Popularly Used Medicinal Plants by Tamang Ethnic Group at Three VDCs (Chilime, Thuman and Gatlang) of Rasuwa District

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CERTIFICATE

This is to certify that the dissertation work entitled "**Popularly Used Medicinal Plants by Tamang Ethnic Group at Three VDCs (Chilime, Thuman and Gatlang) of Rasuwa District**" submitted by **Ms. Saroj Yadav** has been carried out under my supervision. The entire work is based on the results of her research work and has not been submitted for any other degrees to the best of my knowledge. I recommend this dissertation work to be accepted for partial fulfillments of Master of Science in Botany.

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APPROVAL LETTER

The dissertation work submitted by **Miss Saroj Yadav** entitled **"Popularly Used Medicinal Plants by Tamang Ethnic Group at Three VDCs (Chilime, Thuman and Gatlang) of Rasuwa District"** has been accepted as a partial fulfillment of M.Sc. in Botany.

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ABSTRACT

Rasuwa districts is a mountainous least developed and remote district with rich floral diversity due to altitudinal variation. Along with rich biodiversity, it is supported with natural beauty, typical medicinal and aromatic plants, several endemic threatened and endangered animals and plants, ethno medicinally and economically useful plant species and ancient cultural heritage. Along with the floral diversity this district is also rich in cultural diversity. Tamang ethnic group is the dominating group in this district. There are 18 VDCs in Rasuwa district and out of that three VDCs have been selected this study where there is the dominance of Tamang ethnic group.

The study was undertaken primarily to document the ethno medicinal information of three VDCs, Chilime, Gatlang and Thuman which was accompanied by three field visits made from Sept. 2006 to Aug. 2007. The focus was also made to quantify the indigenous knowledge of Tamang communities within the three VDCs using the consensus methodology.

The ethnomedicinal study indicates that large number of plant species is used as traditional medicines. There were 53 species of ethno medicinal importance survey in the study area. Out of the total 49species, 45 species were reported in consensus list. The medicinal uses of the plants were grouped into 11 categories and the "informant consensus" (F_{ic}) factor for each usage category was calculated. The result of consensus suggested a well defined medicinal tradition in the study area. Trade of medicinal and aromatic plant was found to be very high. The frequently traded species were *Nardostachys grandiflora, Neopicrorhiza scrophulariiflora, Rheum australe, Swertia chirayita, Valeriana jatamansii and Delphinium* sp. The people of Chilime were seen to be highly engaged in the collection of MAPs.

There was found no any appropriate method of sustainable harvesting and management practices. Most of the people seemed always in hurry to collect those products which have high market value. This has led many species to go under high threat. Therefore, there is a need of promotion of other kind of options to be dependent on, like the cultivation practices and sustainable utilization of the medicinal plants. It seems to be most viable option for their effective management.

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List of acronyms

CBS	Central Bureau of Statistics
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
DDC	District Development Committee
DFO	District Forest Office
DNPWC	Department of National Parks and Wildlife Conservation
DPR	Department of Plant Resources
ESON	Ethnobotanical Society of Nepal
IUCN	The World Conservation Union
KATH	National Herbarium and Plant Laboratories, Godawari
LNP	Langtang National Park
MAP	Medicinal and Aromatic Plants
TU	Tribhuvan University
TUCH	Tribhuvan University Central Herbarium
WWF	World Wide Fund for Nature
VDC	Village Development Committee

CHAPTER ONE

1. Introduction

1.1 Background

The utilization of plants and plants products as medicine has not diminished in anyway in recent times, but can be traced as far back as the beginning of human civilization (Kunwar *et al.,* 2006). During their evolution, they utilized the plant knowingly or unknowingly. Later on their practical knowledge came in the form of tradition. The indigenous knowledge about, which plant to use and not to use through their self practices was transferred from generation to generation through their self sustaining nature (Rajbhandari, 2001).

Rigveda is one of the earliest record in which the use of medicinal plant in the Himalayas is found and the work was written between 4500 BC and 1600 BC. It describes about 67 plants and is supposed to be the oldest repository of human knowledge (Malla and Shakya, 1984).

Apart from *Rigveda,* use of medicinal plants is also found in *Atharva-veda* (2,000 – 1,000 BC) and *Ayurveda* (1,000 – 600 BC) in Indian sub-continent. Ayurveda is the "Foundation of science of life and the art of healing of Hindu culture" which describes the medicinal importance of 1200 plants. After the 16th century AD, the holistic way of thinking in *Ayurveda* decayed due to decadence and the advance of Traditional Chinese Medicine (TCM) and modern western medicine in India. Other important works in the region was *Charaka Samhita* an encyclopaedia of Indian medicine, written at Varanasi between 1,000 BC and 100 AD (Farooqi and Sreeramu, 2001). 'Charak' or 'Caraka Samhita' (900BC) and 'Susruta Samhita' (500BC) has enumerated the art of surgery, therapeutics and medicines in detail (Nambiar, 2002). The process of accessing the knowledge was followed by Nepali *Vaidhays* and *Kabirajs* (879AD) with free formulation of Ayurvedic System (IUCN, 2000).

"Nepali Nighantu" written by Kosh Nath Devkota (1969) covers 750 plants in detail and is probably the first written efforts towards a compilation of the traditional knowledge about medicinal plants of Nepal (IUCN, 2004). Ethno-medicine has contributed significantly to social economical, cultural and environmental development. What is traditional about traditional knowledge is not its antiquity, but

the way it is acquired and used. In other words, the social process of learning and sharing knowledge which is unique to each indigenous culture lies at the very heart of its “traditionality” (Rajbhandari, 2001).

