ETHNOMEDICINAL STUDY IN THE RUBIVALLEY RURAL MUNICIPALITY, DHADING, CENTRAL NEPAL

A THESIS SUBMITTED FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER'S DEGREE IN BOTANY

BY

SAROJ ADHIKARI

SYMBOL NO: BOT 754/075

REG. NO: 5-1-33-511-2008

DEPARTMENT OF BOTANY

AMRIT CAMPUS

TRIBHUVAN UNIVERSITY

KATHMANDU, NEPAL

May 2024

DECLARATION

The thesis entitled **"Ethnomedicinal study in the Rubivalley Rural Municipality, Dhading, Central Nepal"**, which is being submitted to the Department of Botany, Amrit Campus, Lainchaur, Kathmandu, Nepal for the award of the Master's Degree in Botany, is a research work carried out by me under the supervision of Dr. Giri Prasad Joshi.

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. Any literature, data or works done by others and cited within this thesis has been given due acknowledgement and listed in the reference section.

.....

Saroj Adhikari

Department of Botany

Amrit Campus

Kathmandu, Nepal

May 2024

Tribhuvan University

Institute of Science and Technology

AMRIT CAMPUS

P.O Box No: 102, Thamel, Kathmandu,

Nepal. E-mail: amritcampus@ntc.net.np

Institute of Science & Technology
Amrit Campus

RECOMMENDATION LETTER

This is to certify that the dissertation work entitled **"Ethnomedicinal study in the Rubivalley Rural Municipality, Dhading, Central Nepal"**, has been completed by **Saroj Adhikari** under my supervision. This entire work was accomplished on the basis of candidate's original research work. To the best of my knowledge, the work has not been submitted to any other degree. I hereby recommend for the acceptance of this dissertation as a partial fulfillment of the requirement of Master's Degree in Botany at the Institute of Science and Technology, Tribhuvan University, Nepal.

.....

Supervisor

Dr. Giri Prasad Joshi

Associate Professor

Central Department of Botany,

Tribhuvan University

Kirtipur, Kathmandu, Nepal

Tribhuvan University
Institute of Science and Technology
AMRIT CAMPUS
Department of Botany
Thamel, Kathmandu

Tel.: 01-4410408
01-4411637

LETTER OF APPROVAL

The M.Sc. dissertation entitled **"Ethnomedicinal study in the Ruby Valley Rural Municipality, Dhading, Central Nepal"** submitted at the Botany Department of Amrit Campus Tribhuvan University by Mr. Saroj Adhikari has been accepted as a partial fulfillment of requirement of Masters of Science Degree in Botany.

EXAMINATION COMMITTEE

.....
Supervisor
Dr. Giri Prasad Joshi
Associate Professor
Central Department of Botany
Tribhuvan University, Kirtipur,
Kathmandu, Nepal

.....
External Examiner
Dr. Krishna Pant
Associate Professor
Tribhuvan University, Kirtipur,
Kathmandu, Nepal

.....
Internal Examiner
Dr. Shila Singh
Associate Professor
Department of Botany
Amrit Campus
Tribhuvan University
Kathmandu, Nepal

.....
M.Sc. Co-ordinator
Dr. Laxmi Joshi Shrestha
Assistant Professor
Department of Botany
Amrit Campus
Tribhuvan University
Kathmandu, Nepal

.....
Head
Dr. Jaya Prakash Hamal
Assistant Professor
Department of Botany
Amrit Campus
Tribhuvan University,
Kathmandu, Nepal

Date: 24th May, 2024

ACKNOWLEDGEMENTS

First and foremost, I would like to sincerely thank my supervisor, **Associate Professor Dr. Giri Prasad Joshi** of the Central Department of Botany, Tribhuvan University, Kathmandu, for his exceptional supervision, incredible support, encouragement, enthusiasm and clear guidance throughout the completion of this study. I would also want to express my gratitude to Assistant Prof. Dr. Jaya Prakash Hamal Head Department of Botany and Assistant Prof. Dr. Laxmi Shrestha Joshi, M.Sc. Coordinator, Department of Botany, Amrit Campus, TU for their invaluable counsel, lectures, and technical and administrative assistance. I am very thankful to Assistant Prof. Gyanu Thapa Magar, Department of Botany, Amrit Campus, T.U., for over viewing my study. Mr. Sujan Chaudhary, Miss Sanju Neupane and Mr. Nabin Singh Karki and Chirinjivi dangi for helping me with the data collection in the field. I am also appreciative of the direct and indirect assistance provided by the entire faculty of the Department of Botany at the Amrit Science Campus, Kathmandu, as well as other non-teaching staff members.

I sincerely appreciate all of the respondents, especially Prakash Ghale RVRM -1, Dinesh Gurung, RVRM-4, Bishnu prashad Acharya, DFO, Dhading, locals, and informants for their generous responses, conversations, and assistance in supplying me with study materials and sharing their insightful knowledge. I'm very thankful to my Parents and family members for financial, physical, motivational and psychological support till the date and the staffs and people's representative of RVRM.

Saroj Adhikari

May 2024

ABBREVIATIONS AND ACRONYMS

CR	Critically Endangered
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DD	Data Deficient
DFO	Division Forest Office
ENT	Ear, Nose and Throat
FI	Fidelity Level
FL	Frequency Index
Gov.	Government
HVMP	High Value Medicinal Plant
ICE	International Society of Ethno biology
ICF	Informant Consensus Factor
ITK	Indigenous Traditional Knowledge
INGO	International Non-Governmental Organization
IUCN	International union for conservation of nature
LC	Least Concern
MAP	Medicinal and Aromatic Plants
MASL	Meter above sea level
MP	Medicinal Plant
NGO	Non-Governmental Organization
NTFP	Non-Timbered Forest Product
No.	Number
PRA	Participatory Rural Appraisal

RM	Rural Municipality
RVRM	Rubi Valley Rural Municipality
Spp.	Species
T	Threatened
TU	Tribhuvan University
UV	Use Values
USD	United State Dollar
V	Vulnerable
VDC	Village development Committee
WHO	World Health Organization

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABSTRACT

The Dhading district's Rubivalley Rural Municipality (RVRM) is located in Central Nepal's Bagamati Province. This region has a unique terrain that ranges from roughly 1000 meters above sea level to 7000 meters above sea level, making it rich in both biodiversity and medicinal plants. The current study document the medicinal plant species used by different ethnic groups of the area. During ethnomedicinal investigation, quantitative measures such as the Informant Consensus Factor (ICF), Frequency Index (FI), and Used Values (UV) were calculated to determine the significant applications of plant species in the study area. Knowledge transfer, threats, and conservation practices were also evaluated by a questionnaire survey and data analysis. A total of 70 species were recorded as medicinal plants in the study area, belonging to 52 families, and 67 genera, while herbs were the largest life form with 37 species. Asteraceae was the largest family, with seven species. Among the species, *Ophiocordyceps sinensis* has the highest FI, i.e., 33.63, and has a high market value. Highest use value for *Osyris lanceolata,* i.e., 3. Leaf was the most used plant parts (36%) and used in the form of paste, i.e., 33, and orally, i.e., 43. The highest ICF value was found for gastro-intestinal (0.887) and the lowest 0.33 for ENT among the 11 ailment's categories. *Swertia chirayta* was found to be collected in the highest amount from the study area, but they could earn more money by harvesting *Delphinium denudatum*. Around 40% of the respondents think forest fires was the top threat to MPs in RVRM, and 31% blame unsustainable harvesting practices. Five species fall under the CITES categories, 29 were on the IUCN Red List, and 10 were in the national threat categories. The plan and program should be applied to obtain sustainable benefits form the medicinal plants in RVRM.

Keywords: Conservation, Frequency index, Indigenous knowledge, Threat, Use value

शोधसार

उत्तरमा हिमालयदेखि दक्षिणमा महाभारत पर्वतसम्म फैलिएको धादिङ जिल्लाको रुबि भ्याली गाउँपालिका नेपालको बागमती प्रदेशमा समुद्र सतहदेखि लगभग १००० मिटर देखि ७५०० मिटरसम्मको उचाइमा अवस्थित छ । जलवायु र भौगोलिक विविधताले विभिन्न थरिका वनस्पति र जीवजन्तुलाई बस्नयोग्य ठाउँ बनाउँने हुदा हालको अध्ययनमा यस क्षेत्रमा पाइने जडिबुटिको प्रजातिको संख्या, स्थानिय प्रयोगको तरिका, ज्ञान हस्तान्तरण, लोप हुने खतरा र संरक्षाणका प्रयासहरु लाई समावेशगरि दस्तावेज गरिएको छ । अध्ययन क्रममा नतिजा निकाल्नको लागि विभिन्न संख्यात्मक र गुणात्मक अध्ययन गरी विश्लेषण गरियो । अध्ययनबाट यस क्षेत्रमा ७० प्रजातिका जडिबुटिहरु देखियो । ७० जडिबुटि मध्ये धेरैजसो पोथ्रा रहेछन् भने Asteraceae सबैभन्दा ठूलो वनस्पति परिवार थियो । अनुसन्धानको क्रममा यार्चागुम्बा धेरै जनाले प्रयोग गर्ने र बजारमा उच्च मुल्य भएको जडीबुटी थियो, नुनढिकिको प्रयोगमान उच्च थियो । जडिबुटीको पात प्रयोग गर्ने, तिनिहरुलाई लेदोको रुपमा खाने र ग्यास्ट्रिकको उपचारमा धेरै प्रयोग हुने पनि अनुसन्धानको क्रममा देखियो । वर्षमा स्थानियले धेरै मात्रामा चिराइतो संकलन गरेता पनि आम्दानि भने निरमशी बाट गर्दा रहेछन् । लगभग ४० प्रतिशत उत्तरदाताले यस गाउँपालिकामा आगलागि जडिबुटीको लागि सबैभन्दा ठूलो खतरा माने भने ३१ प्रतिशतले अव्यवस्थित संकलन लाई प्रमुख कारण बताए । अध्ययनको क्रममा दस्तावेज गरिएका जडिबुटी मध्ये ५ प्रजातिहरु CITES category, २९ प्रजाति IUCN रातो सूचीमा, र १० प्रजाति National Threat Category मा परेको देखियो । यस गाउँपालिकामा हूनेँ जडिबुटीहरुको थप अध्ययन, बिकास र विस्तार गरि दिगो लाभ प्राप्त गर्नको लागि थप योजना र कार्यक्रमहरु लागु गर्नुपर्ने देखिन्छ ।

TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

1.1. Background

Plants provide majority of the materials needed by humans for food, clothing, shelter, and sustenance. Apart from water for drinking, plants were the main source of sustenance for the people of ancient times (Wang *et al*., 2002). Ethnic people profit greatly from indigenous remedies for plants and their parts by the experiences of elder ethnic peoples through observation, and trial and error. The commercially and geographically isolated major rural population mainly depends on local plants and their products for their livelihood (Singh *et al*., 1979). For medical purposes, more than 60% of people on the planet- and 80% of those in underdeveloped countries, only use plants. According to the World Health Organization (WHO, 2002), over 25% of contemporary medications are derived from conventionally utilized plant sources, and around 21,000 plant species are known to have therapeutic benefits worldwide.

Medicinal Plants (MPs) provide vital services to humankind with its unique ability to cure diseases, recover wounds, fight with infections and provides relief to the patients (Oladeji, 2016). Both crude and processed plant products are in medicinal use since ancient time (Manandhar, 2002). MPs and human beings are inseparable parts of nature, with the medicine man (Vaidya) being regarded as the first botanical professional in human history (Marpa *et.al*, 2021). Medicinal plants are the diverse group of plants traditionally used for healing purposes (Khakurel *et al*., 2022). They are recognized as vital element to primary health care system in many rural communities due to its effectiveness, lack of alternatives and cultural preferences (Bannerman *et al*., 1983; Manandhar, 1994, Svarstad & Dhillion, 2000). Plant constituents continue to be a vital part of western medicine and are still considered an important source of novel component in the field of drug discovery (Hamilton, 2004). The demand for medicinal plants have been increasing due to their easy availability and affordability, and often the only healthcare option for the poor people (Acharya *et al*., 1970). The interest of local people in traditional plants for curing ailments and diseases has shifted to the discovery of modern medicines (Pan *et al*., 2013).

The entire world somehow depends on plants for medicinal ingredients; over 60% of the world's population has relied on wild plants for treatment for very long (Singh *et al.*, 1983). About 70-80% of local people depend on traditional, largely herbal, medicine to meet their primary healthcare needs (Yusri, 2020). About 35,000 to 70,000 plant species have been used by the local people of different ethnic groups for medicinal purposes worldwide. At least 6500 species are used alone in Asia as home remedies for various ailments (Karki *et al.*, 1999). It has been estimated that over 1600 to 1900 species of plants are commonly used in traditional medicinal practices (Manandhar, 2002) and are responsible for maintaining the health of about 70-80% of total people in Nepal (Ghimire, 2008; Baral & Kurmi, 2006). Among them, the herbs which contain about 25% of the total country´s vascular flora, are used under different traditional systems, including the Ayurveda, Homeopathic (folklore), and Amchi (traditional Tibetan medicine) medicinal systems (Bhattarai, 1997).

In the context of Nepal, majority of the town's economically downtrodden population is dispersed among various hilly terrains, out of reach of standard routes. It can take several days to go to isolated areas of the nation where access to conventional allopathic medicine is unfeasible (Singh *et al*., 1979). The Rigveda, a Sanskrit scripture composed between 4500 and 1600 BC, contains the first record of the use of plants as medicine, despite the fact that the usage of medicinal herbs dates back to the dawn of human civilization in Nepal. The ethno-medicinal knowledge is transmitted through Vaidya's (traditional healers) and elderly people to the next generation via communication (Kunwar *et al*., 2010). There may be risk of declining traditional knowledge in coming generation due to modern facilities, rapid urbanization and loss of biodiversity.

In the present context, people are more aware and seeking treatment through the use of medicinal plants, knowing their benefits and efficacy. They are attracted to them because they are following different Vedic and traditional knowledge scattered all over the world. The commercialization of traditional medicines and healing approaches has increased the demand for medicinal plants and, therefore, increased the threat to the medicinal plants in their natural habitat. On the other side, it has been a sole source for the health care system since time immemorial for marginal, poor, and extremely difficult rural people (Acharya *et al*., 2009). The physiographical variation due to the altitudinal gradient and climatic fluctuations has greatly contributed to the abundance

of herbal medicinal plants in Nepal (Singh *et al.,* 1979). Besides knowledge and application, what matters is the quick need for medicinal plant conservation in their natural state before they disappear incessantly.

The changing world's context has inclined demands and priorities for the traditional Ayurvedic treatment system over the modern allopathic treatment system with high effectiveness and multidimensional health and economic benefits, with few exceptions. The global market for herbal medicines has been estimated to be worth USD 40-60 billion annually and is growing dramatically at a rate of 7-10% (Nagpal & Karki, 2004). Natural forest degradation, overexploitation, and unmanaged harvesting to fulfill the demand for medicinal plants lead to negative consequences that pose threats to its natural population (Bhattarai, 2005). It brings change to ecological processes at the individual, population, community, ecosystem, and landscape levels (Hall & Bawa, 1993).

There are several issues that traditional medicinal plants are currently experiencing. It is challenging for people to locate them because of the devastation of their natural habitats and the loss of local knowledge (Kelbessa *et al.,* 1992). Both natural and man-made factors might pose a threat to medicinal plants. Different risks were observed in the case of medicinal plants due to natural causes like droughts, bushfires, volcanoes, floods, landslides, diseases, and insect outbreaks, as well as anthropogenic factors like population growth, the need for fuel, urbanization, timber production, overharvesting, invasive species, commercialization, degradation, agricultural expansion, and habitat damage (Kelbessa *et al.,* 1992). The goals and passions of the youth of today vary, hastening the decline of traditional wisdom even more quickly than the elimination of plant life (Sofowora, 1982). Therefore, it is essential to put medicinal plants and associated indigenous knowledge under effective conservation.

The exact diversity of medicinal plants and their distribution in Nepal is still unclear. Out of 6973 flowering plants recorded in Nepal, about 10% of species are considered to have medicinal properties (Shrestha *et al*., 2018, Malla & Shakya, 1984; Bhattarai & Ghimire, 2006). Despite the efforts to conserve, 51 species have been assigned to various threat categories as per the IUCN guidelines: 3 taxa as critically endangered, 14 as endangered, 23 as vulnerable, 3 as nearly threatened, 1 as least concerned, and 7 as data deficient (Bhattarai *et al*., 2002). Many species are missed in one another's list,

and it is therefore accepted that there are more medicinal plants than reported yet in Nepal (Rokaya *et al*., 2012).

1.2. Justification of study

Nepal Himalaya, occupying the central third of the entire length of the Himalayan ranges, has the most distinctive wild flora in the world. Besides high MP diversity and ethno-botanical knowledge, many parts of it are still unexplored (Singh *et al*., 1979). In Nepal, community forest (CM) management is one of the forest conservation practices of local forests and is handed over to 'user groups'. The majority of them only focus on the management of timber plants and have no or little concern about MPs (Malla *et al*., 1995; Subedi, 1997).

Plants contain a large number of pharmacologically active ingredients, and each herb has its own unique combination and properties. Ethnic people depend on the plants around them to acquire knowledge of the economic values and medicinal properties of many plants, which is based on need. Approximately 5 to 15% of species of global higher plants have been investigated systematically (Coley *et al*., 2003). Despite many studies on medicinal plant resources, large number of medicinal plants still lack proper documentation (Chaudhary, 1998).

Different parts of Dhading district have been explored for medicinal plant diversity (Kunwar *et al*., 2006; Tamang *et al*., 2018). However, the present study area, Rubivalley Rural Municipality (RVRM), has physiographic and climatic variations flourishing, and important medicinal plant diversity is still unexplored. Therefore, present study aimed to explore the diversity of medicinal plants, ethnomedicinal knowledge of RVRM peoples and its transmission to the next generation.

1.3. Research Questions

- What are the plants used for medicinal purposes in RVRM?
- Is the ethnomedical knowledge transferred properly to the young generation?

