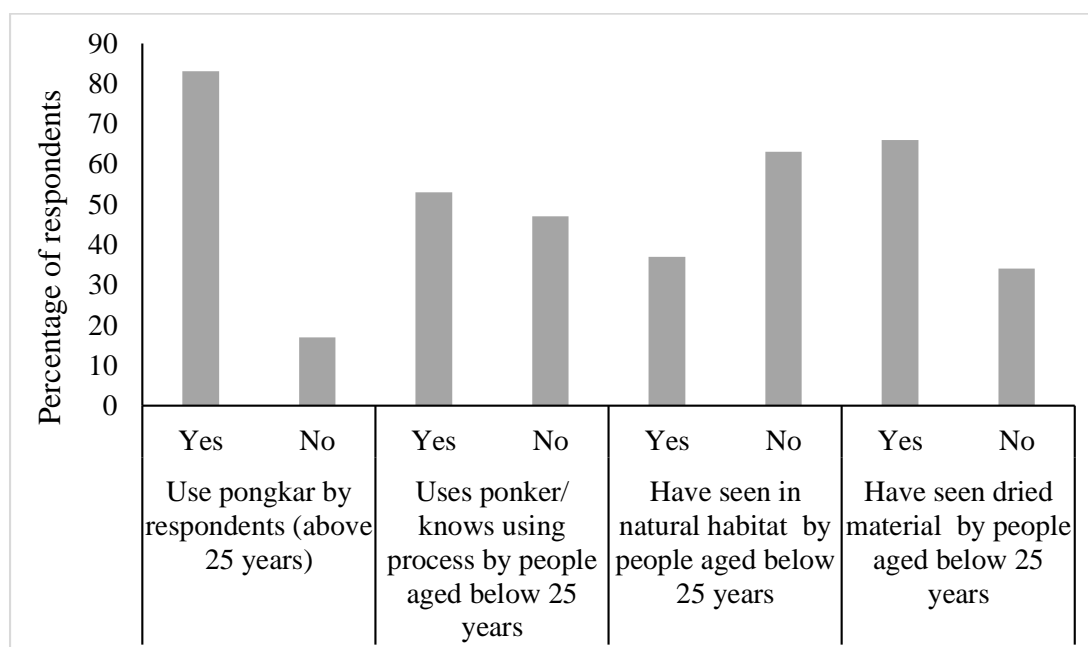


Figure 20: Transfer of knowledge about the use of *Aconitum naviculare*

CHAPTER - FIVE

5. DISCUSSION

5.1. Traditional ecological knowledge

Aconitum naviculare is found to be known with four different local names in Manang: Ponkar, Ponkarpa, Ponkarma and Bhonkar. It is interesting that the traditional understanding of biodiversity has its roots in common names so, isolated human communities give different names to the same species, and some of the names could be related to the localities, use, and special property of the plant (Berlin, 1992; Kristomo, 2017). Bhattarai et al. (2010) also mentioned the use of the name Ponkar by *Amchi* of Mustang district. However, yak herders of Mustang district (Gurung community) called this plant as Bhalaponkar (Acharya and Kafle, 2015) and Tamang community of Gorkha district (Nubri and Kutang valley) name this plant as Mongar (Sherpa et al., 2019).

Most of the respondents preferred *Aconitum naviculare* as an association of sclerophyllous and spiny scrubs found on south facing slope, slightly water deficient area with high solar radiation and warm temperature. As various factors like aspect, slope and vegetation type influence the plant distribution (Ghimire et al., 2001), thorny species such as *Juniperus squamata*, *Cotoneaster microphyllus*, *Caragana gerardiana*, and *Berberis* spp. adapted to south facing slopes can guide the availability of *A. naviculare* (Shrestha and Jha, 2009).

It was found that, people collected this species from Ghorkeyang above Ghyaru having elevation 4146 m to near thronng Phedi of elevation 4416 m in Manang. Similarly, in Narpabhumi rural municipality, people have been collecting from lower elevation place Jyagometa near Nar village (3835 m) to higher elevation place Thatong above Phu village (4629 m). The range of distribution mentioned by different researchers is in favor of this finding. It is distributed in central Nepal between 4090-4650 m asl (Shrestha and Jha, 2009), in west and central Nepal between 4200-4900 m asl (Lama et al., 2001; Ghimire et al., 2021b), between 4100 – 5000 m in Tibet (Cou et al., 2008) and between 3000-4900 m. asl. in South Sikkim (Agnihotri et al., 2015).