Medicinal and aromatic plants are local heritage of the global importance (Purohit and Vyas, 2004), they constitute the base of health care systems in many societies. Total 60% of the population of the world and 80% of the population of the developing countries depend on traditional medicine, mostly plant drugs, for their medical purpose (Shrestha and Dhillion, 2003). About 70% of the population of India (Gadgil and Rao, 1998) 80% of Pakistan (Ahamad and Ghafoor, 2002) and 80% of Nepal rely directly on traditional medicinal plants (Manandhar, 1999; Bhattarai, 1999). Traditional medical practitioners are found in every rural villages of the country and occupy an important position in the Nepalese societies. Consequently, the people depend largely on faith healers and shamanistic treatments (Rajbhandary and Ranjitkar, 2006).

Poverty in Nepal particularly in rural areas is widespread and is deeper in the remote areas of the hills and mountains. Poorest households in these areas tend to have very small land holdings less than 0. 5 ha, some are landless (Basnet, 2007). Therefore, 90% of the people are dependent on agricultural based activities but the sector doesn't absorb all unemployed population. This situation clearly indicates that there is the shift in population towards the use of wild plants.

The recovery of the knowledge and practices associated with medicinal and aromatic plants are part of an important strategy linked to the conservation of biodiversity, the discovery of new medicines, and the bettering of the quality of life of poor rural communities. These plants are always helping in alleviating human suffering and are broadly used as additives, beverages, cosmetics, bitters, spices, dying agents insecticides and hand to hand-directly uplifting their economic status. Therefore, it is necessary to have information about the economic status of local people and status of natural resources around their settlements prior to launch any activity related to poverty alleviation objectives. Natural resources like valuable NTFP and especially the medicinal plants, which are highly distributed around the local community play very vital role in raising the economic status of that community.

1.2 Status of Medicinal Plants in Nepal

Nepal is an excellent repository of cultural heritage for diverse ethnic groups and it has a rich tradition of folk practices for utilization of wild plants (Manandhar, 1993a) especially as medicinal plants. Different ethnic group within Nepal uses about 23% of flowering plants for their medicinal properties (Shrestha *et al*. 2000). Nepal is rich in medicinal and aromatic properties and out of ca 6,500 flowering plants, there are over 2000 species of plants with ethno-botanical importance out of which about 1,600 species of plants have been estimated to be used in traditional medicine and a majority of which awaits proper documentation (Shrestha *et al.* 2000). It is estimated that only 15-20 percent of the population of Nepal living in and around the urban areas have access to the modern medicinal facilities, whereas, the rest depend on traditional medicines. Recently figure of 1,792 species of medicinal plant have been provided by Baral and Kurmi (2006).

These are distributed from tropical, sub-tropical, temperate and alpine regions of the country. A tentative list of the alpine flora of the Nepal Himalayas consists of 1227 species belonging to 317 genera (Obha, 1998), including 114 and 45 medicinal plants respectively from the sub alpine and alpine zone as mentioned by Malla and Shakya (1984). The Himalayan region shows the highest richness for endemic species and medicinal herbs (Kunwar and Duwadee, 2003).

Medicinal plants have been harvested from the wild since ancient times (Singh *et al.*, 1979). Traditional medicine is still recognized as the primary health care system (Manandhar 1994, 1998) in many rural communities because of its effectiveness, lack of medical alternatives and cultural preferences (Plotkin and Famolare, 1992). Nepal consist of ethnic diversity, as there exists more than 102 caste groups and more than 92 different languages are spoken within the country (CBS, 2005) because of this a wide range of traditional medicinal knowledge are still practiced in the country.

1.3 Trade of Medicinal Plants in Nepal

Medicinal Plants from Nepal were traded to the borders to Tibet as early as 600 AD (Sung and Yiming, 1998). According to Edwards (1996) 20% of the medicinal and aromatic plants which is a category of NTFP are commercially utilized. The NTFP are important because of their value as a perennial source of income to the

society to conserve biodiversity (Chaudhary and Karmarcharya, 2001). High value but less abundance MAPs are mainly found in wild in the high mountains. The large proportion of local people makes their life to be highly dependent on the collection and sale of these products. About 10-15 thousand tons of MAPs are exported every year from the country (Bhattarai and Maharjan, 2001). Presently, over 90% of the total export every year from Nepal is to India and mostly in crude form (Bhattarai, 1997).

Conservation estimates of the annual Nepalese alpine and sub-alpine medicinal plant vary from 480 to 2500 tons, with a total harvest value of US $ 0. 8 – 3. 3 million (Olsen and Larsen, 2003). *Nardostachys grandiflora, Swertia chirayita, Neopicrorhiza scrophulariiflora, Zanthoxylum armatum and Sapindus mukorosi* are the top five species of NTFPs currently in trade (Olsen, 2005).

1.4 Statement of Problem

Constant encroachment of the local territories, forests, socio-cultural tradition by non-native people as well as social exploitation due to migration are some of the major issues in the loss of traditional knowledge and lack of authentication of traditional knowledge, lack of well documented information, lack of interest in younger generation are the other factors in the loss of traditional knowledge (Rajbhandary and Ranjitkar, 2006). Similarly, the use of herbal medicines in Ayurvedic System has led great majority of people in Himalaya to rely primarily to it in comparison to western medicine (Ghimire *et al.,* 2005) and they depend on the harvesting of wild MAPs for their income. Due to the changing time, changing life style, they are forced more and more towards the collecting, trading and selling of MAPs (Godgil *et al*., 1993) which has led to the degradation of indigenous knowledge on resources (Silori and Rana, 2000). Due to the lack of awareness of social factors affecting plant use and market, there is no proper management of traditional medicine. As a result of which the number of these plants are decreasing at an alarming rate (Kunwar and Duwadee, 2003).

Local people, the primary producers, get only a small fraction of value of end sales in international markets. The royalty rates are fixed according to some unclear procedure that is not related to market prices in different community forest of Rasuwa district. There is high royalty rate of Yarshagumba NRs 10000/Kg; Paanchule

(*Dactylorhiza hatagirea*) is 500/piece resulting illegal trading practice. DFO staffs have difficulties in correctly identifying NTFPs because they are often referred by various local names. According to the traders royalties are paid for only part of NTFPs collected but most of the materials are illegally traded.