1.4. Objectives

The main objective of the study is to enumerate MPs and their uses in RVRM, Dhading, Nepal. The present study has the following specific objectives:

- To determine the ethnomedicinal uses of plants from the area.
- To determine the ways of using medicinal plants
- To analyze the knowledge transfer to the young generation.
- To enlist the market value, major threats to MPs and their conservation approaches

CHAPTRER TWO: LITERATURE REVIEW

Nepal, a multicultural, multiethnic, and multilingual country, provides great opportunities for ethnomedical studies as traditional healing practices are the major treatment systems in Nepal. The number of previous studies on medicinal plants from different parts of Nepal has documented a good number of plant species and their curing properties. Although medicinal plants have been utilized for very long, one of the earliest mentioned applications of medicinal herbs is in the Nepal Himalaya, as described in the 6500-year-old Rigveda manuscript (Malla and Shakya, 1984). In the fifth century, during the reign of Great King Mandev, the Saushrut Nighantu was an additional early account that may be the oldest book on Nepali medicinal plants. It documents the use of 278 Nepalese medicinal plants (Subedi and Tiwari, 2000; Gewali and Awale, 2008). Later herbal pharmacopoeias, namely Chandra Nighantu and Nepali Nighantu, which were published in the 19th and 20th centuries, respectively, contained 971 items and 750 plants (IUCN Nepal 2004). Presently, it has been safeguarded by the Singha Durbar Vaidhya Khana Development Committee. It includes vernacular, scientific, and other names as well, and stands as a reference book for Ayurveda science and ethnopharmacology.

Later, many scientific documents and publications were made on the medicinal plants of Nepal. The first scientific publication was made by Pandey (1961) with 73 medicinal and aromatic plants (MAPs) from Nepal. A detailed ethnobotanical study has been carried out by Manandhar (2002), where 1,500 plant species have been described from different parts of Nepal, with more than 1000 having medicinal value. Rai (2003) documented 105 species of vascular plants used to cure different diseases. Shrestha and Dhillion (2003) acknowledged 58 species of MPs from Dolakha district. Similarly, Rai (2004) collected 64 medicinal plant species from Jhapa district. Recently, Ghimire (2008) revealed a total of 1950 species of medicinal plants in Nepal, and out of them, 1906 species were represented by vascular groups comprising 1614 native, 192 introduced or cultivated, and 100 naturalized taxa. Ghimire (2010) obtained a total of 1906 MPs with 77 pteridophytes, 19 gymnosperms, and 1810 angiosperms.

Acharya and Acharya (2009) reported 45 plants used for medicinal purposes from *the Tharu* community of Rupandehi district. Bhattarai *et al*. (2009) recorded 121 MPs from Mustang district. Uprety *et al*. (2010) documented 56 plants with their medicinal

properties from Rusuwa district. Shrestha and Shrestha (2012) reported 51 medicinal and aromatic plants and 20 species of highly valued medicinal plants from Langtang National Park. The Magar community of Gulmi district uses 161 medicinal plants, as reported by Acharya (2012).

Luitel *et al*., (2014) studied useful plants in Tamang community of Makwanpur district including medicinal plants and reported 161 species in total. Bhattarai and Ghimire (2006) listed 143 species as commercial MPs. The export amount was 4000 tons during 1970, reaching over 13500 tons after 1992 (Malla *et al*., 1995). Approximately 60% of households in the rural areas of mountain regions are involved in the commercial collection of MPs, and it covers 50% of their family income. The annual export value ranged from USD 8.6 million (Shrestha *et al*., 1995) to USD 19 million (Subedi, 2006). With increasing demand for natural medicines and raw ingredients for pharmaceutical companies, medicinal plants are declining at an alarming rate in their natural habitat.

Over 50 MPs are listed as threatened species based on the threat assessment of the IUCN (Tandon *et al*., 2001). According to Sharma *et al*. (2004), large numbers of medicinal plants in the wild are being depleted due to continuous and haphazard harvesting without any plans to regenerate and sustain them. Ghimire *et al*. (2005) claimed the threatened status of many MAPs species from high collection pressure. Due to a lack of proper conservation protocols, declining medicinal plant species create problems in ecosystems as well as in distribution patterns (Hunter & Yonzon, 1993).

The establishments of herbal farms have been successful in conserving medicinal plants found in the respective localities. However, these ex-situ conservation efforts are insignificant compared to the vast resources available to the country, and their methods of documentation are poor: the accession of conserved plants has not been maintained properly, and methods of propagation have not been properly documented (Sharma *et al*., 2004). According to Rokaya *et al*. (2012), there are more conservation threats to medicinal plants, not only because of direct harvesting of the plants but also due to other human-induced activities such as habitat encroachment for agriculture and settlement, deforestation, forest fires, and grazing.

Kunwar and Bussmann (2008) reviewed ethnobotanical knowledge and resource utilization along the altitudinal and longitudinal gradients and focused on 264 species

with medicinal and aromatic values. The study revealed decreased richness of medicinal plants with increasing altitude, but use percentage increased with increasing altitude. Also concluded the immense need for documentation of many more medicinal plants from Nepal. Tamang and Singh (2014) studied ethnobiological knowledge among the Lapcha people of Ilam. A study revealed high medicinal plant species richness and traditional use knowledge among Lapchas for their primary health care services. A total of 61 species of medicinal plants belonging to 39 families have been reported.

Acharya and Rokaya (2005) studied medicinal plants traded on the roadside of the Kathmandu valley. They surveyed different streets of Kathmandu Valley in different seasons from 2003 to 2004 and revealed the trade of 36 medicinal plants belonging to 28 families. Details on local names, scientific names, and traditional uses in major trading areas were known. Luitel and Pathak (2019) studied the MAPs of Dhorpatan Hunting Reserve using a semi-structured questionnaire and group discussion among local respondents. A study documented 88 species belonging to 69 genera. They also concluded illegal trade and a lack of commercial cultivation practices for MAPs in the area.

Kunwar *et al*. (2006) conducted an ethnobotanical investigation of the medicinal plants in the Dhading district, specifically in the areas of Pida, Murali Bhanjiang, and Dhadingbesi. Of the 108 beneficial species they reported, several had local medicinal potential. In Dhuniibesi RM in the Dhading district, Shah *et al*. (2018) carried out an ethnobotanical survey and identified 23 medicinal plants used by the Tamang community.

Gurung and Subedi (2021) documented the utilization of sixty medicinal herbs by the Gurung community residing in Siddhalek RM, Dhading. They recommended the ethical collection and accurate recording of these beneficial and therapeutic plants from as-yet-undiscovered regions of Nepal.

Another ethnomedical study has been carried out among the Chepang community of different districts in Nepal, including Dhading district. In total, 9 VDCs from 4 districts were included, and a semi-structured questionnaire was taken for interviewing local key informants. In total, 226 medicinal plant species from 93 families were reported to be

used by the Chepang community in Nepal. The study also revealed a decline in ethnic knowledge among the younger generation and the immense need for its conservation.

Addressing the need for proper documentation and conservation of ethnic knowledge about our medicinal resources, the present study has been proposed for research work. Thus, it may add additional information on the medicinal plant list of Nepal and may explore the Rubivalley for its bank of medicinal herbs.

CHAPTER THREE: MATERIALS AND METHODS

3.1. Study area

Dhading district, which is known as the only district of Nepal that stretches from the Himalayas in the north to the Mahabharata in the south, The former Lapa, Sertung, and Tipling VDCs were merged to form Rubivalley Rural Municipality (RVRM) because the most rare and precious mineral “Rubi” in the world can be found in large quantities in this municipality, which is divided into 6 wards, with Sertung declared the administrative center of the RM.

There are exciting views in the lap of ‘Ganesh’ and ‘Pawil Himalaya'. The beauty of ‘Ankhu khola’ originates from these Himalaya and flows continuously in the middle part of the RVRM and the almost middle of the district, as the natural assets of this municipality are the ‘Kalo daha’, ‘Seto daha', ‘Nak pokhar’, ‘Dongden pokhari’, ‘Gothen Mane’, ‘Tato pani daha’, ‘Ganesh Kunda', 'Melbu darabar’, ‘Pyoldoar dada’, ‘Pangsang view’ etc., which are also known as meeting points of cultural diversity and social integration (Village Profile RVRM).

3.1.1 Location

Rubivalley Rural Municipality is located in the Dhading district of Central Nepal and is located in the Bagamati province, about 57 km northwest of Kathmandu valley. The geographical spread of RVRM, which is almost spherical in shape, is connected with Rasuwa district in the East, Gorkha in the West, China-Tibet in the North, and Khaniyabas RM and Gangajamuna RM in the South. It covers a 425 square kilometers area, with an altitudinal range of about 1000 m to 7,500m asl. Pabil Himal (Ganesh IV) is the highest peak in the area. The study area lies at 28° 10′ 35.76″ N and 85° 5′ 0.24″E (Village Profile RVRM).

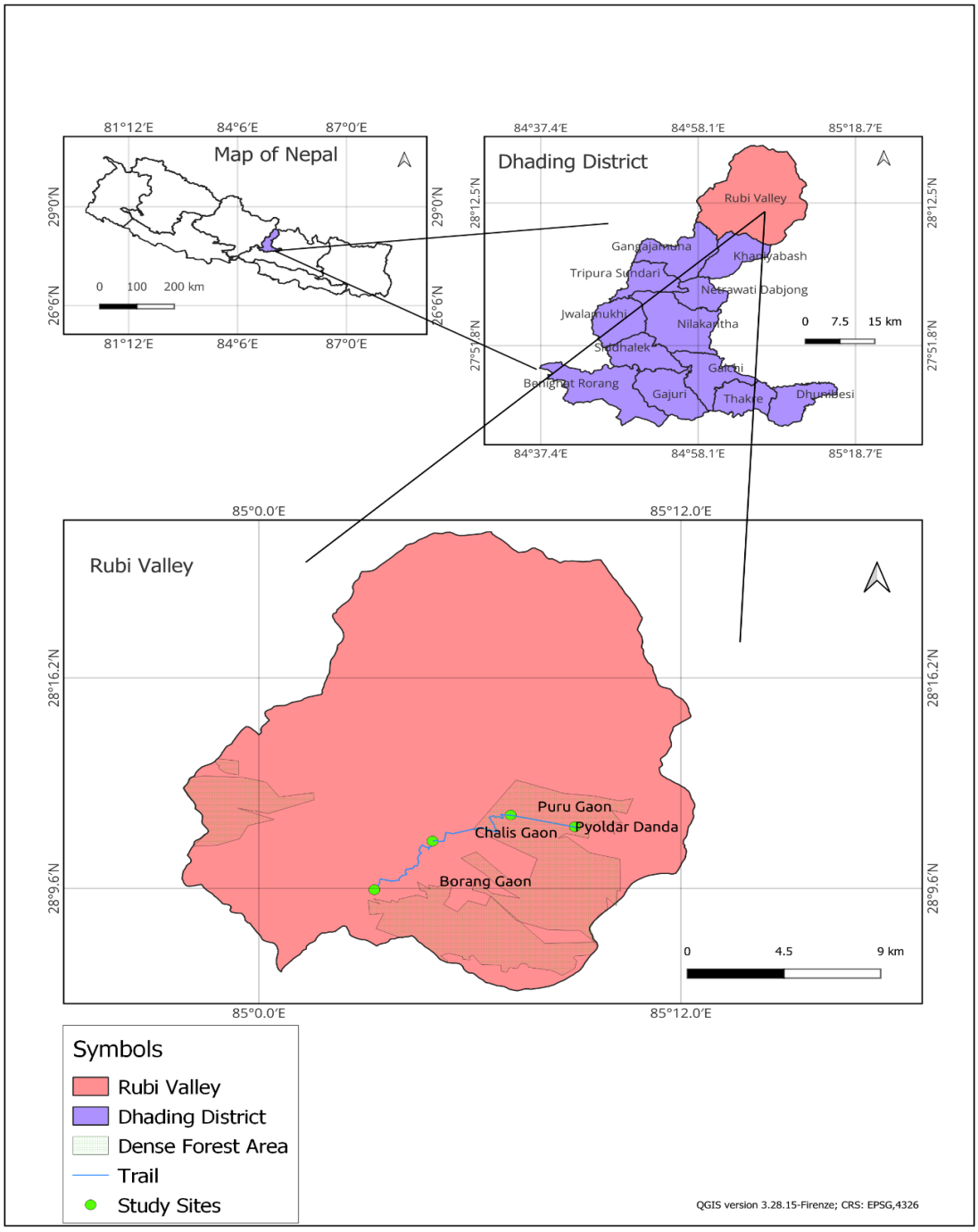

Figure 1: Map of the study area

3.1.2 Climate

High altitudinal variation causes differences in temperature, rainfall, vegetation, microclimate, and geography. The temperature here ranges from snow-forming to more

than 30 ºC in summer along the river basins. Precipitation ranges from 3500 mm on lower land to about 1900 mm along highlands annually and shown in figure 2 (Village Profile RVRM).

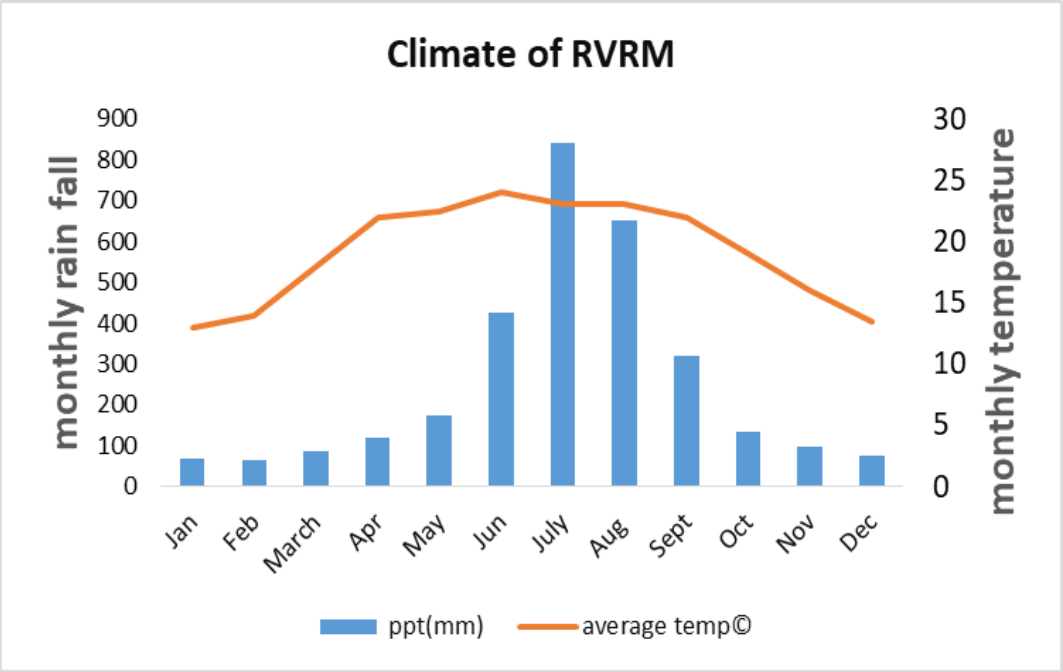

Figure 2: Climate of RVRM

3.1.3 Land use and soil type

Of the total 425 square kilometers of RVRM, 27.93 square kilometers are covered by agricultural land, 229.8 square kilometers by forests, and 0.78 square kilometers by water bodies (Village profile RVRM). There are mainly four types of soil documented: fragmental loamy on the north-east side, fragmental sandy at 'Tars', boulder loamy at river basins, and skeletal loamy at the northern and step cliffs of the southern side.

3.1.4 Forest

The climatic variations in the RVRM result in habitat for a variety of plants, animals, and birds. Different forest types were as follows:

Schima-Alnus Forest

The major forest types along the subtropical region (1000 m-1500 m) of the study area are *Schima wallichiana* and *Alnus nepalensis;* other associated species are *Diplokenma butyracea, Magnolia champaca, Prunus cerasoides, Shorea robusta, Castanopsis*

indica, Acacia catechu, Dalbergia sissoo Bombax ceiba, Ficus religiosa, F. bengalensis, Aegle marmelos, Lyonia ovalifolia, Acorus calamus, Bergenia ciliata, Prinsepia utilisa, Berberis aristata, etc.

Rhododendron-Castanopsis Forest

From 1500 to 2500m asl. lies the *Rhododendron-Castanopsis* forest. *Rhododendron arboreum* and *Castanopsis indica* are followed by *Lyonia ovalifolia, Lindera neesiana, Alnus nepalensis, Rhododendron campanulatum, Pinus wallichana,* etc. *Daphne bholua* and *Cirsium verutum* serve as the herb vegetation.

Oak conifer mix forest

The major tree species are *Pinus wallichana, Quercus semecarpifolia, Quercus lamellosa, Rhododendron campanulatum, Tsuga dumosa,* and *Cedrus deodara*. Other shrub and herb species are *Rumex nepalensis, Daphne papyracea* etc.

Rhododendron-Cupresus Forest

This type of forest is found above an elevation of 3500m. The major vegetation is *Cupresus sempervirens, Rhododendron anthopogen, R. lepidotum, and Rumex nepalensis,* with many shrubs and herbs that make the landscape grassland (Village Profile RVRM).

3.1.5 Wild Animals and birds

Throughout the RVRM, Tiger, Bear, Chitaha, Porcupine, Spotted deer, Ghoral, Himalayan Tahr, Wild Pig, Pangolin, Jackel, Deer, Wild Cat, Rabbit, Garking deer Monkey, and Snakes are the major animals, and Mynas, Oriental turtle dove, House sparrow, Peacock, Owl, Bulbul, Vulture, Hornbill, Parrot, Himalayan Monal, Tailorbird, Red-wattles, and Lapwing are the major birds (Village Profile RVRM).

3.1.6 Agriculture

The major crops of RVRM are the Potato, Buckwheat, Barley, Millet, Paddy, Maize, Soybean, lemon, banana, etc., and the domestic animals are goats, fowl, cattle, buffalo, sheep, etc., which have a great contribution to their livelihood. They also made money from tourism, lodging, handcrafts, government work, and the collection and trade of MPs (Village Profile RVRM).