Phenological events reported during the survey matched well with the previous scientific reports. For example, the respondents reported that the plant sprouts during May/June, flower from July and reach peak at August/September, and fruiting occur

during September-October. Lama et al. (2001) and Ghimire et al. (2014) support this result. They mentioned that flowering and fruiting of *A. naviculare* occurs during July to October.

5.2. Harvesting and use patterns

The collection place of most locality has been found to be different although some locality (Mungji, Bhraga, Manang, and Tanki Manang) have same collection place. Similarly, the collection place of people of Pishang was found to be same as Ghyaru, Nar and Phu. It has been found that the collection area is close (up to 3h – 6h walk) to the settlements where this plant is easily found. This results are in line with Stepp and Moerman (2001) and Cristina da Silva et al. (2018) who mentioned that selection of medicinal plants by communities is determined by the proximity, abundance and affordable place from community.

The people were found selecting collection period according to availability of plant parts (e.g. summer season to harvest mature plant with flower) required to treat specific disease or having good feasible quality of original material and extracted product. This is similar with the selective harvesting method applied by *Amchi* of Dolpo based on ethnoecological and ethnobiological knowledge described by Ghimire et al. (2004).

There exists specific methods of collection for different plant parts. People in Manang are harvesting *Aconitum naviculare* at the time of flowering by not clearing all the population of plant applying handpicking method. Since *A. naviculare* can regenerate from underground tubers, collection of aerial parts at the time of flowering should have relatively low impacts on the regeneration of this plant. As mentioned by various researchers, consideration of regenerative behavior should be done during harvesting of whole plant of medicinal herb (WHO, 2003; Heron and Maiti, 2010; Pandey and Das, 2014). More respondents of the present study preferred shade drying than sun drying method. This is similar to the ethnobiological knowledge of Terai Nepal where people store plant parts in dry place or shade by maintaining original form (Thron et al., 2020).

The dried components of *Aconitum naviculare* were utilized by the majority of respondents of study to make decoction and powder for therapeutic purposes, either on their own or in combination with other ingredients. It is exciting that single fresh or dried and mixed form of plant parts for ethnomedicines using by making decoction as

well as crushing give best result, as these techniques are useful to extract active compounds (Deeba, 2009; Hassan et al., 2017). Previous researchers such as Bhattarai et al. (2006), Shrestha et al. (2007), Bhattarai et al. (2010) and Acharya and Kaphle (2015) also reported similar methods of use of this plant; mixing with water and the decoction is drunk with or without adding yak ghee and other medicinal plants.

The whole plant of *A. naviculare* has been utilized for several medicinal purposes. In the present study, it was found to be used to treat fever, common cold, cough, high blood pressure, jaundice, diabetes, and internal poison effect. Previous studies have also reported a similar use in various region of Nepal. Lama et al. (2001), Bhattarai et al. (2006), Shrestha et al. (2007), Acharya and Kaphle (2015) and Ghimire et al. (2021b) mentioned its use for fever, jaundice, high blood pressure and cold. Some other studies revealed additional use of plants. Disease treated using this plant was gall bladder disorder in Manang (Chetri et al., 2006) and Mustang (Pandey, 2006). Bhattarai et al. (2010) reported bile and liver diseases as another ailment treated by the people of Mustang district. Pyakurel and Gurung (2006) and Sherpa et al. (2019) indicated its use as antidote along with fever by the people of Manaslu region of Gorkha. Additionally in Tibet, Gao et al. (2004) reported that the plant is used as analgesic, sedative and febrifuge as well as Cao et al. (2008) presented its use for treatment of gastritis, hepatitis and nephritis.

According to respondents of study area, low pressure, body weakness, diarrhea, vomiting, and kidney problem are some side effects of excess use of this plant. Bhattarai et al. (2006) and Shrestha and Dall'Acqua (2011) also indicated about weakness of body as side effect in their findings. They pointed out that people used decoction with ghee to avoid weakness of the body after taking *A. naviculare*. Quantification of amount used for single dose has not been made in previous studies. When quantifying the use of *A. naviculare* by people, it has been found that 41% of respondents used 0.51-1.0 g followed by 26% of people using below 0.50 g and 26% using 1.01 to 1.50 g. at a time for single dose. Quantity or dose of substances taken, use frequency and variation of plant to other species determine the toxicity of plant (Loomis, 1970 and Doull et al., 1986). Therefore, those factors should be considered while using medicinal plants.