Most of them believe that all MAPs collection and trade is illegal and hence reluctant to provide any information about NTFPs use, collection and trade. Lack of clear vision policy of interaction with the people and the forest department / other related agencies dealing with MAPs has paralyzed the collection and trading system which are beyond the control of local people. Random and illegal collection of these MAPs, without any substantial measures to regenerate them, has imposed serious threat to the medicinal plants. Thus, over-exploitation of biological resources, stimulated by inappropriate economic policies and faulty institutions, insufficiently protected areas, poaching; poor law enforcement, local encroachment and illegal trade are the main problems of the natural conservation of biodiversity in the region.

Rasuwa district is one of the least developed district of Nepal, with its excessive potential in resources like forest, water and herbs. In spite of being least developed, it is renowned of having religious place i.e. Gosainkunda, has a long history of its origin. Analysis the human development index, all the area of Rasuwa district comes at the bottom of Nepal's district. Even though the area is very near from Kathmandu valley with transportation facilities, the area still considered to be remote due to its vulnerable physiography.

1.5 Justification of the study

Rasuwa district has rich biodiversity as well as it is also rich is cultural heritage. The area harbours a number of high valued medicinal plants that are widely utilized by the local communities. Due to its richness in the biodiversity many scientists as well as researchers are attracted towards this region and plants from the area. The most significant were those of Manandhar (1980b) Joshi and Edington (1990), Yonzon (1993), Shrestha and Shrestha (2002), Dangol (2002) and Shrestha *et al.* (2002). Despite many botanical explorations, there is limited information available on the ethnobotany of the area. Only the selected area of the Rasuwa district is

covered, but there is still lacking of complete, information about the diversity of plant resources and the mode of the uses made by different ethnic people.

The ethnobotany and traditional knowledge in three VDCs i. e. Chilime, Thuman and Gatlang have not been previously explored. Therefore, the study is mainly addressed to document the indigenous knowledge of Tamang communities on the utilization of wild plant resources to fulfill their requirements.

Access and benefits sharing of resources and traditional knowledge of people from Rasuwa are deprived (Basnet, 2007). This study will attempt to find out the resource potential; their conservation, and also highly traded medicinal and aromatic plants. A research about Rasuwa district is crucial to interlink the whole region with mainstream. This study will try to provide information about the potential area, highly traded MAPs and dependency of local household to the MAPs.

The research objectives of many early ethnomedicinal and ethnobotanical studies were simply to document traditional botanical knowledge (Amatya, 1996, Bhattarai, 1992a, 1992b, Chhetry, 1996, Shrestha, 1997). However, there has been a recent trend towards ethnobotanical studies that look beyond documentation toward elucidating patterns of traditional botanical knowledge and cross-cultural comparisons (Moerman *et al*. 1999; Shepard 2004; Vandebroek *et al*. 2004).

Focus is mainly made to study the consensus of the medicinal plants of that area, in order to identify the plant species which are used therapeutically to provide baseline information for future pharmacological and phytochemical studies. On the other hand it is also important to know whether the plant that is highly preferred by the local healers, community levels, is practical or not. This study will help in developing the correlation between the mentioned and usage category and also help us to understand the trade of those plants which are utilized in different ailments so that conservation management program can be launched. Therefore, in this research preliminary attempt has been made to study quantitative comparison of medicinal plants knowledge among Tamang ethnic group for medicine using the consensus methodology.

1.6 Objectives

The present study was conducted to fulfill the following objectives through scientific documentation of the indigenous knowledge of Tamang communities in three Village Development Communities i.e. Chilime, Gatlang and Thuman.

1. To enumerate wild plant resources used by indigenous Tamang people for folk medicine and identify the most potential area of medicinal plants in three VDCs of Rasuwa District.
2. To assess the dependency of local community upon wild medicinal resources and to find the highly preferred medicinal plants in trade
3. To conduct a preliminary work involving a quantitative comparison of the medicinal plant knowledge among Tamang people of three VDCs of Rasuwa district using Trotter and Logan's (1986) "informant consensus factor".

1.7 Limitations of the Study

The study intends to explore ethno-medicinal knowledge possessed by the ethnic Tamang community in three different VDCs of the Rasuwa district. Out of 18 VDCs of the Rasuwa district it was only possible to cover three VDCs due to time constrains. The settlements of the VDCs are so scattered that it was very difficult to reach all the household of the community. There are many limiting factors during this ethno-botanical work, such as diverse weather, many landslides on the way, inaccessibility and the difficult mountain physiography are other reasons in addition to time constrains. Furthermore, as the study was limited to few places within Rasuwa district, the present findings cannot be generalized for the people of whole district. Likewise the distance between the harvesting/collection area and the settlement of village was so far that sufficient collection of many species could not be made.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Ethno botanical work done outside Nepal

The medicinal plant traditions of the Laklei and Idate cultures were compared using Trotter and Logan's (1986) quantitative "informant agreement ratio" by Collins, *et al*. These findings have important implications for the understanding of ethnobotany as they demonstrate how relatively closely situated cultural groups can have significantly different traditional knowledge systems.

Virginie *et al* (2005) studied the ethnobotany of the Q'eqchi Maya of Southern Belize by using consensus methodology, which mentioned 169 species belonging to 67 families. The frequency of use for each plant and the informant consensus factor for each usage category revealed a consensus among the healers on the use of plant species as well as on the related diseases. The result suggested a well-defined medicinal tradition.

Past and present medical provision in Africa was studied by Busia (2005). The use of medicinal plants and animals-derived remedies for treating illness by Africans, which was mentioned many years back is given in this study. Traditionally, rural Africans communities have relied mainly on the invaluable spiritual and practical skills of traditional medicinal practitioners (TMPs) for their health care.