3.1.7 Ethnicity and demography

RVRM had a population of 10781; out of them, 49.7% are male and 50.3% are female, with a population density of 27 ind/sq km .Out of these, 85.4% speak Tamang, 14.2% were Nepali, 0.2% were Gurung, and 0.3% were others. In terms of ethnicity/caste, 74.1% were Tamang, 12.4% were Ghale, 7.9% were Gurung, 3.5% were Kami, 0.7% were Damai, 0.5% were other Dalits, 0.4% were Hill Brhamin, 0.1% were Kshetry, and 0.3% were others. RVRM had 53.3% of the population were Buddhist, 39.1% were Christian, 7.4% were Hindu, and 0.1% were others. In terms of literacy, 58.7% are literate, 64.6% are literate males, and 52.9% are literate females. According to age group, 35.72% of the population is under 15 years old, 49.65% are 15–59 years old, and 14.62% are 60 and older (Village Profile RVRM), (Census 2078).

3.2 Field survey and data collection

A survey of MPs was carried out in 3 villages of RVRM. In total, 10781 people reside in the municipality. People were classified based on age group and occupation for the collection of ethnomedicinal information. Respondents in each group were selected by snowball sampling methods, in which we asked the respondents about other people who knew more about the medicinal plants so that the possibly more related people were included in the survey. A semi-structured questionnaire was used for interviews with local respondents in the area, in which the respondents were also asked questions that were not included in the questionnaire for more information. A checklist of medicinal plants with local and Nepali names, use methods, and ailments was noted. Detail on use method, use parts, collection time, collection methods, conservation protocols, and trade route, if available, further species confirmation was done with the help of herbarium and clear photographs for threatened and endemic species.

3.2.1 Ethnomedicinal data collection

The ethno-medicinal data were gathered by applying PRA (Participatory Rural Appraisal) and household sampling techniques (Martin, 1995). Secondary data from published sources were also used. The medicinal data were collected using two basic approaches:

3.2.1.1 Participatory Rural Appraisal (PRA) Method

Participatory rural appraisal means involving the local people of a particular community to achieve certain goals and objectives. In PRA, involvement of males, females, old people, and everyone else is practiced. Through the direct involvement of local peoples in RVRM, medicinal data were collected, compiled, analyzed, and discussed. Involvement of local *Dhami* and *Jhankris* were done to achieve reliable and accurate data.

3.2.1.2 Interview and demography

Artifact/interviewing technique: Semi-structured questionnaires were asked about the uses of plants for medicinal purposes. The interviews were conducted in the different wards and different villages of the RVRM to understand their curiosity and knowledge about medicinal plants available in agriculture land, forests, cliffs, and wetlands around the village, and how their different parts are used for various ailments. The interviews were conducted and field observations were made using conventional ethno-botanical techniques, following the ethical principles established by the International Society of Ethno Biology (ICE) (Martin, 1995; Alexiades, 1996; Cotton, 1996). Before conducting interviews with the locals, verbally seek their prior informed consent. First met the locals and leaders of the community and made sure they understood what research was all about. The gathering of information didn't start until had their full permission. At first, the interview was conducted in the RVRM-4 Sertung, Borang, situated at altitude of 1500 masl with local farmers, teachers, healers like Vaidya, Dhami, students, etc. Out of a total 110 respondents, 43 were from these villages, with all types of age groups, genders, and occupations. The next questionnaire survey were conducted in Puru village, located in ward number 01 at an altitude about 2300 m in the RVRM, with 47 respondents. The major community of this village is Ghale. The survey was held in the 'Chalis' village of ward number 04 of the RVRM with 20 respondents, which is located at about 1700 masl. Gurungs are the major inhabitants of this village.

Interview was also conducted with the "specimen display" method (Shrestha *et al.*, 2016). After collecting plant specimens, display the specimens to the public in order to learn more about their potential medical applications. To ensure the accuracy and validity of the information, same plant specimen was displayed to different respondents.

Since main language of the most of respondents is Tamang, a local interpreter was used for translation in Nepali. After recording the data, field notes of the plant species on taxonomic characters (location, habit, habitat, color of leaves, flowers, etc.) were noted. Based on the locals' agreement regarding the use of medicinal herbs, an overall list of plants was prepared. The demography of the respondents are presented in the Table 1.

Table 1: Demography of the Respondents

Categories	Demographic variables	Number	Percentage
Gender	Male	68	62.38%
	Female	41	37.61%
Age group	Below 30	32	29.35%
	30-59	52	47.70%
	60 Above	25	22.93%
Occupation	Farmer	56	51.37%
	Housewife	4	3.66%
	Job	17	15.59%
	Students	27	24.77%
	Business	5	4.58%
Education	Literate	98	89.91%
	Illiterates	11	10.09%

3.3 Plant collection

The plant specimens of MPs were collected from RVRM around the village and trails of the study area to the ‘Pyaldor dada’. The specimens for herbarium purposes were collected in as flowering and fruiting conditions as possible. In the case of larger plant specimens (trees, shrubs, larger herbs, and climbers), twigs bearing at least flowers or fruits or both were collected. In the case of grasses, sedges, and small herbs, the whole

plant, including the underground part, was collected. The collected specimens were properly tagged with the field numbers before being put in polythene bags to avoid further desiccation and to protect them from withering.

3.4 Pressing and drying specimens

Herbaceous specimens were brushed to remove mud from the roots. The plants had many leaves or branches; a few were removed to show all parts clearly. The specimens were stretched carefully between newspapers and pressed under herbarium pressure. These were dried with a daily change of drying sheets for 6-10 days.

3.5 Herbarium preparation

The dehydrated and well-pressed specimens were used for the preparation of herbarium specimens using standard techniques (Forman and Bridson, 1989). The specimens were affixed to a sheet of herbarium paper measuring 29×42 cm with the help of synthetic adhesive. Before the plant was glued, it was placed on the sheet in a suitable position. Only one specimen was placed on one sheet. The field number tagged with the plant was pasted in a proper, straight position.

3.6 Identification of specimens

The specimens were critically studied, identified and confirmed with the help of available literature and other online herbarium (Hooker, 1872–1897; Hara *et al.*, 1978, 1979, 1982; Siwakoti & Jha, 1987; Siwakoti & Varma, 1996, https://www.gbif.org). Further, their identification was confirmed with the help of experts. The specimens are deposited at the herbarium section of the Botany Department, Amrit campus, T.U. Lainchaur, Kathmandu.

3.6 Secondary data collection

Secondary data were collected from various sources, like data about population, total land, irrigation, resources, etc. by the village profile of the RVRM, policy, plan, program, etc. from the district forest office (DFO), Dhading, IUCN red list, CITES, the Department of Statistics, and other relevant literature like published articles, etc. that was also consulted from the various sources.

3.7 Presentation of data

The study mainly focused on the ethnomedical use of the plants by the people of the RVRM. The name of the species is followed by the original citation and other citations. The catalog of the plant species was found at https://www.gbif.org. The description were followed by the distribution and field notes along with uses. Various uses of plants were given regarding medicinal or other uses, if any, gathered from local people.

3.8 Analysis of ethnomedicinal data

The collected data were entered and analyzed using MS Excel 2010. The following quantitative parameters were assessed for the traditional uses of plants in the area: Inferential statistics were performed in R software. The normality of the data was initially observed before conducting correlations between the age groups and plants known to them.

3.8.1 Used values (UV_i)

It indicates the relative value of every single plant species to the informants in terms of its ethno-medical applications. The use values of different plants used by the local community were calculated using the equation given by Phillips and Gentry (1994)

$$\text{Use Value (UVi)} = \frac{\Sigma \text{Ui}}{\text{Ni}}$$

Where,

Ui = No. of use reports cited by each informant for a given plant species

Ni = the total number of informants interviewed for a given plant species.

3.8.2 Frequency index

In addition, a frequency index was computed for the quantitative examination. According to Mahwasane *et al. (*2013), the frequency index is a quantitative representation for the percentage frequency at which informants cite a certain botanical species. The frequency index was computed using the formula below.

$$FI = \frac{FC \times 100}{N}$$

Where N is the total number of informants and FC is the number of informants who indicated using the species (Madikizela *et al*. 2012).

3.8.3 Informant Consensus Factor (ICF)

The Informant Consensus Factor were used for identifying the categories of ailments first introduced by Trotter et al. (1986), calculated as:

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where, Nur = Number of use report in a particular illness category by informants and

Nt = Number of taxa or species used to treat that particular category by informants.

CHAPTER FOUR: RESULTS

4.1 Diversity of medicinal plants

A total of 70 medicinal plant species were recorded under 52 families, out of which 44 belong to angiosperms with 59 genera and 62 species, 3 to Fungi with 3 genera and 3 species, 2 to Gymnosperms and Pteridophytes with equally 2 genera and 2 species for each, and 1 to Lichen with one genera and 1 species, for a for a total 67 genera in the study area (Figure 3, Appendix Table 1). The medicinal plants, along with their scientific name, parts used, and applications, are listed in Appendix Table 2.

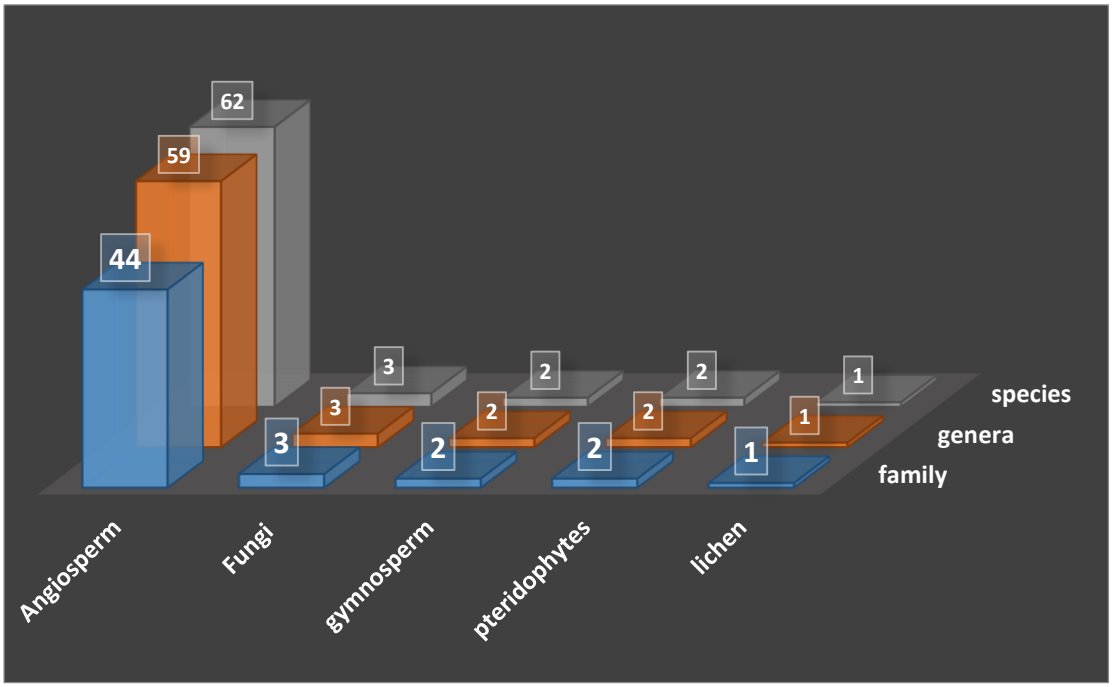

Figure 3: Diversity of MPs species in Taxa, Family, Genera and species

Among 52 families, Asteraceae had the highest number of species (n = 7), followed by Ericaceae (n = 3), Rosaceae (n = 3), Amaryllidaceae, Ranunculaceae, and Zingiberaceae with two species each. However, the remaining 46 families possessed one species each (Figure 4). In total angiosperm, there were 53 di-cotyledons and 9 monocotyledons in the present study.

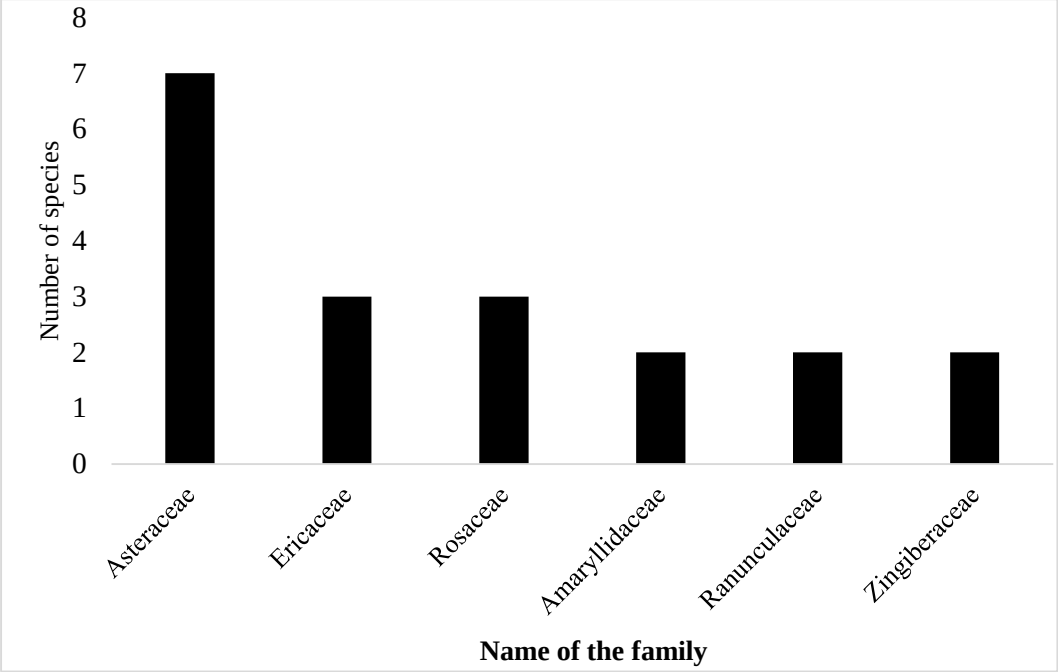

Figure 4: Number of species in different families

A total of 70 medicinal plant species were recorded under seven different habits or, at some point, reported as life forms. The most frequently observed habit of the plant species in the study area was herb, with 36 species, followed by shrub and tree (10 species each), climber and creeper (8 species), mushroom (3species), fern(2 species), and lichen (1 species) (Figure 5).

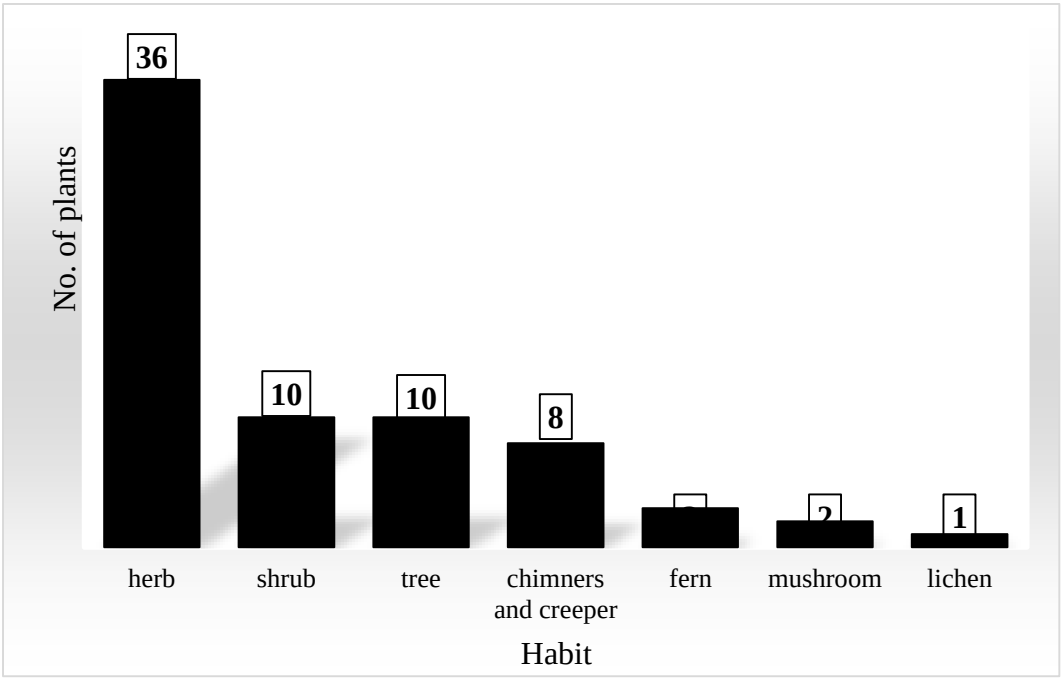

Figure 5: Species richness of MPs Based on life forms.

4.2 Plant parts used

The medicinal plants in the study area were used for different parts to treat various ailments and disorders. The present study has categorized 10 different categories as plant parts, which encompass almost all parts of the plant. The most used plant part was the leaf (n = 37), followed by fruit or seed (n = 12) and so on is shown in Figure 6. In the comparison of multiple and single parts used, a larger number of species have multiple parts used (38 species).

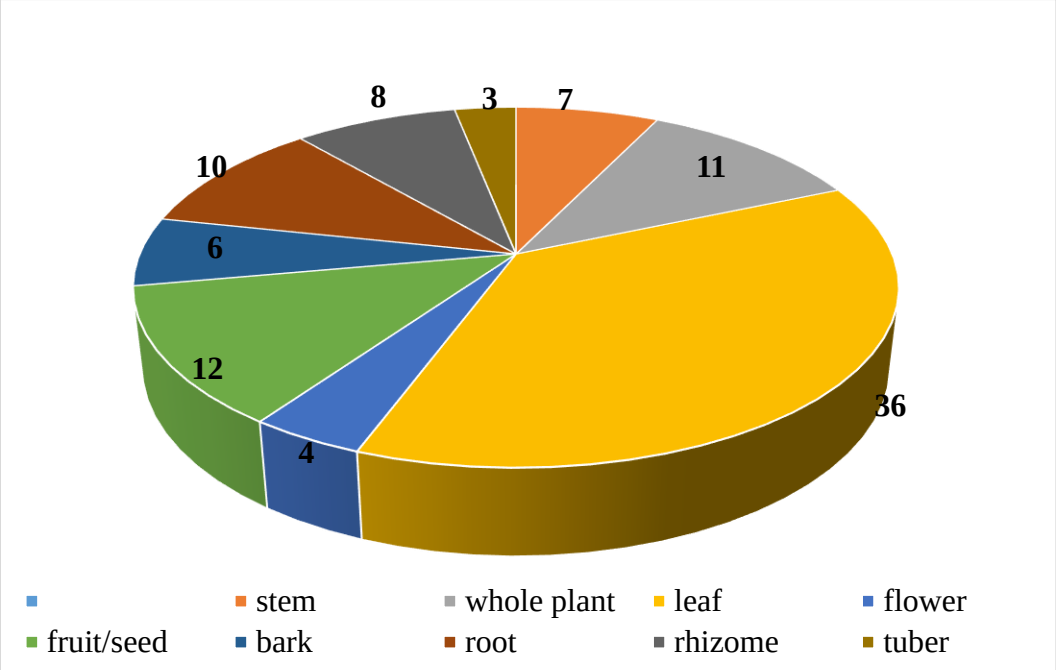

Figure 6: Parts of MPs used in different ailments

4.3 Use category, forms of medication and route of administration

Use category here simply means the number of ailments recorded from all respondents for particular MPs. Out of the 70 MPs recorded, 29 have applications for the treatment of three or more ailments, which is 41% of the total MPs recorded. Of these, 27 (39%) species are in practice for two ailments, and 14 (20%) species were recorded as used for only one single ailment (Figure 7).