5.3. Conservation and resource management practice

In Manang, trade of *Aconitum naviculare* was not recorded. However, according to Shrestha et al. (1995), 47% of households in Manang district gathered medicinal herbs from mountain meadows and forests for sale. The DFO, Manang has issued permits for the collection and trade of nine species of MAPs totaling an average of 6786 kg during the year 1995-1998 (Chhetry, 1999). This amount is equivalent to 7.29% of the 93140 kg of medicinal plants that were traded in the central Nepal.

People who agreed that its population might decline due to changing environmental factors are more conscious in favor of conservation. High percentage of people agreed that conservation should be done in both natural habitat and by cultivating it in their own land. Four respondents were found cultivating the plant in their own land. That is the good representation of consciousness towards conservation (Dorm-Adzobu et al., 1991). Commercial collection and habitat degradation are the greatest threats to Nepalese alpine medicinal plants (Shrestha and Joshi, 1996; Chaudhary, 1998). Elsewhere habitat is concurred with area having livestock pressure as a result damage is high but somewhere plant is associated to the thorny bushes and collection or damage is relatively low. It seems that collection pressure and trampling damage caused the plant to vanish from the open areas. Therefore, preventing overgrazing in these places is essential for the preservation of *A. naviculare* (Shrestha and Jha, 2009).

Transfer of knowledge about the uses of *Aconitum naviculare* is decreasing in Manang. Children under 25 year has been found comparatively less than that of older people on using this plant. Most of them have not seen the plant in its natural habitat. The risk of loss of knowledge is existing in the study area. Sustainability of medicinal plants is possible only by involvement of community (Larson and Olsen, 2007). So, young people should concern about keeping knowledge existence in society.

It is possible to develop applied ethnobotanical projects in Nepal that address issues of biodiversity conservation as well as the promotion of local economic efficiency because of the country's rich traditional knowledge systems and long history of community involvement in the management of natural resources (Ghimire et al., 2001). It is vital to take account local knowledge and practices to manage Himalayan medicinal plant resources sustainably (Ghimire et al., 2005).

CHAPTER - SIX

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

Aconitum naviculare has great traditional medicinal value in the Trans-Himalayan region of Manang as evidenced by its wide uses. Biologically the plant grows on the south-west facing slopes above 4000 m with thorny bushes and grassland. Germination of this plant starts from April, reaches peak in June/July and flowering occurs. Flowers fully matured in August/September and fruiting starts during the end of September and October. The best collection time is during flowering i.e. August/September. Collection places are nearby areas of village where plant is easily available.

It has been found that the plant is one of the most frequently and efficiently used medicinal plant applying two processes namely making decoction and powdered form by the people of study area. Local people preferred *A. naviculare* to treat diseases such as fever, common cold, high blood pressure, jaundice, diabetes and poison effects. Knowledge of using this plant is found to be the oldest among other medicinal plants. No conservation plan and policies related to this specific plant has been found so far. Some people have tried cultivating rhizome to their own land for test, with some positive results. Many respondents said that it should not be commercialized and if it is commercialized it may cease to exist. From this, it has been found that people are very concerned about conservation of local resources. Some respondents opined that if this plant can be cultivated and commercialized under good policy guidelines, it could be a good source of income and can conserve this biological resource as well as traditional knowledge on it.

There is no trade of this plant in Manang and Nepal; it has been found that relatives and neighbors easily share this medicinal herb without any cost. Also sometimes, as gifts to their relatives. It is understandable that there is a good sense of belonging with people and less likely to decline with respect to use depending upon present scenario. There is high trust of people towards the medicinal importance of this plant because those who have even migrated from Manang to other places also have been using this medicinal herb. However, the knowledge on *Aconitum naviculare* has been found to be gradually decreasing from old age to young age people.

6.2. Recommendation

The role of people for conservation and management of *Aconitum naviculare* is crucial. Based upon the present study and previous research following recommendation are made:

- i. Awareness among young people about the use and conservation of this plant should be raised.
- ii. Cultivation of this plant should be initiated in a suitable area.