An agenda for the medicinal plant cultivation and conservation in the Himalaya was highlighted by Sundriyal (2005). This paper highlights strategy for large scale cultivation and long-term conservation of medicinal plants involving different stakeholders in the Himalayas.

Yadav (2005) developed a market information system for removing market-imperfections in the trace of medicinal and aromatic plants in India. He found that increasing consumer awareness and preference for herb-based natural products including herbal medicines has resulted in an unexpected surge in the demand for medicinal and Aromatic plants (MAPs) and thus resulting into over-exploitation of

MAPs. He concluded that the markets for the most non-timber forests products including MAPs are highly unorganized and secretive. Thus people suffer from various market imperfections mainly due to lack of information about the demand and supply of the products being traded to the disadvantage, collectors and cultivators and sustainable resource availability.

Kumar *et al.* (2005) reported the trading of ethnomedicinal plants in the Indian arid zone and found 131 plants to be of ethno-medicinal value. Out of 131 species, 41 species are collected and sold within Indian arid zone markets where large inter and intra district variation in sale price was found.

Collins *et al.* (2006) studied the medicinal plant traditions of two distinct East Timorese cultures, the Laklei and Idate. They compared the traditional use of medicinal plants by using quantitative ethnobotanical methods. A total of 86 medicinal plant species were identified.

Leonti *et al.* (2006) performed the study, which was based on comparison of ethnobotanical data obtained from the field conducted in southern Italy, southern Spain, and mainland Greece resulting in the identification of core group of 18 culinary used wild gathered plant species.

A quantitative in the Bolivian Amazon has been studied by Victoria *et al.* (2006). The study was performed to estimate the significance of plant species for humans. The cultural practical economical and total values of 114 plants species from 46 families were calculated.

2.2 Ethno botanical work done inside Nepal (Except Rasuwa and its adjoining areas)

Ethnobotanical studies started in the mid-1950s, but in Nepal its importance have been recognized only from the last few decades both by Nepalese and foreign researchers. Regarding the foreign researchers like Francis Buchanan, a Scottish medical man, who first collected plant specimens in Nepal in 1802-1803 which was later done by Nathanial Wallich in 1820-1821. A paper on ethno-botanical exploration was published for the first time by Banerjee (1955) based on his work on edible and

medicinal plants from East Nepal is the initiation for the work of ethnobotany in Nepal..

Most of the ethnobotanical works are mainly focused on medicinal plants. The encyclopaedia “Bir Nigantu" compiled by Pandit Kashi Nath Devkota in eight volumes is considered as the earliest record of Nepalese literatures on the use of medicinal and aromatic plants (Adhikari, 1998). Later the book named "Medicinal plants of Nepal" was published in 1970 by then the Department of Medicinal Plan and now Department of Plant Resources that provides comprehensive information on 393 plant species, their therapeutic uses, distribution etc. (HMG\N 1970). It was supplemented by another volume in 1984 with additional 178 species plants (HMG\N 1984).

Malla and Shakya (1984) have listed 630 species of plants from Nepal that have potential medicinal uses.

Sacherer (1979) studied the high altitude ethnobotany of Rolwaling Sherpa and he identified 297 different plant species in the region. He has discussed the uses of 80 plants species together with their Sherpa names.

Shrestha (1988a&b) documented the ethnobotanical information on 100 wild plants used by Tamang of Kathmandu valley for various purposes such as medicine, fodder, food, firewood, timber, fibre, and miscellaneous uses.

Manandhar and Chaudhary (1993) discussed the traditional medicinal uses of 64 plant species used by the tribal people of Saptari district in treating 44 ailments.

Similarly, there are many studies which are based particularly on ethnic groups such as. Sherpa (Nepal, 1999); Lama (Lo Bue 1981; Toba 1975), Tamang (Shrestha 1988a&b; Tamang 1998), Tharu, Danwar, Route, Limbu (Chhetry 1996); Mooshar, Satars (Siwakoti *et al.* 1997); Gurung (Coburn 1984); Magar (Mahato 1998) etc.

N. P Manandhar has given outstanding contribution regarding ethnobotany of Nepal covering different parts of the country with diverse ethnic groups. His contribution covers different ethnic groups of the country such as Sherpa. Lama, Tamang, Tharu, Danwar, Route, Limbu, Mooshar, Gurung, Chepang etc. He also carried out his

studies in Nepalgunj, Rasuwa, Nuwakot, Dang-Deokhuri, Jumla, Dhanusha, Lamjung, Manang, Makawanpur, Gorkha, Chitwan, Surkhet, Baglung, Kaski, Jajarkot, Myagdi, Dadeldhura etc. (Manandhar, 1974, 1980a&b; 1983, 1985, 1986a&b; 1987a&b; 1989, 1990a, b&c; 1993a&b; 1994, 1995a&b; 1998)

A medicinal and aromatic plant database of Nepal (MAPDON) is prepared by ethnobotanical society of Nepal (ESON) in 2000 in which there is list of 1624 medicinal and aromatic plants of Nepal, out of which there are some species which are commonly available as crude drug in the market, under cultivation and in wild form (Shrestha *et al*, 2000).

In the year 2000 IUCN Nepal published a national register of medicinal plants (IUCN, 2000), which has been revised and updated in 2004 that describes 187 species of medicinal plants (IUCN, 2004)

Kunwar *et al.* (2006) described the richness of ethnobotanical knowledge, of local people of Pinda, Muralibhanjyang and Dhading Besi and other areas of Dhading district in Central Nepal. A total of 108 species have been recorded which are being used locally. Out of them, 96 are used as medicine.

Shrestha and Shrestha (2007) documented 411 medicinal and aromatic plants including 383 angiosperms, 8 gymnosperm, 19 pteridophytes and 1 fungus. The study reports 73 types of common disease with the use of medicinal herbs. They have also made an effort to collect dispersed information of medicinal plants and accumulate them at one place.