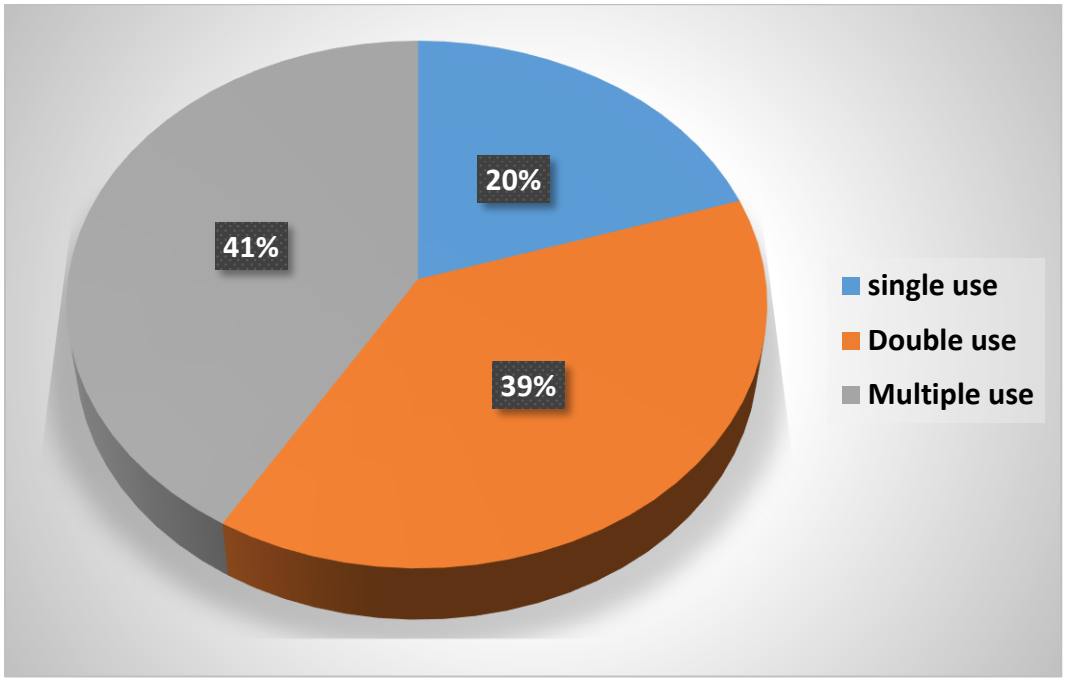

Figure 7: MPs with single, double and multiple use

Out of 8 forms of medication, most of the plants were used as paste, i.e., 33 species, followed by raw use (27), and decoction (25). Only 3 plants were used as smoke (Figure 8).

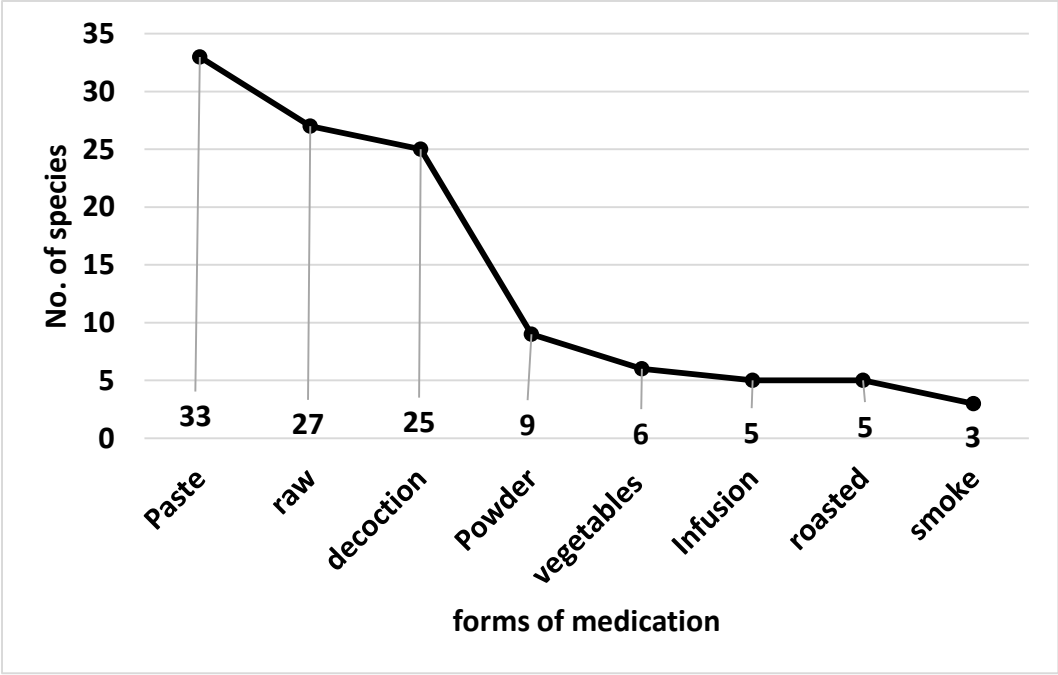

Figure 8: Forms of medication

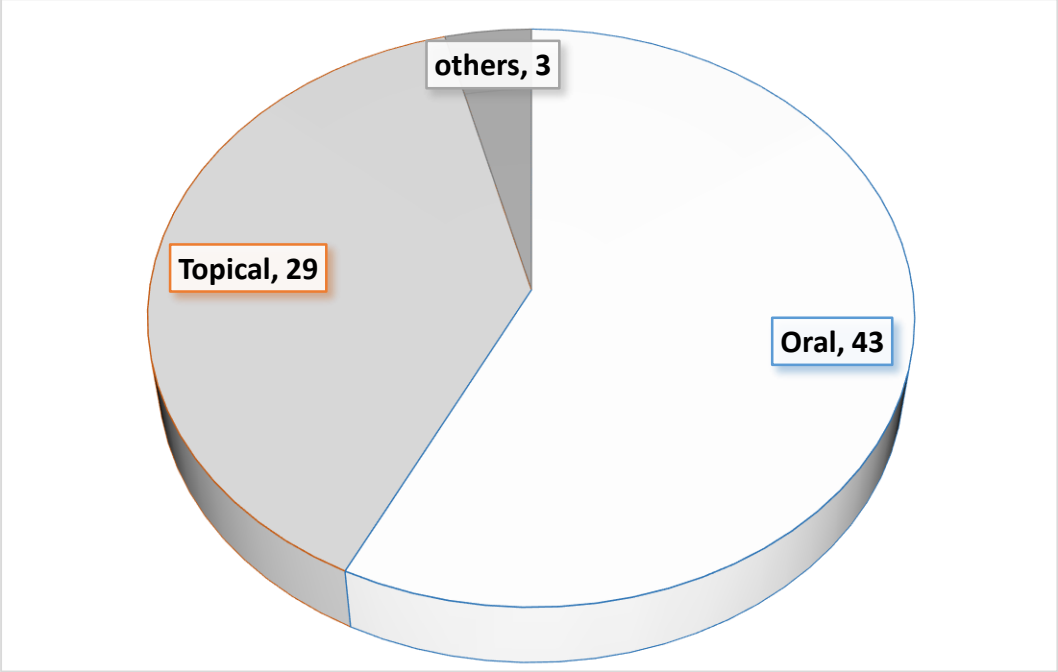

Figure 9: Display of mode of administration of MPs in pie chart

In the study, it was found that during the interview, 43 of the MPs were taken directly from the mouth (oral), 29 were topical, and 3 were species used as brush and smoke (Figure 9).

4.4 Use value (UV) and Frequency index (FI) value

The use value of the MPs used by the local people of the RVRM is calculated from the data gathered from interviews. The species *Osyris lanceolata* has the highest use value i.e. 3, which is followed by *Justicia adhathoda* and *Nardostachy jatamansi* with use values of 2.5 and 2.11, respectively and so on. The 11 MPs with the highest use value are shown in the following chart (Figure 10) and all detail is shown in Appendix Table 3.

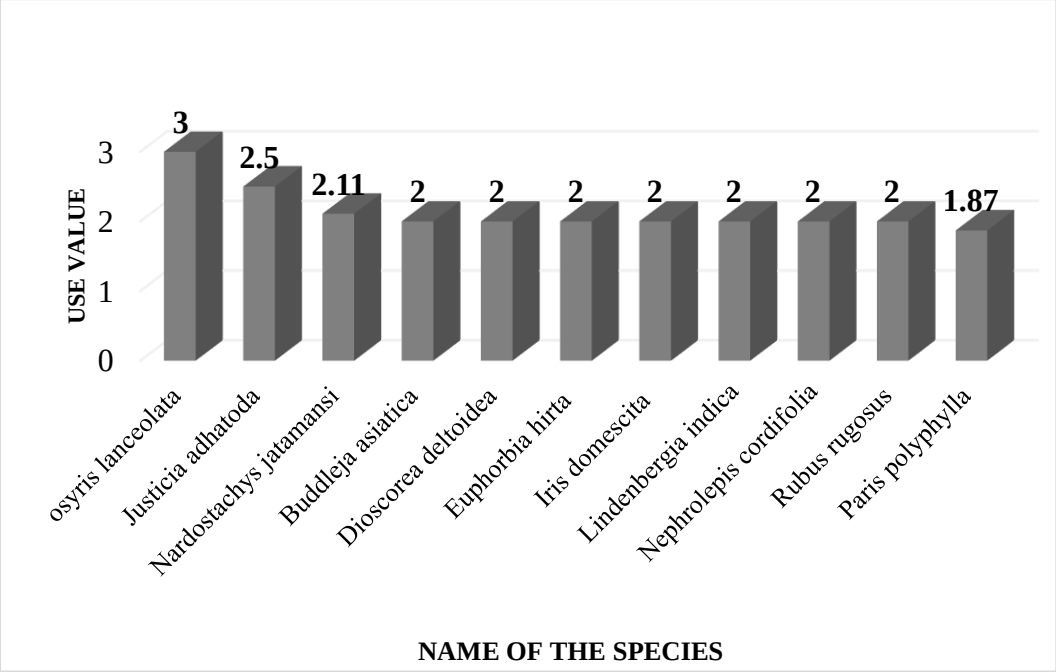

Figure 10: Medicinal plant species with use value

The frequency index of the medicinal plants showed that the most frequently used plant in the study area was *Ophiocordyceps sinensis* (FI value = 33.63%), followed by *Ageratina adenophora* (31.81%), *Delphinium denudatum* (29.09%) and so on. However, *Buddleja asiatica, Euphorbia hirta, and Dioscorea deltoidea* had the lowest frequency index value of 0.9% (Figure 11, Appendix Table 3).

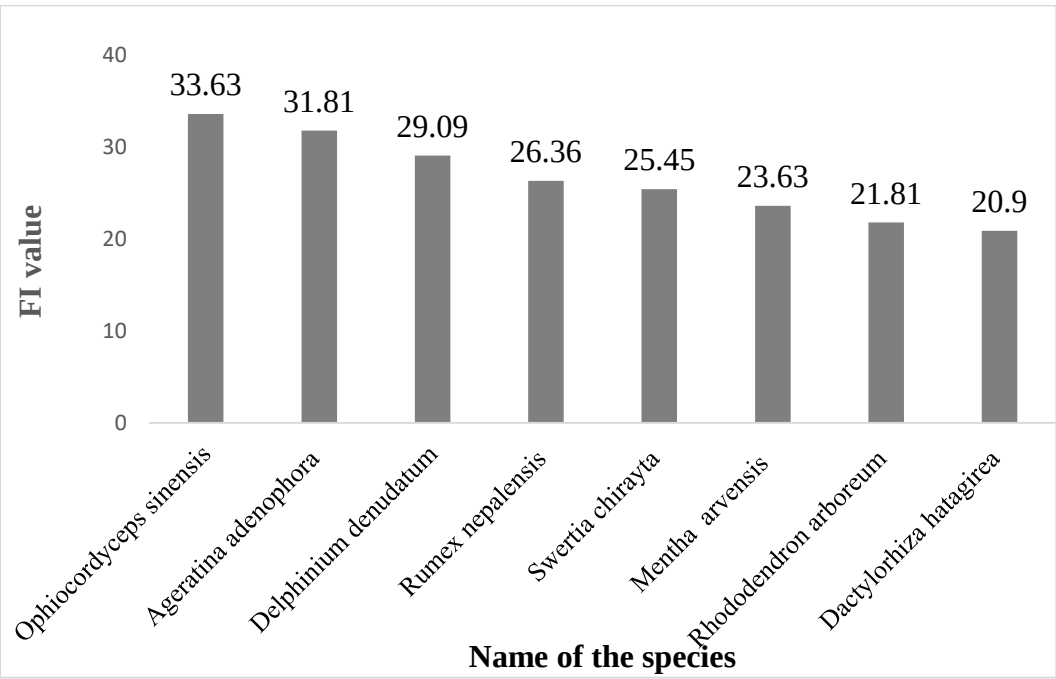

Figure 11: MPs with their FI value

4.5 Informants consensus factor (ICF)

The present study has reported 52 ailments that were treated, cured, or prevented by 70 plant species. All the ailments were kept in eleven different categories. The highest FIC value was seen in gastro-intestinal, with an ICF value of 0.887, followed by fever/headache (0.877) and so on the detail of ICF and ailments categories were presented in Table 2 and Appendix Table 4.

Table 2: ICF value of various ailments categories.

Ailment categories	ICF
Gastro-intestinal	0.887
Fever/headache	0.877
Miscellaneous	0.875
Respiratory	0.736
Neurological	0.727
Dermatological	0.725
Neurological	0.7
Cardio vascular	0.666
Ortho-muscular	0.629
Dental and oral	0.5
ENT	0.333

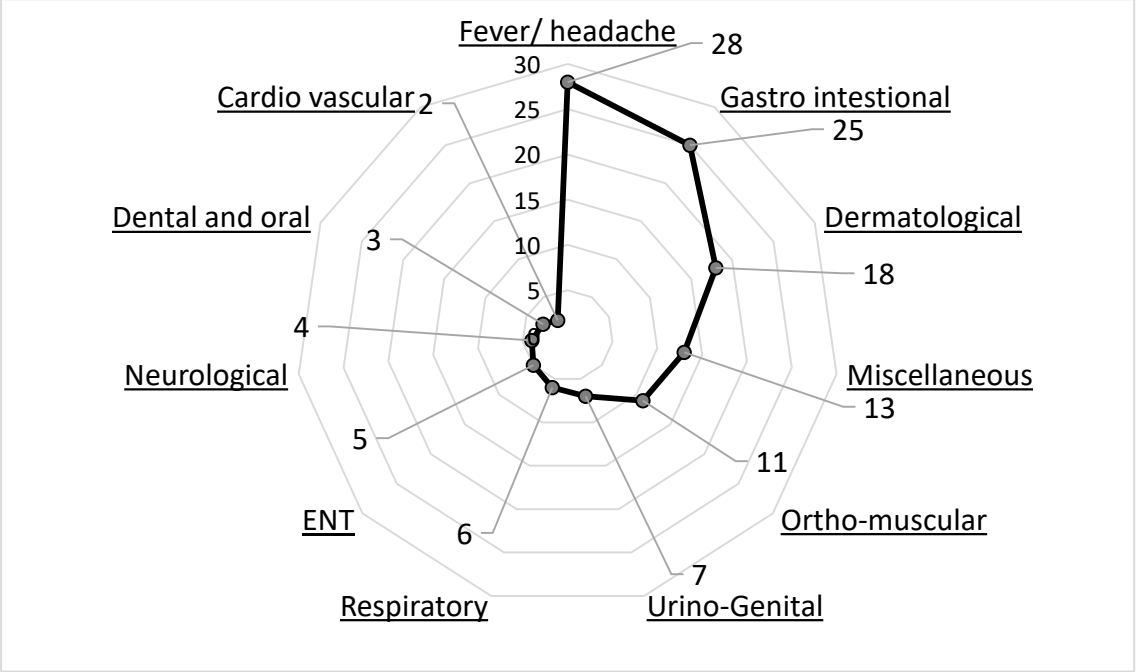

Figure 12: Rader diagram showing ailments categories and number of plants

4.6 Knowledge distribution and transfer among age groups

All the respondents were divided into three categories on the basis of their age groups. The first category included the respondent with an age below 30 years old; the second category included the age group between 30 and 59 years old; and the third group included the respondent with an age greater than 59 years old.

Altogether, 26, 52, and 31 respondents were included in the first, second, and third categories, respectively. The present study recorded that the individuals from the first, second, and third categories had an average knowledge of 7, 6, and 8 plants, respectively. Moreover, the Pearson correlation between the age groups and the number of plants described by them also did not have any relationship (p value = 0.901, r = 0.010) with each other. The Pearson correlation was also supported by the simple linear regression (R^2 = 0.0018). Age groups and number of use reports for different ailments also did not have any relationship with each other (p value = 0.071, r = 0.168), as supported by the simple linear regression (R^2 = 0.028). (Figures 13 and 14).