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APPENDICES

Appendix I: Permission letter for field visit



नेपाल सरकार
वन तथा वातावरण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
(..... शाखा)

फोन नं. : ४२२०८५०
४२२०९१२
४२२७९२६
फ्याक्स नं. ४२२७६७५



पत्र संख्या :- ३२
०७८/७९ इको
चलानी नं :- २८०



पो. ब. नं. - ८६०
बबरमहल, काठमाडौं
Email: info@dnpsc.gov.np
http://www.dnpsc.gov.np

मिति: २०७८/५/२०

विषय: अध्ययन अनुमति सम्बन्धमा ।

श्री अन्नपूर्ण संरक्षण क्षेत्र आयोजना, हरियोखर्क, पोखरा ।
प्रस्तुत विषयमा तहाँ संरक्षण क्षेत्रमा निम्नानुसारको अध्ययन अनुसन्धान अनुमति प्रदान गरिएको व्यहोरा निर्देशनानुसार अनुरोध छ ।

अनुसन्धानकर्ताको नाम	Bharat Babu Shrestha		
ठेगाना	शहिद लखन थापा गाउँपालिका-०९, गोर्खा	इमेल: Shresthabb@gmail.com	फोन नं. ९८४९२४९४८४
समूह संस्था	वनस्पतिशास्त्र केन्द्रीय विभाग, त्रिभुवन विश्वविद्यालय, किर्तिपुर, काठमाण्डौ ।		
अनुसन्धानको प्रकृती	व्यक्तिगत		
पद	सह-प्रध्यापक		
अनुसन्धानको तह	राष्ट्रिय स्तर		
अनुसन्धानको शिर्षक	Impact of climate change on germination, growth, pollination and distribution of Himalayan medicinal herbs <i>Aconitum spicatum</i> and <i>A. naviculare</i>		
अनुसन्धान विधि	Transplant Experiment in field	नमुना संकलन गर्ने	नमुना परिक्षण कहाँ गर्ने नेपालमा
अनुसन्धानको अवधि	२० भाद्र २०७८ देखि १९ भाद्र २०८० (दुई वर्ष)		
शर्त:	<p>१. अनुसन्धानकर्ताले राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐन, २०२९ र नियमावली, २०३० तथा मातहतका सबै नियमावलीहरूको पूर्ण पालना गर्नु पर्नेछ ।</p> <p>२. अध्ययन गर्दा सम्बन्धित संरक्षित क्षेत्र कार्यालयसंग समन्वय गरी कार्यालयमा कार्यरत कर्मचारीको रोहबरमा गर्नु पर्ने पर्नेछ ।</p> <p>३. अनुसन्धानकर्ताले आफ्नो अनुसन्धानको प्रस्ताव सम्बन्धित संरक्षित क्षेत्र कार्यालयमा समेत पेश गर्नु पर्नेछ ।</p> <p>४. अनुसन्धानकर्ताले अनुसन्धान समाप्त भएपछि प्राप्त तथ्याङ्क, एक प्रति कागजी प्रतिवेदन र एक प्रति इलोकट्रोनिक प्रतिवेदन यस विभाग र सम्बन्धित संरक्षित क्षेत्र कार्यालयमा बुझाउनु पर्नेछ ।</p> <p>५. अनुसन्धानकर्ताले नतिजाहरू प्रकाशित गर्दा अनुसन्धानमा संलग्न यस विभाग र अन्तरगतका कर्मचारीको योगदानको आधारमा सहलेखकको रूपमा समावेश गराउनु पर्नेछ ।</p> <p>६. सञ्चालित नमुना विदेश लैजान पाईने छैन ।</p> <p>७. तोकिएका शर्तहरूको पालना नगरेमा विभागले कुनैपनि समयमा अनुमतिपत्र रद्द गर्न सक्नेछ ।</p>		

हेम राज आचार्य
सहायक इकोलोजिष्ट

बोधार्थ:

श्री Bharat Babu Shrestha: सम्बन्धित संरक्षित क्षेत्र कार्यालयसंग समन्वय गरी अध्ययन अनुसन्धान गर्नु हुन र अनुसन्धान समाप्त भएपछि एक प्रति कागजी तथा विद्युतीय प्रतिवेदन सम्बन्धित कार्यालय र विभागमा बुझाउनु हुन अनुरोध छ ।
श्री अन्नपूर्ण संरक्षण क्षेत्र सम्पर्क अधिकारीको कार्यालय: जानकारीको लागि अनुरोध छ ।
वनस्पतिशास्त्र केन्द्रीय विभाग, त्रि.वि: जानकारीको लागि अनुरोध छ ।



**NATIONAL TRUST FOR NATURE CONSERVATION
ANNAPURNA CONSERVATION AREA PROJECT**



Headquarters, Pokhara

Headquarters, Pokhara

Ref: *SO* /078/079

Date: 2078-05-30

Dr. Bharat Babu Shrestha
Associate Professor
Central Department of Botany
TU, Kathmandu

Re: Permission to conduct research in Annapurna Conservation Area

We received your request letter regarding permission to conduct research on “**Impact of climate change on germination, growth, pollination, and distribution of Himalayan medicinal herbs *Aconitum spicatum* and *A. naviculare***”. You have been given permission to carry out your field research in ACA with the following terms and conditions.

1. The research must be for scientific and academic purpose with the aim of making contribution in conservation and development of conservation area.
2. This permission will be **valid up to August 31, 2023** (2080 Bhadra 14).
3. You have to follow the ACAP Minimum Impact Code and the Conservation Area Management Regulation 2053.
4. You have to follow the terms and conditions mentioned in the research permit provided by Department of National Park and wildlife Conservation.
5. You are **allowed to collect sample only** from the study area.
6. You will have access to the NTNC-ACAP Resource Library in Pokhara.
7. Upon the completion of the research, **you must submit a hard copy and digital copy of your report** to the NTNC-ACAP Headquarters, Pokhara.
8. You have to **coordinate with ACAP Unit Conservation Offices** while performing your field research work.
9. You and your research **team have to strictly follow all rules, guidelines and social norms to keep in safety from COVID-19 while doing your fields work.**
10. Any dispute arose during the execution periods will be solved by mutual understanding.
11. Any unsolved disputes will be handled as per the existing law of Nepal government.

Thank you and wish you all the best.

Raj Kumar Gurung
Project Chief

CC:
NTNC-ACAP Unit Conservation Office
Ghandruk / Lwang / Manang / Jomsom / Lomanthang

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Appendix II: Household survey questionnaire

Respondent No.:....., Date (Y/M/D): 2022/.../..., R. Municipality:.....,
 Ward No.:....., Specific Locality:....., Elevation (m. asl):.....
 Latitude (DD):....., Longitude (DD):....., Way Point:.....

1. Informants' details

Name:....., Age:....., Gender:....., Contact:.....
 Education:....., Main Occupation: Sub Occupation:

2. Species Details

What is the local name of this plant?

How do you distinguish this plant from other?

Habitat: Aspect:....., Elevation:

Which Habitat do you think best for the species?

Forest Shrubland Grassland Wetland/Spring side Rocky slopes

What is the month of germination, flowering and fruiting?

Month of Germination	Month of Flowering	Month of Fruiting

What are the associated species with this Species?

3. Harvesting and storage details

Do you involve in collection of *Aconitum naviculare*? Yes No Sometime

From where do you collect this plant? Place name:

Time to reach collection site (hr.):.....

Reason to choose this location for collection:.....

Season (Month) of collection:..... Amount harvested in one season:.....

Is there any particular season/month/day where harvesting is not done for any reasons?

For which purpose do you harvest?

Trade Household use Other (.....)

If trade, please give the details of following:

Where	Qty. per year	Rate per g.	Raw/Processed	Since how long

At what stage of the plant do you usually harvest for maximum yield?

Before flowering Flowering Fruiting

Which parts do you frequently harvest?

Root / Stem / Leaves / Flower / Fruit / Whole Plant / Aboveground part

Could you provide the customary practice for the collection?

.....

Since when did you involve in harvesting?

How do you store the harvested product?

Drying

Direct sunlight Shade Drying Other (.....)

Storing:

3. Use Details

Please provide the medicinal use detail of this plant. (part used, disease treatment, form of use, process of use, doses of medicine etc.),

.....
.....
.....
.....
.....
.....