Joshi and Joshi (2007) documented the uses of 44 medicinal plants with indigenous knowledge in Macchegaun. Nepal, they have found some species and their habitats under serious threat due to various natural and anthropogenic stresses.

Gurung *et al.* (2007) documented the indigenous knowledge on plant utilization as natural remedy by indigenous people of Sikles area. Altogether 66 species of medicinal plants used by the Gurung community has been documented.

Rai (2007) on his survey to the mid western Nepal revealed 74 aromatic plants, belonging to 19 families. He documented ethnobotanical usage of plants along with the presentation of chemical constituents of the essential oils from such plants.

Joshi (2007) explored the tribal methods of utilization of 73 different plant species belonging to 43 families under 62 genera by local people in Sarmoli VDC of Darchula district far western part of Nepal. He found very rich knowledge of medicinal value of plants among the traditional healers of local community.

2.3 Ethnobotanical exploration in Rasuwa and its adjoining areas

Malla *et al*. (1976) described 911 species of vascular plants from the Langtang National Park and adjoining areas. Out of these, about 132 species have been reported to have medicinal value.

Manandhar (1980a) described 37 medicinal plant species with their uses. In an another study, (1980b) he described some less known medicinal plants of Rasuwa district along with their specific uses, doses and mode of preparation respectively.

Joshi and Edington (1990) reported 66 species of medicinal plants belonging to 46 families from two VDCs (Chaubas and Syabru) of Rasuwa district, Central Development Region.

Manandhar (1991) gave an elucidation of Medicinal plants of Tamang tribe of Kabrepalanchowk district. He reported 95 plant species, both wild and cultivated have been found to be of common use for the treatment of various ailments.

Yonzon (1993) published 90 species of plants with Medicinal value from Langtang area.

Shrestha and Shrestha (2000) described 82 species of ethno-medicinal plants of Langtang National Park, which have been used to cure 32 types of diseases.

Shrestha *et al*. (2002) documented and mapped medicinal plants of Langtang National Park. They found some 95 species of medicinal plants belonging to 52 families in the region which were widely used by local communities for treating up to 40 different types of diseases.

Dangol (2002) assessed the forest community diversity and associated medicinal plants in Langtang National Park and reported a total of 85 species of medicinal plants in the eight vegetation communities.

Shrestha *et al.* (2002) documented some flora of Langtang National Park and studied deeply to explore its flora. They presented a brief report on plants species of the National Park which are not included in the flora of Langtang and cross section vegetation survey (1976).

Chhetri and Joshi (2003) reported the direct relationship of plants with people for food, fibre, dye, fuel wood, medicines, and useful other products. They have explored the tribal methods of utilization of non-timber forest products of 50 different species of plants belonging to 35 families under 47 genera by Tamang in Langtang National Park of Nepal.

2.4 Trade of medicinal plants

The trade of medicinal plants have been started only in the recent years. Nowadays commercially traded Himalayan plant species have received scientific attention and their potential for contributing to rural livelihoods and their conservation consequences of harvest and trade are highly discussed. Various studies have been made on identifying the species and products in trade (Manandhar, 1980b; Murty; 1993).

Burbure (1981) focused in obtaining information on the production, processing, trade and usage of medicinal plants in Nepal. He found that trade of medicinal plants with India and other countries remain of considerable significance to the Nepalese economy, while trade with Western market was found to be comparatively small.

Malla *et al.* (1995) reported an average annual licensed collection of kutki (*Neopicrorhiza scrophulariiflora**)*** in Nepal of approximately 25 tonnes and trader estimate of annual national trade of 98 tonnes from 1989 to 1992.

Edwards (1996) reported that, every year about 10,000 to 15,000 tons of non timber forest product (NTFPs) are harvested from the middle hills and mountains of Nepal and traded to foreign country like India. His estimation for the export of kutki

(*Neopicrorhiza scrophulariiflora**)*** was 24 tons from five districts in eastern Nepal in 1991\1992.

Olsen and Helles (1997) investigated the trade in medicinal and aromatic products from the rural area of Gorkha district in Central Nepal to the wholesale market in India over a two-year period.

Basnet (1998) reported 102 plant species as medicinal plants. Total species reported are represented by 59 families belonging to 92 genera. Plants used in different disorders diseases and their percentage coverage is well presented in the result. He also provided the lists of medicinal plants exported from Sindhuli district.

Olsen (1999) estimated that Nepal's annual export to India of dried unprocessed rhizomes of *Nardostachys grandiflora* involves approximately 1000 tons per year *N. grandiflora* is one of the most important species traded from Nepal.

Chhetri (1999) studied the diversity of medicinal and aromatic plants (MAPs) in the lower valleys of Manang District and evaluated the status of commercially potential MAPs in terms of availability, trade and value of it to the local people. On his assessment he reported 12 species of MAPs from the area which falls under threat and protected lists and also showed that large quantities of MAPs are traded illegally from that area.

Gahire (2003) reported that the DFO records show only 9. 5% of the total amount of Kutki (*Neopicrorhiza scrophulariiflora)* legally traded from Manang district and the remaining 90. 5% was harvested, collected and passed illegally from the district.

Das (2005) reported that there are about 7000 species of plants in Nepal, out of which 165 species are currently in trade, 20 species cover over 80% of volume and value of commerce and 250 species have high potential for marketing.

CHAPTER – THREE

3. DESCRIPTION OF THE STUDY AREA

3.1 Geographical location and climate

Rasuwa district lies in Bagmati zone of central Development region of Nepal in the North West part. It is the high Himalayan and mountainous district of Nepal. Rasuwa district falls within 27^{o} 57' 30" to 28^{o} 23' 30" N latitude and 85^{o} 07' 00" to 85^{o} 48' 15" E longitude. It is situated about 120 km north from the capital city of Nepal, Kathmandu. It is surrounded by the Langtang and Salang-Sungo ranges from the northern boarder and Tibet – the Autonomous region of China, Sindhupalchowk in southeast, Nuwakot in south and Dhading to the west. Its area is 151,179 hectare. Rasuwa district consists of 18 VDCs and the study was conducted in the three VDCs naming Chilime, Gatlang and Thuman.