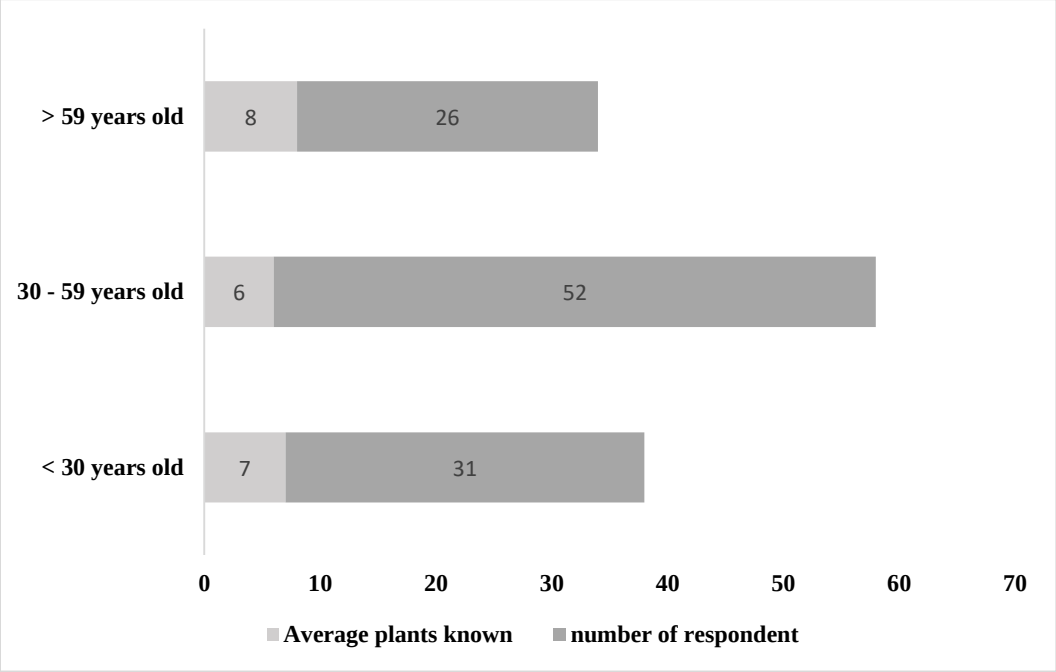

Figure 13: Age group with average number of plants known

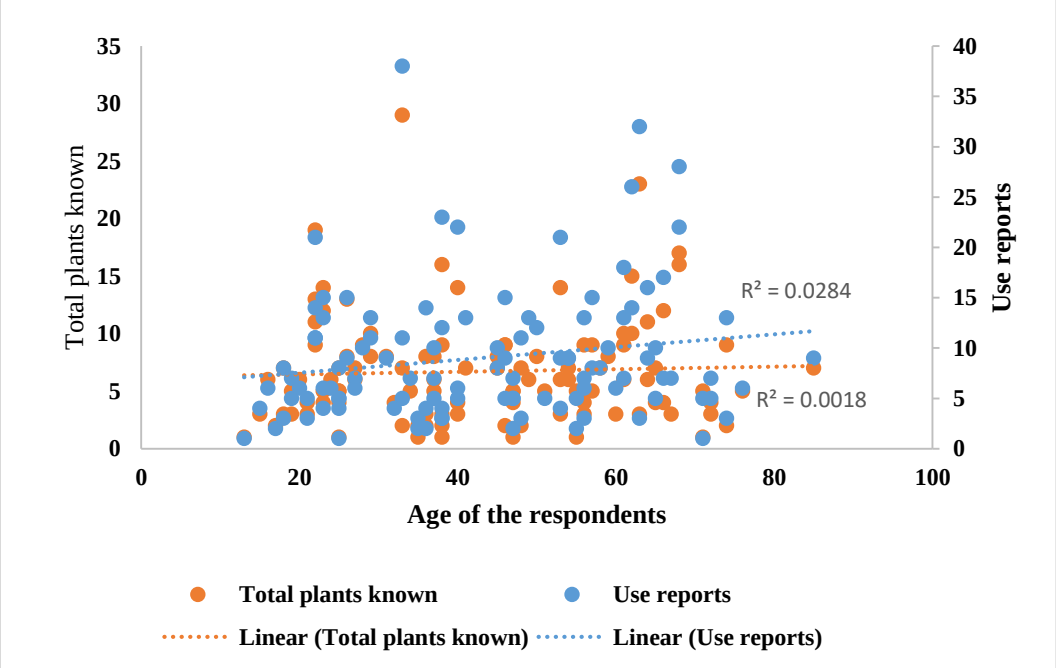

Figure 14: Knowledge transfer trend with respect age

4.7 Collection, Trade and market value of MPs

The MPs in the RVRM are found everywhere in the farmland, trails, and forests. The majority of the people are involved in the collection and trade. According to the

interview, out of 109 respondents, 23 are self- involved in the collection or trade of MPs and so on (Figure 15).

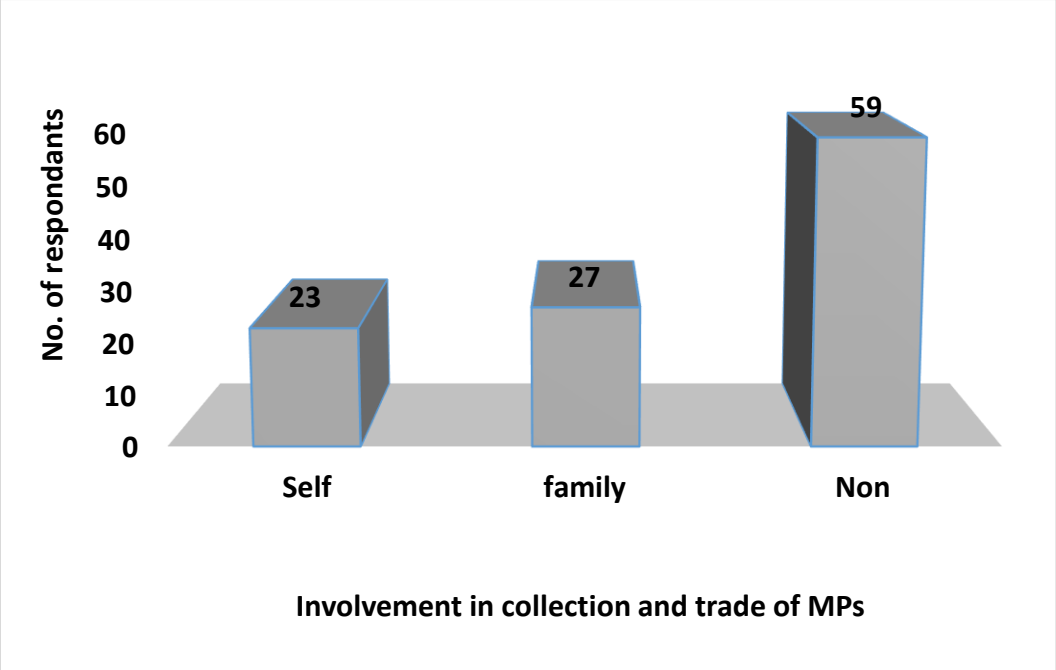

Figure 15: No of respondents involved in the MPs collection and trade

The informants were asked questions about the collection, trade, and market value of the MPs found in RVRM. According to their response, the ranking of the harvested MPs is prepared based on economic value and quantity of harvesting. The data (Table 3) shows that most of the respondents believe that they are earning more money from harvesting *Delphinium denudatum* (Nirmasi), followed by *Paris polyphylla* (Satuwa), and *Rheum nobile* (Padamchal). In terms of quantity of harvesting, most people assumed *Swertia chirayta* (Chiraito) was harvested for trade in huge amounts, followed by *Bergenia ciliata* (pakhanbhed) in the second and *Delphinium denudatum* (Nirmansi) in the third.

Table 3: Importance of MPs according to Economic value and mass harvesting

According to economic value	**According to mass harvesting**
1. *Delphinium denudatum* (Nirmasi)	1. *Swertia chirayta* (chiraito)
2. *Paris polyphylla* (Satuwa)	2. *Bergenia ciliate* (pakhanbhed)
3. *Rheum nobile* (padamchal)	3. *Delphinium denudatum* (Niramasi)

The market value of some important medicinal plants at the local level is averaged, and the top ten highly valued medicinal plants found in RVRM are tabulated (Table 4).

Table 4: Top 10 MPs with high market Value.

Name of the Species	**Market value (Price-Rs/Kg)**
Ophiocordyceps sinensis	500000
Morchella sp.	10,000
Paris polyphylla	6000
Delphinium denudatum	5000
Rheum nobile	2500
Aconitum heterophyllum	2000
Allium carolinianum	1500
Nardostachys jatamansi	630
Lindera neesiana	400
Swertia chirayta	300

The *Ophiocordyceps sinensis* (Yarchagumba) is the most valuable MP found there, with a local market value of 5 lakh/kg, although this value reaches up to 30–40 lakh in international markets, followed by the *Morchella* mushroom with a market value of 10000/kg, *Paris polyphylla* with a market value of 6000/kg, and *Delphinium denudatum* with a market value of a market value of 5000/kg and so on (Table 4).

4.8 Threats to medicinal plant species

Out of 109 respondents, 17 believe that there is no threat to the MPs in RVRM, and 6 are unanswerable. Eighty-six respondents feel a threat to the MPs of RVRM; out of them, 34 respondents reported forest fire as a major threat to the medicinal plants in the study areas, followed by unsustainable harvesting (27 respondents), grazing (17 respondents), and illegal harvesting and trade (8 respondents) (Figure 16).

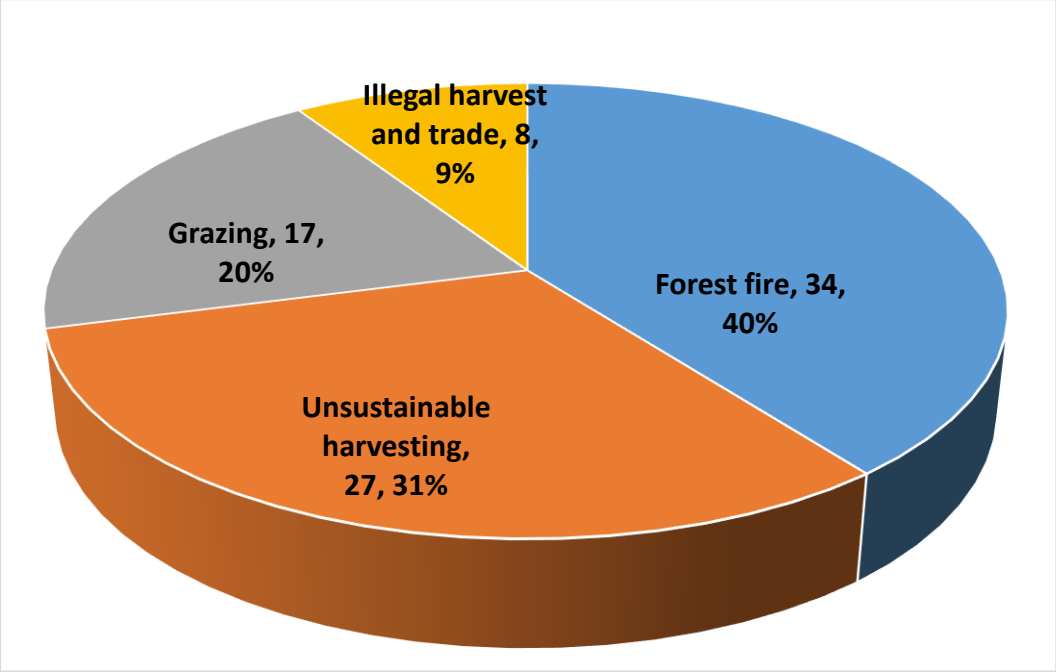

Figure 16: Pie chart showing various threats according to respondents

4.8.1 Threat status

The lists of MPs used by local people in RVRM are compared to the databases of CITES, IUCN, and national threat status.

Table 5: CITES categories of MPSs in study area

CITES categories	Name of the plants
Appendix II	*Dactylorhiza hatagirea*
Appendix II	*Dioscorea deltoidea*
Appendix II	*Nardostachys jatamansi*
Appendix II	*Picrorhiza kurroa*
Appendix II	*Taxus wallichiana*

Among the recorded MPs in RVRM 5 are those in the Appendix II categories of the CITES checklist. According to IUCN red list categories, 29 species fall under the checklist, number are shown in table 5 and name of species are in Appendix Table 5.

Table 6: MPs with IUCN red list Categories in study area

IUCN red list categories	No. of the MPs
Least concern (LC),	18
Endangered (E	4
Vulnerable (V),	3
Data-deficient (DD),	2
Critically endangered (CR	1
Threatened (T).	1

Nine species are included in the national threat categories. The threat status of the collected MPs was compiled in the Annex.

4.9 Conservation and cultivation practices

Present study revealed some threats to the medicinal plants in the RVRM, although some conservation practices were carried out at different levels viz. the local people, local government and state government.

At the level of local people, many of them were found unaware of the threat and conservation of MPs. However, they were unknowingly involved in the protection of MPs to fulfill their own daily medicinal requirements and ease by planting MPs around the house and agricultural farm. Besides, some people were involved in the farming of medicinal plants like *Delphinium denudatum* (Nirmasi), *Rheum nobile* (Padamchal), *Zanthoxylum armatum* (Timur), *Aconitum heterophyllum* (Atis), etc. in their natural habitats for trade purposes. The local inhabitant in collaboration with the Division Forest Office (DFO) was found to build a greenhouse in the Puru Village to cultivate, propagate and generate seeds of different medicinal plants like *Bergenia ciliata* (Pakhanbhed), *Delphinium denudatum*, *Juglans regia* (Okhar), *Lindera neesiana* (Siltimur), *Paris polyphylla* (Satuwa), *Swertia chirayta* (Chiraito), *Taxus wallichiana* (Lauth Salla), and *Zanthoxylum armatum*. Besides, they also developed farmland in pasturelands (between 3000 to 4000m asl.) of high elevation

At the level of local government, there were absence of policy or program related to farming, enhancement, conservation, sustainable harvesting, and use of MPs in the RVRM. There were no records of action against illegal trading of high value MPs. But as mentioned in the village profile, they are planning to make policies and programs for the sustainability of medicinal plants and their use for the economic benefit of local people.

At the level of state and central government, different criteria for the cultivation, collection, and trade of medicinal plants was formulated. An Ayurvedic Medicine Center (Baidhyakhana) was found to establish in the Borang village of RVRM-4, which collects, processes, and stores various MPs of the area and provides assistance to the local people in case of illness or accidents.

CHAPTER FIVE: DISCUSSION

5.1 Diversity of medicinal plants

Ethnomedicinal study in the RVRM revealed 70 species of plants including 3 fungal species. There were highest number of angiosperms (mostly dicots and few monocots) compared to the pteridophytes and gymnosperms. The high number of NTFP species from distinct families and genera that have been seen may be caused by a variety of factors, including diverse microclimates, geographic variances, and knowledge of various ethnic populations and their traditions, lifestyles, and beliefs. Previous research conducted in various regions of Nepal (Shakya *et al*., 2002; Bhattarai and Vetaas, 2006; Chhetri and Gupta, 2007; Bhatta and Chaudhary, 2009) has also supported it.

Asteraceae is the world's largest flowering plant family, with members found in all regions except Antarctica (Ansari *et al*., 2016). In present study, Asteraceae had the highest number of plant species, which was also recorded in the previous literature (Mesfin *et al*., 2009; Bhattarai *et al*., 2009; Bhaila *et al*., 2022). However, various data contradicts with present study like, Solanaceae (Dulal *et al*., 2022), Lamiaceae, and Orchidaceae (Magar *et al*., 2022), as well as Rosaceae (Ojha Khatri *et al*., 2021), were shown to be prominent in various places. The climatic condition, edaphic factors, biotic interactions, and topographic circumstances may be the factors that favor or restrict the growth of various plants in specific areas which contributed to the domination of different families in different places and conditions. The outcome has been supported by similar findings (Chhetri and Gupta, 2007; Bhatta and Chaudhary, 2009).

The most commonly reported habit of the plant species by the respondents in the study was herb, followed by shrub, tree, climber and creeper, fern, mushroom, and lichen. This could be owing to the natural abundance of herbs. According to Shrestha & Dhillion (2003), herbs are abundant and spontaneously occurring in the environment. Moreover, herbs may be more easily collected, stored, transported, and extracted for active components than other forms (Shrestha & Dhillion, 2003; Dulal *et al.,* 2022).The existence of a higher number of secondary metabolites in herbs could be another cause for the high reports of herbs rather than other life forms (Stepp & Moerman, 2001). A similar result was also reported in the previous literature (Uprety *et al.,* 2010; Malla *et al*., 2015; Bhaila *et al*., 2022; Magar *et al*., 2022).

5.2 Plant parts used

The medicinal plants found in the research area were utilized to cure variety of diseases and disorders with the aid of various plants' parts. Among them, leaf was the most the most widely used part. Local people used to spend their time raising their livestock in the forests and grasslands, which might be a relevant point to connect them with plants and the use of their parts (Magar *et al*., 2022; Bhattarai *et al*., 2009; Uprety *et al*., 2016). Leaves are commonly used because they may be more readily available and easier to collect, store, and transport than other plant parts. The leaf is responsible for nutrition generation and storage, which may enhance its frequency of use (Magar *et al*., 2022). The present result in the study also relates to the studies of Mallik *et al.* (2020) and Chaudhary *et al.* (2020).

5.3 Use categories Form of medication and route of Administration

Most of the plants having double and multiple uses illustrate that the respondents in the study area are more curious about medicinal plants and their uses. Paste of medicinal plants is easy to prepare and serves external and internal use, followed by raw eating for most of the MPs, and the information is transferred from generation to generation. Several MPs are taken in the form of fruit and salad, and many are taken in the form of vegetables, boiled, and roasted in the study area may be due to easy availability and easiness to prepare.

5.4 Use value and FI Value

The use value indicates the importance of particular MP species in disease curing for the respondent citing the MPs. In this study, *Osyris lanceolata* had the highest use value among 70 species with high antioxidant capacity. Various bioactive compounds and easy access may be responsible for curing multiple diseases, which is followed by *Justiacia Adhathoda* and *Nardostachys jatamansi*. This indicates this species were used for multiple ailments by the same respondents.