Does the species have additional use other than medicine? If yes, what?

.....

How did you acquire the knowledge to utilize this plant?

From Family Members From Traditional healers Self-Study and Research
 Any Other (.....)

How much quantity approximately do you use in one year?

.....

Why really you use this species as a medicine?

believe on traditional practices no access to modern health facilities
 Cheaper than modern drugs Other (.....)

What are three most important medicinal plants used by you based on their efficiency?

1..... 2..... 3.....

4. Conservation and Management Practice

If you know, what is the status of this plant in collection area?

Increasing Depleting No change

What might be the reason behind depleting or increasing?

.....

For how long have you been observing its decline or increase?

.....

Have you adopted any method so that this plant can be available for longer period?

.....

Do you cultivate this plant in your field? Yes No

If yes, please give the details of following:

Area of cultivated (m ²)	Year of Cultivation	Production per year (g.)

If no, what are the reason for not cultivating?

Do you share the knowledge about this plant to younger people in the society?

Yes No Sometimes

Is there any customary practice for the conservation of the species?

.....

Do you think this plant is necessary to be conserved for use in the future? Yes/No

If yes, Please give your idea about the following statement:

Statements	Yes/No
They should be conserved in their places by not allowing their harvesting for selling	
In addition to their conservation, cultivation should also be done	
There should be a herbal farm for cultivation of medicinal plants	
Instead of cultivation, they should be conserved in the natural habitat only.	
Both cultivation on farm land and conservation in natural habitat should be done	
Others (Please specify):	

If no, please give the reason:

.....

5. Quantification

How much quantity of this plant do you have now? If possible, give the details of following:

Mass (g)	Site of collection	Year of collection	Collector
			Self / Family Member / Neighbor

What are other medicinal plants in use? Please provide following information.

Name	Parts use	Uses	Amount you have

Surveyor:

Appendix IV: Informants details

Table 3: Household surveyed informants

Respondent Key No	Date of Interview in AD	Rural / Municipality	Ward No.	Specific Locality	Permanemt Address
HSI01	17 October 2022	Manang-Nyesyang	6	Yakkharkha	Same
HSI02	17 October 2022	Manang-Nyesyang	6	Ledar	Same
HSI03	18 October 2022	Manang-Nyesyang	6	Ledar	Same
HSI04	18 October 2022	Manang-Nyesyang	6	Ledar	Same
HSI05	20 October 2022	Manang-Nyesyang	6	Yakkharkha	Same
HSI06	21 October 2022	Manang-Nyesyang	4	Manang	Same
HSI07	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI08	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI09	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI10	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI11	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI12	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI13	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI14	22 October 2022	Manang-Nyesyang	9	Khangsar	Same
HSI15	24 October 2022	Manang-Nyesyang	8	Manang	Same
HSI16	24 October 2022	Manang-Nyesyang	6	Manang	Same
HSI17	24 October 2022	Manang-Nyesyang	6	Manang	Same
HSI18	24 October 2022	Manang-Nyesyang	6	Manang	Same
HSI19	24 October 2022	Manang-Nyesyang	8	Tanki Manang	Same

Respondent Key No	Date of Interview in AD	Rural / Municipality	Ward No.	Specific Locality	Permanemt Address
HSI20	24 October 2022	Manang-Nyesyang	6	Manang	Same
HSI21	24 October 2022	Manang-Nyesyang	8	Pocho Gumba, Manang	Same
HSI22	24 October 2022	Manang-Nyesyang	8	Pocho Gumba, Manang	Same
HSI23	24 October 2022	Manang-Nyesyang	8	Pocho Gumba, Manang	Same
HSI24	24 October 2022	Manang-Nyesyang	5	Bhraka	Same
HSI25	24 October 2022	Manang-Nyesyang	5	Munji	Same
HSI26	24 October 2022	Manang-Nyesyang	5	Bhraka	Same
HSI27	24 October 2022	Manang-Nyesyang	5	Bhraka	Same
HSI28	24 October 2022	Manang-Nyesyang	5	Bhraka	Same
HSI29	25 October 2022	Manang-Nyesyang	7	Tanki Manang	Same
HSI30	25 October 2022	Manang-Nyesyang	7	Tanki Manang	Same
HSI31	25 October 2022	Manang-Nyesyang	7	Tanki Manang	Same
HSI32	25 October 2022	Manang-Nyesyang	3	Ngawal	Same
HSI33	25 October 2022	Manang-Nyesyang	3	Ngawal	Same
HSI34	26 October 2022	Manang-Nyesyang	3	Ngawal	Same
HSI35	26 October 2022	Manang-Nyesyang	3	Ngawal	Same
HSI36	26 October 2022	Manang-Nyesyang	3	Ngawal	Same
HSI37	26 October 2022	Manang-Nyesyang	3	Ngawal	Same
HSI38	26 October 2022	Manang-Nyesyang	2	Ghyaru	Same
HSI39	26 October 2022	Manang-Nyesyang	2	Ghyaru	Same