Photo 1: Langtang Himal on the northern side (*Courtesy: Raju Giri*)

This district represents excellent spectrum of vegetation type along the altitude ranging from mid hills to alpine i.e, between 1000m and 7245m and coupled with complex topography and geology that have produced a rich biodiversity unique patch work of vegetation. The district is rich in vegetation characterized by Sal (*Shorea robusta*) forest in southern part and it is gradually taken over by *Schima wallichi* and

Castonopsis indica forest in the subtropical zone (1,000 – 2000m). Hill forest includes *Pinus walliciana*, *Rhododendron arboreum* and *Alnus nepalensis* (Nepalese alder).

The temperate zone (2,600-3000m) is covered mainly by Oak (*Quercus semicarpifolia*) forest fading to old forest of silver fir (*Abies spectabilis*), Hemlock (*Tsuga dumosa*) and Lar ch (*Larix himalaica*) in the lower sub-alpine zone (3,000-3,600m). The upper sub- alpine zone (3,600-4000) is characterized by Birch (*Betula utilis*) forest associated with species of *Rhododendron* such as *R. arboreum, R. barbatum, R. campanulatum and R. lepidotum.* The Nepalese larch (*Larix nepalensis*), the only deciduous conifer in the region is found in the district. All the species like Juniper and Rhododendron shrub (*Rhododendron anthopogan* at 4000m elevation slowly dissolve into the expensive alpine grassland meadows. The upper alpine zone between 4500-5,500m consists of diverse species composition like *Androsace tapete, Gentiana depressa, Pedicularis longiflora* and *Anemone demissa*. (Chaudhary, 1998). Tree species such as *Betula utilis Abies spectabilis, Sorbus macrophylla* and twisted *Rhododendron campanulatum* are found near the tree line.

Photo 2: Vegetation of the study area *(courtesy: Prof. Dr. Krishna K Shrestha)*

3.2 General description of the specific study site

3.2.1 Chilime

Chilime is one of the fourth VDC of Rasuwa district. Its area is of 99. 86 sq km. It has Sangjen River on east flowing in between the East and west facing slopes, Lumbri danda on the west, Chhupchung River on north, and Mangtang Lamsha River on south. This VDC is also famous for its popular natural hot water spring (Tatopani). This VDC has altitudinal variation of 2000m to 4000m.

This VDC comprises warm temperate humid to Alpine with humid climate. The predominance tree species are *Quercus, Abies pindrow* (Thingre salla), *Rhododendron* sp. (Lali gurans), *Alnus nepalensis* (Uttis), *Michelia Champaca, Pinus wallichiana* (Govre salla) are dominated in the community forest of Chilime. They mainly consist of *Alnus nepalensis* and *Pinus wallichiana* and can be called the mixed forest of *Pinus wallichiana* and *Alnus* species (Basnet 2007).

Major NTFP species found in the forest area is *Thysanolaena maxima, Drepanostachyum falcatum, Swertia chirayita, Bergenia ciliata, Neopicrorhiza scrophulariiflora, Rubia manjith, Taxus wallichiana, Lichen* sp.*, Dioscorea deltoidea, Valeriana jatamansii,* etc.

3.2.2 Thuman

Thuman is the 18th VDC of Rasuwa district, which has Ganesh Himal range in the north eastern side. This VDC is surrounded by Tibet/Sangjen Himal in the east, Goljung and Chilime in the south, Timure in the east, Bridim and Bhotekoshi in the western part. The altitudinal variation of this VDC lies from 1600m to 4200m above the sea level. This VDC is popular for the Tamang –Tibeto culture and tradition.

According to the topographic map only 0.50% of the land is covered by forest and it is handed over to the villagers itself as a community forest. The forest is of mixed type. The major dominated flora includes *Quercus semecarpifolia, Pinus wallichiana, Alnus nepalensis, Rhododendron* sp., *Osbeckia stellata, Berberis* sp., *Juglans regia.* The MAPs found are *Daphne bholua, Valeriana jatamansii, Rubia*

manjith, Dactylorhiza hatagirea, Neopicrorhiza scrophulariiflora, Nardostachys grandiflora, etc.

3.2.3 Gatlang

Gatlang is the 6th VDC of Rasuwa district. The village lies at an altitude of 2,300 meters and is situated 30 km. northwest of Dhunche, from the district headquarter. Agriculture is the main source of livelihood in this VDC. This VDC is dominated with Tamang community following the Tamang rituals and cultures (USC Nepal, 2006).

Altogether 131 species of plants and animals are recorded in this VDC. These species are used since long time for different purposes. These species represent both wild and cultivated plants (Dangol, 2005). The most important medicinal plant documented is *Swertia chirayita*, which also can be domesticated by the local people for additional income. Agriculture is the main source of livelihood in this Tamang village.

Osbeckia stellata, Prunus persica, Semecarpus anacardium, Quercus lanata, Eupatorium adenophorum, Cannabis sativa, Swertia chirayita, Berbesis sp., Lyonia ovalifolia, Juniperus recurva, Lichen sp., *Rhododendron* sp., *Viburnum erubescens, Juglans regia, Alnus nepalensis* and *Zanthoxylum armatum* are found to be highly dominant in the forest of this VDC.

3.3 Climate

Climate varies from place to place depending upon the land structure and altitude of the area. The place receives heavy monsoon rain from June to August that is carried by the wind blowing from the south west. In summer, snow accumulates only above 5,500 m. In autumn, it accumulates down to 4,000m and during the winter, precipitation is generally in the form of snow and it starts accumulating from 3000 m. Therefore, September through May, most of the upper part of the study area is covered with snow.

Temperatures vary widely with aspect, altitude and cloud cover. The coolest months are December to February and the maximum temperature reaches between

May and July. Humidity and Cloud cover increases with the onset of the monsoon.