Jussticia adhatoda contains major group of compounds, such as alkaloids, polyphenolics, glycosides, and phyto-sterols. Leaves contain two major alkaloids, i.e., vasicinone and vasicine. These alkaloids exhibit anti-allergic activity (Sharma and Kumar 2016). The leaf juice is used to cure diarrhea, dysentery, asthma, skin diseases (Burlakoti and Kunwar 2008), fever, and other enteric bacteria (Rai, 2003) which is

also supported by the study of Yeboah, & Majinda, (2009), Kumar *et al*. (2014), Shrestha *et al.* (2014). *Nardostachys jatamansi* has been reported to have many therapeutic activities like antifungal, antimicrobial, antioxidant, hepatoprotective and cardio protective properties. It is used in the treatment of insomnia and CNS disorders. The vasodilator, bronchodilator, spasmolytic and platelet aggregation inhibition activities of the plant have also been reported. Jatamansone, nardostachone and actinidine are the major secondary metabolites present in the plant (Pandey *et al.* (2013).

The present study showed that most of the local people use *Ophiodhordyceps sinensis for* various medicinal purposes. The frequency index value is calculated at 33.63%. The Fi value simply gives the percentage of respondents who used the particular MPs in comparison to other MP species. The respondents who indicate the use of *Ophiocordyceps sinensis* in raw or powdered form with goat milk in the high pasture land nearby are collected from the study area, which gives them energy, strength, and immunity to walk to and stay at Pastureland (Kharkas) of high elevation. Almost all respondents have the Farm (Goth) in the 'Kharkas' and they stayed there for grazing of goats and cattle, and the season is the same as in the *Ophiocordyceps sinensis* collection. A similar type of result is found in the study of Devkota (2006) in Dolpa, Western Nepal.

5.5 Knowledge distribution and transfer among genders and age groups

Statistically, the age groups and quantities of plants described by them were unrelated. This means that people of all ages may have a better understanding of the medicinal plants used in a specific area. The younger generations were equally interested in the study and had a solid understanding of medicinal plants, demonstrating that knowledge was transferred from their surroundings and parents. However, it was totally in contrast with the studies of Mussarat *et al.* (2014) and Chaudhary *et al.* (2020). However, the trend of the transfer of use report of the MPs is less to the young age and slightly increasing with age in this study. This means younger people have slightly less knowledge about the preparation and use of the various categories of ailments. This may indicate that young people are still learning about its use, variety, and ailments. In the current study, fewer women than males were participated for interviews. This could be due to a lack of confidence in sharing their knowledge or a fear of approaching an

unfamiliar person (Umair *et al*., 2017). This may also be due to their hesitation to share their expertise with unknown people, strangers, and researchers, fearing that medicinal plants might be abused. Similar reluctance was seen in the studies of Rajbanshi and Thapa (2019) and Ojha Khatri *et al.* (2021). Unlike our study, both genders were comfortable sharing their expertise of traditional medicine in the study of Bhaila *et al.* (2022), which was conducted in Bhaktapur District, Nepal. Our research was carried out in a remote village where the inhabitants are not well educated and female conversation with unknown individuals or strangers is not accepted in society. However, Bhaktapur is a neighboring district of Kathmandu (Nepal's capital city), where modernization is accelerating and inhabitants are well-educated. This could explain why females were reluctant in our study but comfortable in Bhaila et al.'s (2022) investigation.

5.6 Collection Trade market value

In Nepal, between 50 and 100 percent of households in the middle mountain range engaged in the gathering and selling of medicinal plants, demonstrating the potential of MPs as a substantial source of monetary revenue for individuals (Olsen, 1997). In the present study, it was found that around 45% of the respondents or their families were involved in the collection and trade of the MPs. A similar study by Humagain and Shrestha (2009) in Chilime, Rasuwa supported the result. The survey found that among the 70 species recorded, they earn more money from *Delphinium denudatum*, *Paris polyphylla* on second, and *Rheum nobile* on third. According to the quantity of availability and harvesting per season, *Swertia chirayta* is at the top, followed by *Bergenia ciliata* and *Delphinium denudatum.* This indicates that *Swertia chirayta* and *Bergenia ciliata* were found abundantly in the study area. The high-value *Ophiocordyceps sinensis* is also found in the high elevation of the study area, along with *Morchella* sp. and *Paris polyphylla* (Humagain & Shrestha, 2009).

5.7 Threats and conservation activities

From the study area, most of the respondents believed that there is a threat to MPs in RVRM, and forest fires are the main cause. This statement may be supported by the annual forest fire in the forest and the pastureland for the grazing purposes of domestic animals and safety from tigers, bears, and other wild animals. There were no proper

training for harvesting the MPs at an accurate time and the methods; that's why unsustainable harvesting may the second reason for MPs threat. Illegal trade and harvesting are of least concern. The reasons for not mentioning them may be that they don't think illegal poaching is on a small scale or that there may be insecurity among the traders. But some of the respondents strongly believe that unsustainable harvesting and poaching are the main causes of MP depilation in the study area.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

RVRM, a stunning municipality in the Dhading district, possesses an incredible landscape and an abundance of ecological and cultural diversity. The current study focuses on ethnomedical plants and traditional knowledge, which still serve as the basis for primary care and health care for several prevalent illnesses. All life forms, including climbers, shrubs, trees, and herbs, contained useful species. Many plant species in the area have been known to treat a variety of diseases, including gastrointestinal disorders, cardiovascular disorders, fever and headaches, anti-cancer, antidote, anti-venom, dermatological disorders, gynecological disorders, oral and dental issues, respiratory issues, and skeletal muscle problems.

There are numerous high value MPs in the area, including *Ophiocordyceps sinensis, Taxus walliachiana, Delphinium denudatum, Paris polyphylla, Morchella* sp., *Aconitum heterophyllum, Allium carolinianum, and Berberis aristata*. Present study also concludes that there is a good trend of knowledge transfer to the new generation, but the threats to MPs are increasing. Even though the community is crucial to conservation, sustainable use was improperly carried out, and the government is completely ignorant of these resources. The region offers extremely important high-altitude medicinal plant life that has not yet been adequately managed or regulated for the benefit of the local people's economy; instead, it is used directly from the forest in a wild state. Thus, further research and study of plants are still needed in this study area.

6.2 Recommendations

Following an analysis of the MPs used by the local inhabitant's threat and conservation status in the RVRM, the following suggestions are made:

- It's critical to inform the community of the study area about the economic, aesthetic, and biological value of the MPs preservation of rare and endangered species.
- With regard to market demand, each MPs should be assessed individually for its significance to the local community and populace.

- By domesticating, developing, and cultivating MPs, the people should benefit more from their utilization, which lessens the strain on its forest resources.
- To ensure the systematic and lawful extraction, preparation, and trade of NTFPs, local legislation needs to be developed.

REFERENCES

Acharya, C. R., Thakar, H. N. & Vajpeyee, S. K. (1970). A study of oxidative stress in gentamicin induced nephrotoxicity and effect of antioxidant vitamin C in Wistar rats. *National Journal of Physiology, Pharmacy and Pharmacology*, *3*(1), 14-14.

Acharya, K. P. & Rokaya, M. B. (2005). Ethnobotanical survey of medicinal plants traded in the streets of Kathmandu valley. *Scientific World*, *3*(3), 44-48.

Acharya, K. P., Chaudhary, R. P. & Vetaas, O. R. (2009). Medicinal plants of Nepal: Distribution pattern along an elevational gradient and effectiveness of existing protected areas for their conservation. *Banko Janakari*, *19*(1), 16-22.

Acharya, R. & Acharya, K. P. (2009). Ethnobotanical study of medicinal plants used by Tharu community of Parroha VDC, Rupandehi district, Nepal. *Scientific world*, *7*(7), 80-84.

Acharya, R. (2012). Ethnobotanical study of medicinal plants of Resunga Hill used by Magar community of Badagaun VDC, Gulmi district, Nepal. *Scientific world*, *10*(10), 54-65.

Alexiades, M. N. (1996). Collecting ethnobotanical data: an introduction to basic concepts and techniques. *Advances in economic botany*, *10*, 53-94.

Ansari, A. A., Gill, S. S., Abbas, Z. K. & Naeem, M. (Eds.). (2016). *Plant biodiversity: monitoring, assessment and conservation*. CABI.

Bannerman, R., Burton, J. & Wen-Chieh, C. (1983). The role of traditional medicine in primary health care, in traditional medicine and health care coverage-A reader for health administrators and practitioners. *The WHO*.

Baral, S. R. & Kurmi, P. P. (2006). *Compendium of medicinal plants in Nepal*.

Bhaila, A., Shakya, S., Kunwar, B., Baral, B., Chaudhary, S. & Munankarmi, N. N. (2022). Ethnomedicinal exploration of plants utilized by the people of Suryabinayak Municipality in Bhaktapur District, Nepal. *Vegetos*, *35*(3), 763-774.

Bhatta, K. P. & Chaudhary, R. P. (2009). Species diversity and distribution pattern of grassland and cultivated land species in upper Manang, Nepal Trans-Himalayas. *Scientific World*, *7*(7), 76-79.

Bhattarai, K. R. & Ghimire, M. (2006). Commercially important medicinal and aromatic plants of Nepal and their distribution pattern and conservation measure along the elevation gradient of the Himalayas. *Banko Janakari*, *16*(1), 3-13.

Bhattarai, K. R. & Vetaas, O. R. (2006). Can Rapoport's rule explain tree species richness along the Himalayan elevation gradient, Nepal? *Diversity and distributions*, *12*(4), 373-378.

Bhattarai, K. R. (2005). Variation in species richness and spatial turnover among different vegetation types along an elevation gradient in east Nepal. *Banko Janakari*, *15*(1), 25-32.

Bhattarai, K. R., Shrestha, B. B & Lekhak, H. D. (2009). Non-timber Forest Products (NTFPs) in the Sagarmatha National Park, Nepal Himalaya. *Scientific World*, *7*(7), 85-91.

Bhattarai, N. K. (1997). Traditional herbal medicines used to treat wounds and injuries in Nepal. *Tropical Doctor*, *27*(1_suppl), 43-47.

Bhattarai, N., Tandon, V. & Ved, D. K. (2002). Highlights and outcomes of the conservation assessment and management planning (CAMP) workshop, Pokhara, Nepal. *Sharing local and national experience in conservation of medicinal and aromatic plants in South Asia*, 46-53.

Burlakoti, C. & Kunwar, R. M. (2008). *Folk herbal medicines of Mahakali Watershed Area, Farwest Nepal.* In Medicinal Plants in Nepal: an anthology of contemporary research Edited by: Jha PK, Karmacharya SB, Chettri MK, Thapa CB, Shrestha BB. Ecological Society, Kathmandu, Nepal;187-193

Chaudhary, R. P. (1998). *Biodiversity in Nepal: Status and Conservation*. Tec Press Books, Bangkok, Thailand.

Chaudhary, S., Magar, G. T., Sah, S. N., & Parajuli, S. (2020). Ethnic plants of Tharu community of Eastern Nepal. *International Journal of Applied Sciences and Biotechnology, 8*(2), 223-230.

Chhetri, H. B. & Gupta, V. N. P. (2007). A Survey of Non-Timber Forest Products (NTFPS) in Upper Mustang. *Scientific World*, 5(5), 89-94.

Coley, P. D., Heller, M. V., Aizprua, R., Araúz, B., Flores, N., Correa, M. ... & Kursar, T. A. (2003). Using ecological criteria to design plant collection strategies for drug discovery. *Frontiers in Ecology and the Environment, 1*(8), 421-428.

Cotton, C. M. (1996). *Ethnobotany: principles and applications*. John Wiley & Sons.

Devkota, S. (2006). Yarsagumba [*Cordyceps sinensis* (Berk.) Sacc.]; traditional utilization in Dolpa district, western Nepal. *Our Nature, 4*(1), 48-52.

Dulal, K., Chaudhary, S., Uprety, Y., Shrestha, N., Shakya, S., & Munankarmi, N. (2022). Ethnomedicinal plants used by the local people of Changunarayan Municipality, Bhaktapur, Nepal. *Ethnobotany Research and Applications, 23*, 1-27.

Forman, L. & Bridson, D. (1989). The Herbarium Handbook. Royal Botanic Gardens, Kew

Gewali, M. B. & Awale, S. (2008). *Aspects of traditional medicine in Nepal*. Institute of Natural Medicine University of Toyama, Japan. pp. 140-142.

Ghimire, S. K. (2008). Sustainable harvesting and management of medicinal plants in the Nepal Himalaya: current issues, knowledge gaps and research priorities. *Medicinal Plants in Nepal: an Anthology of Contemporary Research*, 25-44.

Ghimire, S. K. (2010). Sustainable harvesting and Management of Medicinal Plants in the Nepal Himalaya: current issues, Knowledge Gaps and Research Priorities. Central department of botany, Tribhuvan University Kirtipur, (p. 14).

Ghimire, S. K., Maskey, D. & Yildiz, A. T. (2005). Conservation of Himalayan medicinal plants: Harvesting patterns and ecology of two threatened species, *Nardostachys grandiflora* DC. and *Neopicrorhiza scrophulariiflora* (Pennell) Hong. *Biological Conservation, 124*, 463-475.

Gurung, S. & Subedi, S. (2021). Ethnobotanical application of medicinal plants by the Gurung community of Siddhalek rural municipality, Dhading, Nepal. *Asian Journal of Pharmacognosy, 4*(3), 13-21.

Hall, P. & Bawa, K. S. (1993). Methods to assess the impact of extraction on non-timber tropical forest products on plant populations. *Economic Botany*, *47*: 234-247.

Hamilton, A. C. (2004). Medicinal plants, conservation and livelihoods. *Biodiversity & Conservation, 13*(8), 1477-1517.

Hara, H. & Williams, L. H. J. (1979). *An Enumeration of the Flowering Plants of Nepal.* (Vol. 2). British Museum (Natural History), London.

Hara, H., Chater, A.O. & Williams, L.H.J. (1982). An enumeration of the flowering plants of Nepal, Vol. 3. British Museum (Natural History), London.

Hara, H., Stearn, W. T., & Williams, L. H. J., (1978). *An Enumeration of the Flowering Plants of Nepal.* (Vol. 1). British Museum (Natural History), London.

Hooker, J.D. (1872-1887). *Flora of British India*. Vol. I-VII. Reev and Company, London.

Humagain, K., & Shrestha, K. K. (2009). Medicinal plants in Rasuwa district, central Nepal: trade and livelihood. *Botanica Orientalis: Journal of Plant Science*, *6*, 39-46.

Hunter, M. L., & Yonzon, P. (1993). Altitudinal Distributions of Birds, Mammals, People, Forests and parks in Nepal. *Conservation Biology*, *7*(2), 420-423.

IUCN. (2004). IUCN Red List of Threatened Species. Retrieved from: https://www.iucnredlist.org

Karki, M. B., Williams, J. T. & Tewari, D. N. (1999). Priority species of medicinal plants in South Asia. In *Expert Consultation on Medicinal Plants Species Prioritization for South Asia (1997: New Delhi, India)*. Medicinal and Aromatic Plants Program in Asia, International Development Research Centre.

Kelbessa, E., Demissew, S., & Woldu, Z. (1992). An ethnobotanical study of medicinal plants in Wayu Tuka district, East Welega province, West Ethiopia. *Journal of Ethnopharmacology, 37(2),* 85-95.

Khakurel, D., Uprety, Y., Ahn, G., Cha, J. Y., Kim, W. Y., Lee, S. H. & Rajbhandary, S. (2022). Diversity, distribution, and sustainability of traditional medicinal plants in Kaski district, western Nepal. *Frontiers in Pharmacology*, *13*, 1076351.

Kumar, A., Mishra, P., Singh, S. C. & Sundaresan, V. (2014). Efficiency of ISSR and RAPD markers in genetic divergence analysis and conservation management of *Justicia adhatoda* L., a medicinal plant. *Plant systematics and evolution*, *300*, 1409-1420.

Kunwar, R. M., & Bussmann, R. W. (2008). Ethnobotany in the Nepal Himalaya. *Journal of Ethnobiology & Ethnomedicine*, *4*, 24. https://doi.org/10.1186/1746-4269-4-24.

Kunwar, R. M., Nepal, B. K., Sigdel, K. P., & Balami, N. (2006). Contribution to the Ethnobotany of Dhading District, Central Nepal. *Nepal Journal of Science and Technology*, *7*, 65-69.

Kunwar, R. M., Shrestha, K. P. & Bussmann, R. W. (2010). Traditional herbal medicine in Far-west Nepal: a pharmacological appraisal. *Journal of ethnobiology and ethnomedicine*, *6*, 1-18.

Luitel, D. R., Rokaya, M. B., Timsina, B. (2014). Medicinal Plants Used by the Tamang Community in the Makawanpur District of Central Nepal. *Journal of Ethnobiology and Ethnomedicine*, *10*, 5. https://doi.org/10.1186/1746-4269-10-5.

Luitel, D., & Pathak, M. (2019). Documentation of Medicinal and Aromatic Plants of Dhorpatan Hunting Reserve, Western Nepal. *Journal of Department of Plant Resources*, *35*, 36-43.

Madikizela, B., Ndhlala, A. R., Finnie, J. F. & Van Staden, J. (2012). Ethnopharmacological study of plants from Pondoland used against diarrhoea. *Journal of Ethnopharmacology*, *141*(1), 61-71.

Magar, R. A., Mallik, A. R., Chaudhary, S. & Parajuli, S. (2022). Ethno-medicinal plants used by the people of Dharan, Eastern Nepal. *Indian Journal of Traditional Knowledge*, 21(1): 72-80

Mahwasane, S. T., Middleton, L., & Boaduo, N. (2013). An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo area, Limpopo province, South Africa. *South African Journal of Botany*, *88*, 69-75.

Malla, B., Gauchan, D. P. & Chhetri, R. B. (2015). An ethnobotanical study of medicinal plants used by ethnic people in Parbat district of western Nepal. *Journal of ethnopharmacology*, *165*, 103-117.

Malla, S. B., & Shakya, P. R. (1984). Medicinal Plants. In: Majpuria TC (eds.) Nepal Nature Paradise. White Lotus Co. Ltd., Bangkok, Thailand, 261-297.

Malla, S. B., Shakya, P. R., Rajbhandari, K. R., Bhattarai, N. K. & Subedi, M. N. (1995). Minor Forest Products of Nepal: General Status and Trade. Forest Resource Information system Project, HMG/FINNIDA, Kathmandu, Nepal.