Respondent Key No	Date of Interview in AD	Rural / Municipality	Ward No.	Specific Locality	Permanemt Address
HSI40	27 October 2022	Manang-Nyesyang	1	Upper Pishang	Same
HSI41	27 October 2022	Manang-Nyesyang	1	Upper Pishang	Same
HSI42	27 October 2022	Manang-Nyesyang	1	Upper Pishang	Same
HSI43	27 October 2022	Manang-Nyesyang	1	Upper Pishang	Same
HSI44	27 October 2022	Manang-Nyesyang	1	Lower Pishang	Same
HSI45	27 October 2022	Manang-Nyesyang	1	Lower Pishang	Same
HSI46	27 October 2022	Manang-Nyesyang	1	Lower Pishang	Same
HSI47	28 October 2022	Manang-Nyesyang	4	Humde	Same
HSI48	28 October 2022	Manang-Nyesyang	4	Humde	Same
HSI49	28 October 2022	Manang-Nyesyang	4	Humde	Same
HSI50	29 October 2022	Manang-Nyesyang	4	Humde	Same
HSI51	29 October 2022	Manang-Nyesyang	5	Munji	Same
HSI52	29 October 2022	Manang-Nyesyang	5	Munji	Same
HSI53	01 November 2022	Manang-Nyesyang	6	Gunsang	Same
HSI54	28 December 2022	Nagarjun	4	Saranpur, Kathmandu	Manang Nyesyang - 5, Bhraga
HSI55	28 December 2022	Nagarjun	5	Saranpur, Kathmandu	Manang Nyesyang - 5, Bhraga
HSI56	28 December 2022	Nagarjun	6	Saranpur, Kathmandu	Manang Nyesyang - 2, Ghyaru
HSI57	29 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-1, Nar
HSI58	29 December 2022	Nagarjun	2	Raniban, Kathmandu	Narpabhumi-4, Phu

Respondent Key No	Date of Interview in AD	Rural / Municipality	Ward No.	Specific Locality	Permanemt Address
HSI59	29 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-4, Phu
HSI60	29 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-1, Nar
HSI61	29 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	NarpaBhumi-5, Phu
HSI62	30 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-4, Phu
HSI63	30 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-2, Nar
HSI64	30 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-5, Phu
HSI65	30 December 2022	Nagarjun	2	Buddha Chowk, Raniban, Kathmandu	Narpabhumi-4, Phu

Table 4: Key Informant's details

Respondent Key No.	Rural Municipality	Ward No.	Specific Locality	Age	Sex
KII01	Manang-Nyesyang	6	Manang	52	Male
KII02	Manang-Nyesyang	7	Tanki Manang	40	Male
KII03	Manang-Nyesyang	7	Tanki Manang	41	Male
KII04	Manang-Nyesyang	3	Ngawal	49	Male
KII05	Manang-Nyesyang	2	Ghrayau	62	Male
KII06	Manang-Nyesyang	2	Ghrayau	47	Male
KII07	Manang-Nyesyang	1	Upper pishang	32	Male
KII08	Manang-Nyesyang	4	Humde	46	Male
KII09	Manang-Nyesyang	4	Manang	47	Male
KII10	Narpabhumi	5	Phu	35	Male
KII11	Narpabhumi	5	Phu	38	Male

PHOTOPLATES



Aconitum naviculare after collection



Aconitum naviculare at natural habitat



Interview taking by showing sample photo of *A. naviculare*



Interviewing with respondents during household survey



Taking weight of dried material



Weighting and showing dry material of *A. naviculare*