Records of Department of Hydrology and Meteorology for the last 5 years (2001-2005) (Appendix II) shows an average minimum temperature of 2.07 °C in January and an average maximum temperature of 24.6 °C in June. The maximum precipitation recorded during the five year period was 635mm in July 2003. The average total precipitation of the five years was 894 mm per annum. Relative Humidity (RH %) was highest in the month of August and lowest in the month of March. Figure 1 shows the maximum and minimum temperature with precipitation and relative humidity taken between 8:45 AM and 17:45 PM in the year 2005.

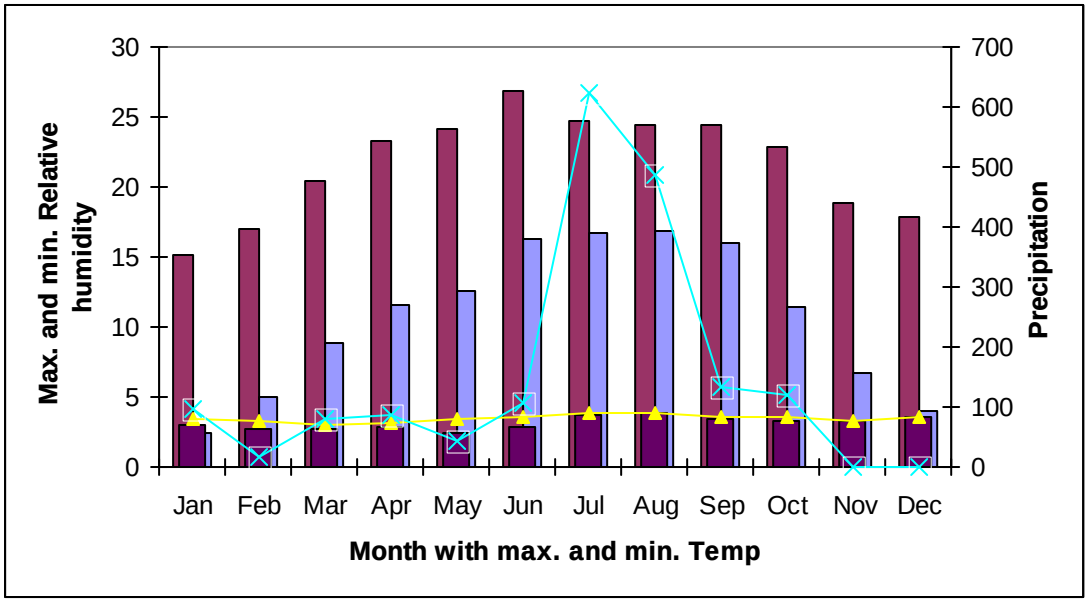


Fig. 1: Climatic data of Rasuwa (2005). Station: Dhunche, Rasuwa

Source: Department of Hydrology and Meteorology, Kathmandu (2007)

3.4 People, Population and socio-economic status

The major ethnic group in three VDCs are Tamang, Kami, Magar, Gurung, etc. The most dominating ethnic group in 3 VDCs is Tamang covering 92.37%, 93.5% and 95.45% respectively of the total household in Chilime, Thuman and Gatlang (Fig 2). The Tamang tribe is one of the renowned tribe of Nepal which occupies 5th position according to the population census of 2001. The Tamang are traditional farmers and cattle herders of the region. They form one of the major Tibeto-Burman speaking communities and originally they were collectively called

'***Bhote***'; that means Tibetan and later on the term 'Tamang' had been attached to them because they were horse traders. In Tibetan language, “Ta” means "horse" and “mang” means "trader" (Bista, 1976). Their farm lands and villages stretch south and west of the Bhote Koshi and Trishuli River.

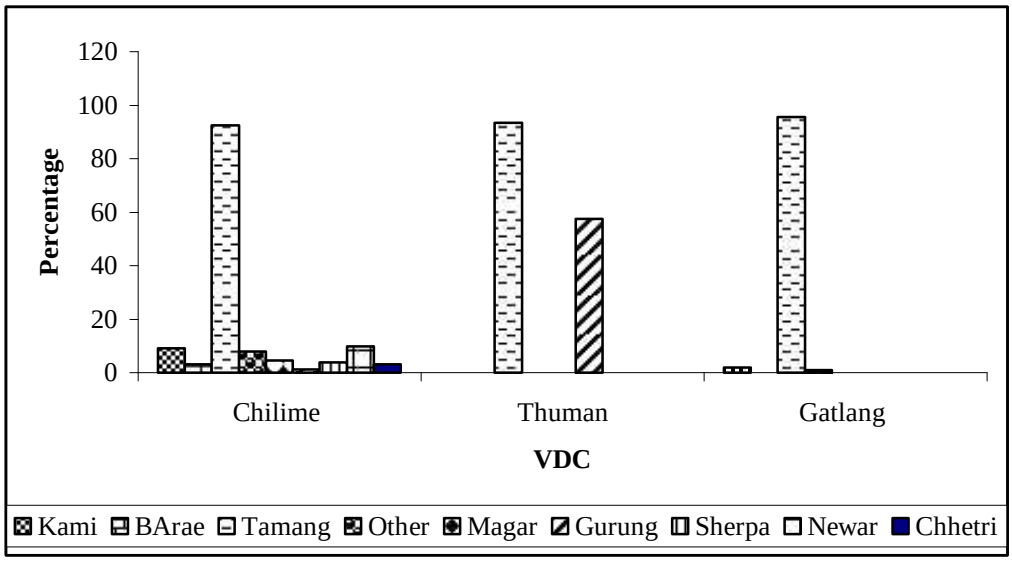


Fig 2. Ethnic composition of three VDCs

A total of 4,247 populations of the Tamang have been registered in the three VDCs. Out of total population, 54.30% of male was found in Thuman, which is more in comparison to other two VDCs, likewise the percentage of female (48.24%) was found to be greater in Gatlang in comparison to Chilime and Thuman (Fig. 3).