Mallik, A., Das, N., Mukherjee, S., & Datta, S. (2020). A systematic review and meta-analysis of different diagnostic procedures to detect gonococcus infection in resource-limited scenario. *Indian journal of medical microbiology*, *38*(3-4), 299-306.

Manandhar, N. P. (1994). An ethnobotanical survey of herbal drugs of Kaski district, Nepal.

Manandhar, N. P. (2002). *Plants and people of Nepal*. Timber press.

Marpa, S., Samant, S. S., Paul, S., & Tewari, A. (2021). Diversity, distribution, indigenous uses and conservation of medicinal plants in Naina Devi Sacred Shrine and surroundings, Bilaspur, Himachal Pradesh, north Western Himalaya. *Journal of non-timber forest products*, *27*(3): 125-138.

Martin, G. J. (1995). Ethnobotany: a methods manual, Chapman Hall. London.

Mesfin, F., Demissew, S., & Teklehaymanot, T. (2009). An ethnobotanical study of medicinal plants in Wonago Woreda, SNNPR, Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, *5*, 1-18.

Mussarat, S., AbdEl-Salam, N. M., Tariq, A., Wazir, S. M., Ullah, R., & Adnan, M. (2014). Use of ethnomedicinal plants by the people living around Indus River. *Evidence-Based Complementary and Alternative Medicine*, *2014*.

Nagpal, A., & Karki, M., (2004). A study on marketing opportunities for medicinal, aromatic, and dye plants in south Asia. Medicinal and Aromatic Plants Program in Asia (MAAPA), International Development Research Centre (IDRC), New Delhi, India.

Nepal, I. U. C. N. (2004). National Register of Medicinal and Aromatic Plants (revised and updated). *IUCN Nepal*.

Ojha Khatri, S., Chaudhary, S., Shrestha, N., & Munankarmi, N. N. (2021). Ethnomedicinal study and phytochemical screening of selected plants in Jhule, Dolakha District, Nepal. *Vegetos*, *34*(4), 834-846.

Oladeji, O. (2016)**.** The Characteristics and Roles of Medicinal Plants: Some Important Medicinal Plants in Nigeria. *Natural Products Indian Journal, 12* (3); 102.

Olsen, C.S. (1997). Commercial non-timber forestry in central Nepal: emerging themes and priorities. Royal Veterinary and Agricultural University.

Pan, S. Y., Zhou, S. F., Gao, S. H., Yu, Z. L., Zhang, S. F., Tang, M. K., ... & Ko, K. M. (2013). New perspectives on how to discover drugs from herbal medicines: CAM's outstanding contribution to modern therapeutics. *Evidence-based complementary and alternative medicine*, *2013*.

Pandey, M. M., Katara, A., Pandey, G., Rastogi, S., & Rawat, A. K. S. (2013). An important Indian traditional drug of ayurveda jatamansi and its substitute bhootkeshi: chemical profiling and antioxidant activity. *Evidence-Based Complementary and Alternative Medicine*, *2013*.

Pandey, P. R. (1961). Distribution of medicinal plants of Nepal. Symposium on Medicinal Plants (Ceylon).

Philips, O., & Gentry, A.H. (1994). The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic Botany, 47, 15-32.

Rai, M. B. (2003). Medicinal plants of Tehrathum district, eastern Nepal. *Our Nature*, *1*(1), 42-48.

Rai, S. K. (2004). Medicinal plants used by Meche people of Jhapa district, eastern Nepal. *Our nature*, *2*(1): 27-32.

Rajbanshi, N., & Thapa, L. B. (2019). Traditional knowledge and practices on utilizing medicinal plants by endangered Kisan ethnic group of eastern Nepal. *Ethnobotany Research and Applications, 18,* 1-9.

Rokaya, M. B., Munzbergova, Z., Shrestha, M. R., & Timsina, B. (2012). Distribution pattern of medicinal plants along an elevation gradient. *Mt. Sci*, *9*, 201-213.

Shah, S., Lamichhane, D., Panthi, R., & Nepali, K. B. (2018). Traditional knowledge of Tamang community on utilization of plant resources in Dhading District, Central Nepal. *J Plant Res*, *16*, 134-40.

Shakya, P. R., Shrestha, I., Paudyal, S., & Shakya, S. (2002). Study on non-timber forest product in Annapurna Conservation Area (ACA), Nepal. Annual report, Pro Natura foundation.

Sharma, A., & Kumar, A. (2016). Pharmacognostic studies on medicinal plants: Justicia adhatoda. *World Journal of Pharmaceutical Research*, *5*(7), 1674-1704.

Sharma, U. R., Malla, K. J., & Uprety, R. K. (2004). Conservation and management efforts of medicinal and aromatic plants in Nepal. *Banko Janakari*, *14*(2), 3-11.

Shrestha, K. K., Sah, J.P., & Ghimire S. K. (1995). Diversity and conservation strategy of some potential medicinal plants of Gyasumdo Valley, Manang. Report submitted to Annapurna Conservation Area Project (ACAP), KMTNC, Kathmandu, Nepal.

Shrestha, N. & Shrestha, K. K. (2012). Vulnerability assessment of high-valued medicinal plants in Langtang National Park, Central Nepal. *Biodiversity*, *13*(1), 24-36.

Shrestha, N., Prasai, D., Shrestha, K.K., Shrestha, S., Zhang, X.C., (2014). Ethnomedicinal practices in the highlands of central Nepal: a case study of

Syaphru and Langtang village in Rasuwa district. *J. Ethnopharmacol*. 155, 1204-1213

Shrestha, N., Shrestha, S., Koju, L., Shrestha, K. K., & Wang, Z. (2016). Medicinal plant diversity and traditional healing practices in eastern Nepal. *Journal of Ethnopharmacology*, *192*, 292-301.

Shrestha, P. M., & Dhillion, S. S. (2003). Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. *Journal of Ethnopharmacology*, *86*, 81-96.

Shrestha, T. B. & Joshi, R. M. (1996). Rare, Endemic and Endangered Plants of Nepal. WWF Nepal Program, Kathmandu, Nepal.

Singh, J. S., Lauenroth, W. K., Heitschmidt, R. K., & Dodd, J. L. (1983). Structural and functional attributes of the vegetation of northern mixed prairie of North America. *The Botanical Review*, *49*(1), 117-149.

Singh, M. P., Malla, S. B., Rajbhandari, S. B., & Manandhar, A. (1979). Medicinal plants of Nepal: retrospect and prospects. *Economic Botany*, *33*, 185-193.

Siwakoti, M., & Jha, S. N. (1987). Angiospermic flora of Biratnagar. *J. Nat. Hist. Mus. Nepal. 11 (1-4)*, 99-118.

Siwakoti, M., & Varma, S. K. (1996). Medicinal plants of the Terai of eastern Nepal. *J. Econ. Taxon. Bot. Additional Series*, *12*, 423-438.

Sofowora, A. J. N. Y. (1982). *Medicinal Plants and Traditional Medicine in West Arica*, John Wily and Sons. New York, *256*.

Stepp, J. R., & Moerman, D. E. (2001). The importance of weeds in ethnopharmacology. *Journal of ethnopharmacology*, *75*(1), 19-23.

Subedi, B. P. (1997). Utilization of Non-Timber Forest Products: Issues and Strategies for Environmental Conservation and Economic Development. Theme paper presented at the workshop on "The Utilization of NTFPs for Environmental Conservation and Economic Development in Nepal", organized by Asia Network for Small Scale Bioresources (ANSAB), 29 March 1997, Kathmandu, Nepal, (p. 11).

Subedi, B. P. (2006). Linking Plant-Based Enterprises and Local Communities to Biodiversity Conservation in Nepal Himalaya. Adroit Publishers, New Delhi, India.

Subedi, K. R., & Tiwari, N. N. (2000). Shausruta Nighantu. *Mahendra Sanskrit University, Beljhundi, Dang, Nepal*.

Svarstad, H., & Dhillion. S. S. (2000). Responding to Bio-prospecting: From Biodiversity in the South to Medicines in the North. Oslo.

Tamang, P., & Singh, N. B. (2014). Medical Ethnobiology and Indigenous Knowledge System of the Lapcha of Fikkal VDC of Ilam, Nepal. *Journal of Institute of Science and Technology*, *19*(2), 45-52.

Tamang, R., Thakur, C., Koirala, D. R., & Chapagain, N. (2018). Ethno-medicinal Plants Used by Chepang Community in Nepal. *Journal of Plant Resources, 15*(1), 21-30.

Tandon, V., Bhattarai, N. K., & Karki, M. (2001). Conservation Assessment and Management Prioritization Report. IDRC Canada/HMG Ministry of Forest and Soil Conservation, Kathmandu, Nepal.

Thapa, S., Rawal, S., Prasai, A., Adhikari, J., Bist, S., & Ghimire, A. (2020). A case study of medicinal plants and their usage by the local community of Dilasaini Gaunpalika, Baitadi district, Nepal. *Archives of Agriculture and Environmental Science*, *5*(1): 50-54. https://dx.doi.org/10.26832/24566632.2020.050107

Trotter, R. T., Logan, M. H., & Etkin, N. L. (1986). Plants in indigenous medicine and diet. *Behavioural approaches*, *91*, 112.

Umair, M., Altaf, M., & Abbasi, A. M. (2017). An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. *PloS one, 12*(6), e0177912.

Uprety, Y., Asselin, H., Boon, E. K., Yadav, S., & Shrestha, K. K. (2010). Indigenous use and bio-efficacy of medicinal plants in the Rasuwa District, Central Nepal. *Journal of ethnobiology and ethnomedicine, 6*(1), 1-10.

Uprety, Y., Poudel, R.C., Gurung, J., Chettri, N., & Chaudary, R.P. (2016). Traditional Use and Management of NTFPs in Kangchenjunga Landscape: Implications for Conservation and Livelihoods. *Journal of Ethnobiology and Ethnomedicine*, 12, 19.

Wang, M. Y., Peng, L., Jensen, C. J., Deng, S., & West, B. J. (2013). Noni juice reduces lipid peroxidation–derived DNA adducts in heavy smokers. *Food science & nutrition*, *1*(2), 141-149.

Wang, M. Y., West, B. J., Jensen, C. J., Nowicki, D., Su, C., Palu, A. K., & Anderson, G. (2002). Morinda citrifolia (Noni): a literature review and recent advances in Noni research. *Acta Pharmacologica Sinica*, *23*(12), 1127-1141.

World Health Organization. (2002). *The world health report 2002: reducing risks, promoting healthy life*. World Health Organization.

Yeboah, E. M., & Majinda, R. R. (2009). Radical scavenging activity and total phenolic content of extracts of the root bark of *Osyris lanceolata*. *Natural product communications*, *4*(1), 1934578X0900400120.

Yusri, M. (2020). Analysis concept and indicator proverty in Medan City. *Indonesian Journal of Education, Social Sciences and Research (IJESSR)*, *1*(1), 51-58.

APPENDIX

Appendix Table 1: Enumeration list of MPs species

S. N	Scientific Name	Family	Local Name	Nepali name	Habit
1	*Achyranthes bidentata* Blume	Amaranthaceae	Pherke	Datiwan	herb
2	*Aconitum heterophyllum* wall	Ranunculaceae	Bhikhama	Atis	herb
3	*Acorus calamus* L.	Acoraceae	Seta	Bojo	herb
4	*Ageratina adenophora* (Spreng) R.M. King and H. Rob	Asteraceae	Thanganawa	Banmara	herb
5	*Ageratum conyzoides* L.	Asteraceae	Gyagarmra	Gandhe	herb
6	*Hemionitis anceps* (Blanf.) Panigrahi	Petridaceae	Ranisinka	Ranisinka	fern
7	*Allium carolinianum* Redute	Amaryllidaceae	Ban no	Ban lasun	herb
8	*Allium sativum* L.	Amaryllidaceae	No	Lasun	herb
9	*Anaphalis busua* (Buch,-Ham.) Hand,-Mazz.	Asteraceae	Taptap	Bokeful	herb
10	*Artemisia vulgaris* L.	Asteraceae	Chenterenowa	Titepati	herb
11	*Asparagus racemosus* Willd	Asparagaceae	Kurilo	Kurilo	herb
12	*Berberis aristata* DC.	Breberidaceae	Chulungse	Chutro	shrub
13	*Bergenia ciliata* (Haw.) Sternb	Saxifragaceae	Danmyagun	Pakhenbhed	herb
14	*Boehmeria nivea* (L.) Gaudich.	Urticaceae	Butijhar	Kamlo	herb
15	*Buddleja asiatica* Lour.	scrophulariaceae	Phyabrosing	Bhimsenpati	tree
16	*Canabis sativa* L.	Cannabaceae	Simo	Gaja	herb
17	*Centella asiatica* (L.) Urb.	Apiaceae	Tilikosyo	Ghodtapre	runner
18	*Cinnamomum tamala* (Buch.-Ham.) T. Nees and Eberm.	Lauraceae	Lephra	Tejpatta	tree

19	*Cirsium sponosissimum* (L.) Scop.	Asteraceae	Pangpop	Kadejhar	herb
20	*Crepis bursifolia* L.	Asteraceae	Karna ful	Gham Ful	herb
21	*Cupressus sempevirens* L.	Cupressaceae	Sukpa	Dhupi	tree
22	*Curcuma longa* L.	Zingiberaceae	Dongboo	Besar	herb
23	*Cuscuta reflexa* Roxb.	Convolvulaceae	Marlangru	Akasebeli	runner
24	*Cynodon dactylon* (L.) Pers.	Poaceae	Narkbyang	Dubo	runner
25	*Cynoglossum zeylanicum* (Vahl ex Hornem.) Thunb. Ex Lehm.	Borangnaceae	Jape	Kanike Kuro	herb
26	*Dactylorhiza hatagirea* (D. Don) Soo	Orchidaceae	Wangloku	Panchaule	herb
27	*Delphinium denudatum* wall.	Ranunculaceae	Myaamen	Niramasi	herb
28	*Dioscorea deltoidea* Wall. Ex Griseb	Dioscoreaceae	Tagi	Bhyakur	climber
29	*Drymaria cordata* (L.) Wild. Ex Schult.	Caryophyllaceae	Naulejhar	Abijalo	herb
30	*Euphorbia hirta* L.	Euphorblaceae	Nigma	Dhudhe jhar	herb
31	*Ganoderma* sp.	Polyporaceae	Michiling	Raato chyaau	fungi
32	*Gaultheria fragrantissima* Wall.	Ericaceae	Chaiso	Dhasingre	shrub
33	*Geranium molle* L.	Geraniaceae	Olamen	Rato jhar	runner
34	*Iris domescita* (L.) Goldblatt and Mnbb.	Iridaceae	Ful	Taraware ful	herb
35	*Juglans regia* L.	Juglangaceae	Kado	Okhar	tree
36	*Justicia adhatoda* L.	Acanthaceae	Auro	Asuro	shrub
37	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	Ajambari	Paththerchatta	herb
38	Lichen	lichen	Pleng men	Jhyau	lichen
39	*Lindenbergia indica* (L.) Bhatke.	Orobanchaceae	Sano jhar	Jhar	herb

40	*Lindera neesiana* (Wall. Ex Nees)	Lauraceae	Kuram	Siltimur	tree
41	*Lyonia ovalifolia* (Wall.) Drude	Ericaceae	Chyndia	Angeri	tree
42	*Malvaviscus arboreus* Cav.	Malvaceae	Khursyan ful	Khursani ful	shrub
43	*Mentha arvensis* L.	Lamiaceae	Patina	Pudina	herb
44	*Morchella* sp.	Morchellaceae	Farsyamu	Guchi chyau	fungi
45	*Myrica esculenta* Buch.-Ham. Ex D.Don	Myriacaceae	Namun	Kafal	tree
46	*Nardostachys jatamansi* (D.Don) DC.	Carpifoliaceae	Pey	Jatamasi	herb
47	*Nephrolepis cordifolia* (L.) C. Persi	Nephrolepidaceae	begangra	Pani amala	fern
48	*Ophiocordyceps sinensis* (Berk.) G.H.Sung, J.M.Sung,Hywel-Jones and Spatafora	Ophiocordycipitaceae	Yarchagumba	Yarchagumba	fungi
49	*Osyris lanceolata* Steud. and Hochest. ex A.DC.	Santalaceae	Nundhiki	Nundhiki	shrub
50	*Oxalis corniculata* L.	Oxalidaceae	Amile jhar	Chari amilo	runner
51	*Paris polyphylla* Sm.	Melanthiaceae	Somba gyal	Satuwa	herb
52	*Phyllanthus parviflorus* Buch.-Ham Ex D.Don	Phyllanthaceae	Yameng sara	Khareto	shrub
53	*Picrorhiza kurroa* Royel ex Benth.	Plantaginaceae	Wan	Kutki	herb
54	*Psidium guajava* L.	Myrtaceae	Ambaru	Amba	tree
55	*Rheum nobile* Hook.fil. and Thomson	Polygonaceae	Churcha	Padamchal	herb
56	*Rhododendron arboreum* Sm.	Ericaceae	Bra mendo	Laliguras	tree
57	*Rubia manjith* Roxb.	Rubiaceae	Tiru	Tiru	climber
58	*Rubus ellipticus* Sm.	Rosaceae	Palang	Aiselu	shrub
59	*Rubus nepalensis* (Hook.fil.) Kuntze	Rosaceae	Saa palang	bhui kafal	herb

60	*Rubus rugosus* Sm.	Rosaceae	Kalo palang	Kaalo Aiselu	shrub
61	*Rumex nepalensis* Spreng.	Polygonaceae	Alpidi	Halhale	herb
62	*Rhus chinensis* Mill.	Anacardiaceae	Ghrusing	Bhakimlo	shrub
63	*Solidago gigantea* Aiton	Asteraceae	Jhamchya	Jyamchta	herb
64	*Solanum violaceum* Ortega	Solanaceae	Ni bhenta	kalo bihi	herb
65	*Swertia chirayta* C.B. Clarke	Gentianaceae	Timta	Chiraito	herb
66	*Taxus wallichiana* Zucc.	Taxaceae	Silincha	Lauth salla	tree
67	*Tinospora sinensis* (Lour.) Merr.	Menispermaceae	Gurjo	Gurjo	climber
68	*Urtica diocia* L.	Urticaceae	Polo	Sisnu	herb
69	*Zanthoxylum armatum* DC.	Rutaceae	Pruma	Timur	shrub
70	*Zingiber officinale* Roscoe	Zingiberaceae	Tungra	Aduwa	herb

APPENDIX Table 2: Plants with ethnomedicinal information

S. N	Scientific Name	Parts used	Mode of use	Ailment's
1	*Achyranthes bidentata*	Stem	As brush	Teeth and gums problem
2	*Aconitum heterophyllum*	Stem, root	Extract inhale, chewing	Sensation of heat, dysentery, fever, throat infection, gastritis
3	*Acorus calamus*	Rhizome, leaf	Roasted, extraction or powder inhale	Cough, fever, throat pain
4	*Ageratina adenophora*	Shoot, leaf	Juice on cute, extract inhale	Cut, delivery pain
5	*Ageratum conyzoides*	Shoot leaf	Paste	Cut, wounds
6	*Hemionitis anceps*	Leaf	Raw eaten	Gastritis, dysentery
7	*Allium carolinianum*	Bulb	Bulb eat, boiled or in vegetable	Gastritis, food poisoning, tonic
8	*Allium sativum*	Bulb	Paste eaten with chilli and salt	Altitude sickness
9	*Anaphalis busua*	Flower, shoot	Paste, extract	Cut, wounds
10	*Artemisia vulgaris*	Leaf, shoot	Paste on forehead extract, incense	Fever, menstrual pain, skin disease
11	*Asparagus racemosus*	Root tuber, shoot	Eaten roasted and as vegetables	Diarrhoea, tonic
12	*Berberis aristata*	Fruit, root, bark	Juice eaten	Epilepsy, Body pain
13	*Bergenia ciliata*	Rhizome	Raw eaten	Fever, kidney stone
14	*Boehmeria nivea*	Leaf	Paste toping or robing	Swelling
15	*Buddleja asiatica*	Leaf	Paste toping	Cut, wounds
16	*Canabis sativa*	Leaf, inflorescence	Smoke	Dyspepsia, stomachache, diarrhoea
17	*Centella asiatica*	Whole	Paste, extract eaten	Fever, headache
18	*Cinnamomum tamala*	Leaf, bark	In tea, as spices	Fever, headache, stomachache, gastritis, diarrhoea
19	*Cirsium sponosissimum*	Leaf, root	Paste on forehead Extract eaten	Headache, indigestion
20	*Crepis bursifolia*	Root	Chewing	Throat pain, infection etc.

21	*Cupressus sempevirens*	Leaf, bark, stem	Make incense	Refreshing, headache, mental health
22	*Curcuma longa*	Rhizome	Powder with water, extract	Diarrhoea, stomachache, gastritis, cold, fever
23	*Cuscuta reflexa*	Whole	Juice eaten	Jaundice
24	*Cynodon dactylon*	Shoot	Paste on forehead, extract eaten	Fever, sensation of heat
25	*Cynoglossum zeylanicum*	Leaf	Extract eaten	Urinary problem
26	*Dactylorhiza hatagirea*	Rhizome, seed	Powder or roasted eaten, robbing on cut	Tonic, body pain, rabies, cut, burn, wound
27	*Delphinium denudatum*	Rhizome	Roasted, extraction or powder inhale, paste	Fever, constipation, gastritis, stomach worms, paste toping on snake bite
28	*Dioscorea deltoidea*	Root tuber	Boiled eaten	Tonic, diarrhea
29	*Drymaria cordata*	Shoot, leaf	Extract eating, paste on forehead	Vomiting, fever,
30	*Euphorbia hirta*	Shoot	Latex, paste	Flooding or topping on cut, wounds
31	*Ganoderma* sp.	Whole	Eaten as vegetable	Tonic, weakness
32	*Gaultheria fragrantissima*	Leaf, fruit, oil, extract	Extract eaten, massage	Joint pain, fracture
33	*Geranium molle*	Leaf	Extraction eat, paste topping	Body pain, cut, wounds
34	*Iris domestica*	Rhizome	Extract eaten	Gastritis, fever
35	*Juglans regia*	Fruit, leaf petiole	Fruit eaten, oil massage, use as brush	Tooth and gum problem, heart disease, mental problem
36	*Justicia adhatoda*	Leaf, inflorescence	Paste, extract eaten	Fungal infection on skin, fever
37	*Kalanchoe pinnata*	Leaf	Raw eaten	Kidney stone
38	Lichen	Whole	Paste powder topping	Cut, wounds
39	*Lindenbergia indica*	Whole	Paste topping, juice flooding	Wounds, cut
40	*Lindera neesiana*	Fruit	Eaten as Pickle, spices in vegetable	Diarrhea, stomachache, gastritis, dysentery

41	*Lyonia ovalifolia*	Leaf	Paste topping	Bone fracture
42	*Malvaviscus arboreus*	Leaf	Drink extract	Fever
43	*Mentha arvensis*	Shoot, leaf	Pickle, extract, eaten	Gastritis, sensation of heat, Anorexia
44	*Morchella* sp.	Whole	Eaten Roasted, as vegetables	Immunity boosting
45	*Myrica esculenta*	Fruit, bark, leaf	Direct eaten, extract inhale	Gastritis, fever, asthma
46	*Nardostachys jatamansi*	Root	Extract eaten placing raw or powder	Urinary problem, menstrual pain, epilepsy skin infection, wounds.
47	*Nephrolepis cordifolia*	Leaf, tuber	Raw eaten, paste topping	Fever, bone fracture
48	*Ophiocordyceps sinensis*	Whole	Direct inhale and powder mix with milk	Tonic, immunity boosting
49	*Osyris lanceolata*	Leaf	Powder, paste topping, as tea	Bone fracture, fever, body pain
50	*Oxalis corniculata*	Leaf	Paste topping, extract eaten	Boils skin, diarrhoea
51	*Paris polyphylla*	Rhizome, twig	Paste topping, extract eaten	Fever, wound, cuts ,piles, fistula, gastritis
52	*Phyllanthus parviflorus*	Leaf	Paste	Bone fracture
53	*Picrorhiza kurroa*	Stem, root	Drink extraction	Fever, cough, joint problem
54	*Psidium guajava*	Fruit, shoot, bark	Raw, extract, paste eaten	Fever, gastritis
55	*Rheum nobile*	Root	Drink as tea	Vomiting, food poisoning, diarrhoea
56	*Rhododendron arboreum*	Flower	Direct inhale	Fish bone stuck in throat
57	*Rubia manjith*	Root, vine	Paste	Skin disease
58	*Rubus ellipticus*	Fruit young shoot	Eaten, paste topping	Tonic, wounds, skin infection
59	*Rubus nepalensis*	Fruit, leaf	Eaten, paste on forehead	Tonic, headache
60	*Rubus rugosus*	Fruit, leaf	Eaten, paste topping	Tonic, skin infection

61	*Rumex nepalensis*	Whole	Boiled, juice eaten, paste topping	Diarrhea, bone fracture, constipation, cut wound
62	*Rhus chinensis*	Fruit, root	Eaten, paste topping on forehead	Constipation, fever, anorexia
63	*Solidago gigantea*	Whole plant	Extract eaten	Urinary problem
64	*Solanum violaceum*	Fruit, bark	Powder, paste place on teeth	Tooth decaying
65	*Swertia chirayta*	Whole plant	Drink extraction or chewing	Fever, stomachache, gastritis, indigestion, stomach worm, diarrhea, anorexia
66	*Taxus wallichiana*	Leaf	Leaf ,bark, wood extract eaten	Stomach cancer
67	*Tinospora sinensis*	Stem	Extract eaten	Fever, common cold, hypertension
68	*Urtica diocia*	Shoot, root	Paste topping, eaten, powder	Fracture, tonic, back pain, diarrhea, constipation, anorexia
69	*Zanthoxylum armatum*	Fruit	Eaten as pickle, in vegetables	Indigestion, ulcer, Gastritis, dysentery, anorexia
70	*Zingiber officinale*	Rhizome	Eaten roasted chewing, in vegetable	Cough, fever, throat infection

Appendix Table 3: Use value and FI of MPs species

S. N.	Name of the species	No. of informants cited this plant (Ni)	No. of citation by informants (Uni)	UV	FI
1	*Achyranthes bidentata*	2	2	1	1.82
2	*Aconitum heterophyllum*	11	18	1.636	10
3	*Acorus calamus*	9	13	1.444	8.18
4	*Ageratina adenophora*	35	38	1.085	31.81
5	*Ageratum conyzoides*	5	7	1.4	4.54
6	*Hemionitis anceps*	3	5	1.666	2.72
7	*Allium carolinianum*	11	14	1.272	10
8	*Allium sativum*	8	8	1	7.27
9	*Anaphalis busua*	3	4	1.333	2.72
10	*Artemisia vulgaris*	17	24	1.411	15.54
11	*Asparagus racemosus*	7	10	1.428	6.36
12	*Berberis aristata*	15	17	1.133	13.63
13	*Bergenia ciliata*	11	16	1.454	10
14	*Boehmeria nivea*	2	2	1	1.82
15	*Buddleja asiatica*	1	2	2.	0.9
16	*Canabis sativa*	12	17	1.416	10.9
17	*Centella asiatica*	19	22	1.157	17.27
18	*Cinnamomum tamala.*	22	31	1.409	20
19	*Cirsium sponosissimum*	4	6	1.5	3.63
20	*Crepis bursifolia*	3	3	1	2.72
21	*Cupressus sempevirens*	5	7	1.4	4.54
22	*Curcuma longa*	10	14	1.4	9.09
23	*Cuscuta reflexa*	6	6	1	5.45

24	*Cynodon dactylon*	3	5	1.666	2.72
25	*cynoglossum zeylanicum*	3	3	1	2.72
26	*Dactylorhiza hatagirea*	23	27	1.173	20.9
27	*Delphinium denudatum*	32	37	1.156	29.09
28	*Dioscorea deltoidea*	1	2	2	0.9
29	*Drymaria cordata*	8	13	1.625	7.27
30	*Euphorbia hirta*	1	2	2	0.9
31	*Ganoderma*	11	15	1.363	10
32	*Gaultheria fragrantissima*	7	11	1.571	6.36
33	*Geranium molle*	12	13	1.083	10.9
34	*Iris domestica*	1	2	2	0.9
35	*Juglans regia*	13	16	1.23	11.81
36	*Justicia adhatoda*	2	5	2.5	1.82
37	*Kalanchoe pinnata*	9	9	1	8.18
38	Lichen	5	7	1.4	4.54
39	*Lindenbergia indica*	1	2	2	0.9
40	*Lindera neesiana*	14	17	1.214	12.72
41	*Lyonia ovalifolia*	3	3	1	2.72
42	*Malvaviscus arboreus*	1	1	1	0.9
43	*Mentha arvensis*	26	30	1.153	23.63
44	*Morchella* sp.	6	6	1	5.45
45	*Myrica esculenta*	13	23	1.769	11.81
46	*Nardostachys jatamansi*	9	19	2.111	8.81
47	*Nephrolepis cordifolia*	2	4	2	1.82
48	*Ophiocordyceps sinensis*	37	57	1.540	33.63
49	*Osyris lanceolata*	1	3	3	0.9

50	*Oxalis corniculata*	7	10	1.428	6.36
51	*Paris polyphylla*	14	26	1.857	12.72
52	*Phyllanthus parvifolius*	2	2	1	1.82
53	*Picrorhiza kurroa*	18	21	1.166	16.36
54	*Psidium guajava*	4	6	1.5	3.63
55	*Rheum nobile*	15	21	1.4	13.63
56	*Rhododendron arboreum*	24	24	1	21.81
57	*Rubia manjith*	4	4	1	3.61
58	*Rubus ellipticus*	6	10	1.666	5.45
59	*Rubus nepalensis*	2	3	1.5	1.82
60	*Rubus rugosus*	1	2	2	0.9
61	*Rumex nepalensis*	29	32	1.103	26.36
62	*Rhus chinensis*	4	7	1.75	3.61
63	*Solidago gigantea*	1	1	1	0.9
64	*Solanum violaceum*	1	1	1	0.9
65	*Swertia chirayta*	28	35	1.25	25.45
66	*Taxus wallichiana*	2	2	1	1.82
67	*Tinospora sinensis*	3	4	1.333	2.72
68	*Urtica diocia*	9	11	1.222	8.18
69	*Zanthoxylum armatum*	13	20	1.538	11.81
70	*Zingiber officinale*	5	7	1.4	4.54

Appendix Table 4: Ailments categories and ICF

Ailment categories	**Different ailments included under particular categories**	**No. of species (Nt)**	**No. of use reports (Nur)**	**ICF**
Gastro-intestinal	Constipation, diarrhea, dysentery, piles, fistula, stomach ache, indigestion, gastritis, food poisoning, vomiting, stomach cancer, ulcer, anorexia, stomach worm	25	215	0.887
Fever/headache	Fever, sensation of heat (dagdi, Garmi gadheko), headache, altitude sickness	28	221	0.877
Miscellaneous	Jaundice, weakness, immunity problem, tonic, rabies, snake bite	13	97	0.875
Respiratory	Cough, cold, asthma, pneumonia	6	20	0.736
Urino-Genital	Mensuration, stone problem, delivery pain, urinary problem	7	23	0.727
Dermatological	Cut, burns, wounds, skin problem, infection, boils	18	63	0.725
Neurological	Memory boosting, epilepsy, mental problem	4	11	0.7
Cardio vascular	Blood pressure	2	4	0.666
Ortho-muscular	Swelling, body pain, fracture, joint pain	11	28	0.629
Dental and oral	Tooth pain, gum problem, tooth decaying	3	5	0.5
ENT	throat pain, bone stock in throat, throat infection	5	7	0.333

Appendix Table 5: Threat status

S.N.	Name of the species	CITES Categories	IUCN Categories	National threat status
1	*Aconitum heterophyllum*		E	
2	*Acorus calamus*		LC	Threatened by over collection for trade
3	*Ageratum conyzoides*		LC	
4	*Artemisia vulgaris*		LC	
5	*Berberis aristata*		LC	
6	*Bergenia ciliata*		T	
7	*Buddleja asiatica*		LC	
8	*Centella asiatica*		LC	
9	*Cinnamomum tamala*		LC	
10	*Curcuma longa*		DD	
11	*Cuscuta reflexa*		LC	
12	*Dactylorhiza hatagirea*	II	E	Banned for collection, use, sale, distribution, transportation and export
13	*Dioscorea deltoidea*	II		
14	*Gaultheria fragrantissima*		LC	
15	*Juglans regia*		LC	Banned for collection, use, sale, distribution, transportation and export
16	Lichen			Banned for export outside the country without process
17	*Malvaviscus arboreus*		LC	
18	*Mentha arvensis*		LC	
19	*Nardostachys jatamansi*	II	CR	Banned for export outside the country without process
20	*Ophiocordyceps sinensis*		V	
21	*Osyris lanceolata*		LC	

22	*Paris polyphylla*		V	Threatened by over collection for trade
23	*Picrorhiza kurroa*	II	E	Banned for collection, transportation and trade
24	*Psidium guajava*		LC	
25	*Rubus ellipticus*		LC	
26	*Rhus chinensis*		LC	
27	*Swertia chirayta*		V	Threatened by over collection for trade
28	*Taxus wallichiana*	II	E	Banned for export
29	Urtica diocia		LC	
30	*Zanthoxylum armatum*		LC	Threatened by over collection for trade
31	*Zingiber officinale*		DD	

Note: DD: Data Deficient, CR: Critically Endangered, E: Endangered, LC: Least Concern, T: Threatened, V: Vulnerable

Appendix 6: Questionnaire

Name: Age: Occupation:

Gender: Education: Address: Hesitation:

Signature: Date:

S. N.	Plants species	Local name	Nepali name	Habit	Parts used	Preparation	Doses	Spiritual value	Mode of uses	Ailments	Altitude
1											
2											
3											

Q. Is the use of medicinal plants increasing or decreasing?

a. Increasing b. Decreasing

Q. Why?

Q. Have you planted any medicinal plant in your home compound? List them.

a. Yes b. No

Q. Have you seen any threat to medicinal plants? If yes than what are they?

Q. What are your personal efforts to conserve the medicinal plants? If yes what are they?

Q. Is this house involved in trade of medicinal plants?

Q. What is the status of trade of medicinal plants in the village?

Q. How many species have being traded from the village? Mention them

Q. Extent of trade

a. Local b. National c. International

Q. Which plants are traded for high economic value with amount? Rank them 1-3 according to economy and quantity.

a. Economy: b. Quantity:

Q. Band categories of medicinal plants by Rural Municipality (Gaupalika)?

Local use……

Trade……

Q. Traded species though they are banded? Where they have been traded?

Q. Efforts to conserve medicinal plants:

Local communities:

Local and central GNOs:

NGO and INGOs:

Q. Penalty for illegal use and trade?

PHOTOPLATES


MPs with local people


Collection of MPs


Anaphalis busua and *Bergenia ciliata*

Discussion about medicinal plants

Rubus rugosus and *Ophiocordyceps sinensis*

Herbarium preparation

PERMISSION LETTER

रूवी भ्याली गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
सेर्तुङ धादिङ
वागमती प्रदेश, नेपाल

पत्र संख्या: ०७९।०८०
चलानी नं:१२६४

मितिः २०८०।०२।१०

विषयः अनुसन्धान अनुमती सम्वन्धमा।

श्री जो जससङ्ग सम्बन्धित छ,

उपरोक्त सम्बन्धमा सरोज अधिकारीले यस गाउँ कार्यपालिकाको कार्यलयमा दिएको निवेदन अनुसार निज सरोज अधिकारी,अमृत साइन्स क्याम्पस, बनस्पति शास्त्र स्नातकोत्तर तहमा अध्ययनरतलाइ " Medicinal plants used by the local community of Rubivalley rural municipality, Dhading, Nepal" शिर्षकमा यस गाउपालिका भित्र अनुसन्धान गरि सोधपत्र तयार गर्न र नमूना संकलनको लागि यस गा.पा. कार्यालयबाट अनुमती प्रदान गरिएको व्यहोरा जानकारी गराइन्छ।

नविन कुमार गोले
प्रमुख प्रशासकीय अधिकृत