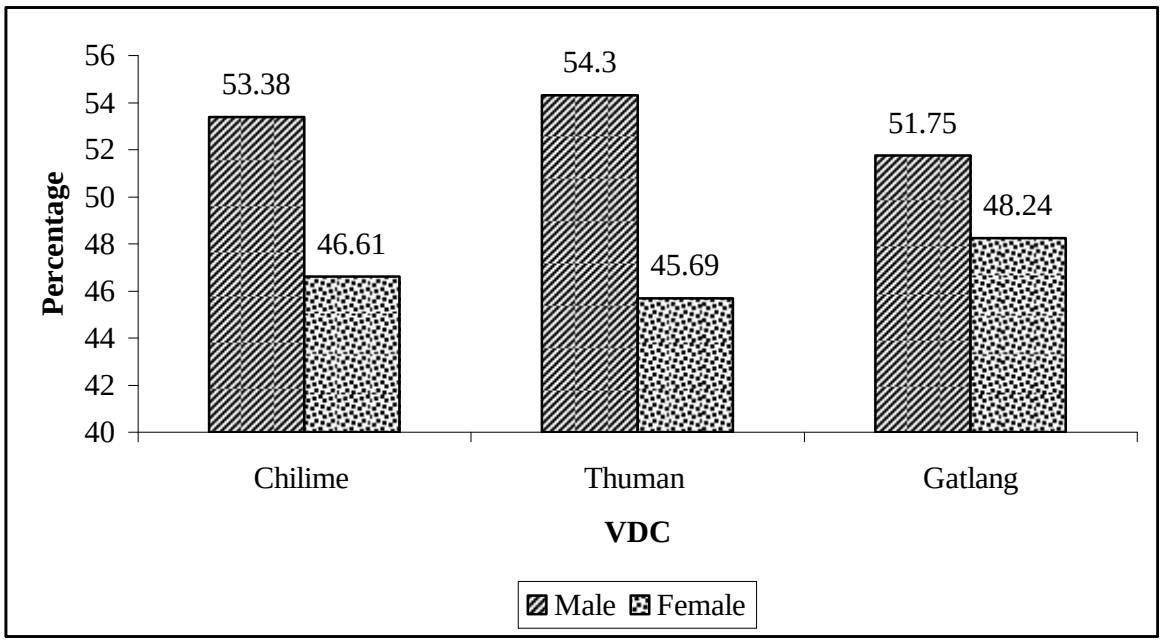


Fig 3. Population size of three VDCs. (*source statistical year of Nepal,2005 HMG***)**

3.5 Landuse Pattern in Percentage

Land use pattern of the specific study area differs from one area to another which is as follows (Fig 3):

- **Chilime:** The total land area of Chilime VDC is 99.86 sq. km. Out of that major area is covered by barren-land which accounts for 32.5 sq. km. Similarly, 31.46 sq. km. of the area is covered with forest and 4.32 sq. km. of the area is covered with Bush/Shrubby land. About 18.8 sq. km. of area is covered by grassland, 10.28 sq. km. is covered by cultivated land. While, 0.41 sq. km. and 2.12 sq. km. are covered by glacier part and water bodies respectively.

- **Thuman:** The total area of Thuman VDC is 154.62 sq. km. Out of that major area is covered by barren-land, forest land and grassland i.e. 78.51 sq. km., 23.36 sq. km. and 18.15 sq. km. respectively followed by bush/shrub land, cultivated land, glacier part and water bodies i.e. 17.73 sq. km., 9.86 sq. km., 4.56 sq. km. and 2.45 sq. km. respectively.

- **Gatlang:** The total area of Gatlang VDC is 132.81 out of the major area barren land, forest-land, grassland has covered major portions i.e. 65.75 sq. km., 32.28 sq. km., 16.58 sq. km.

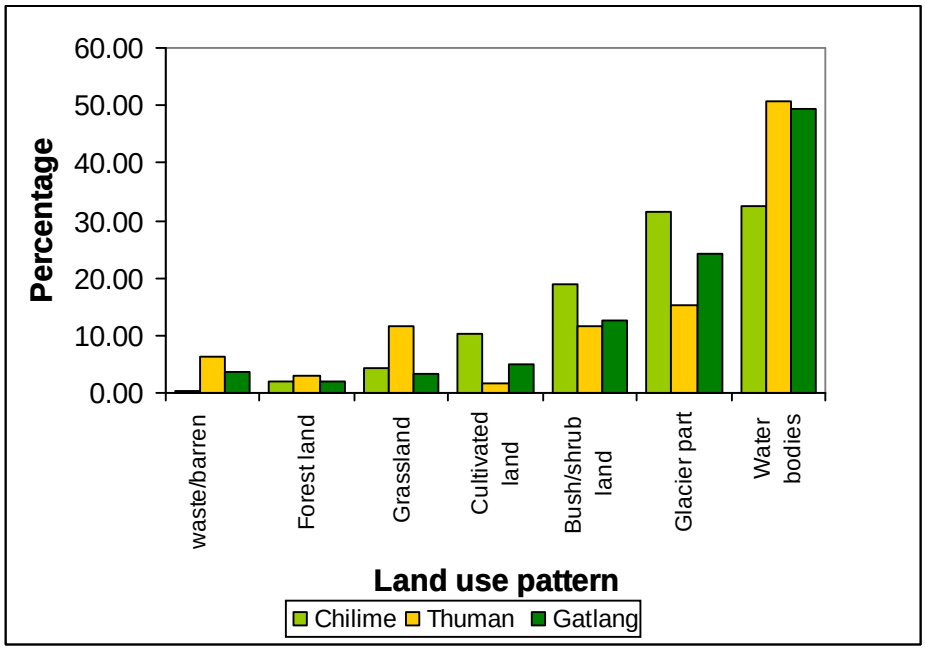
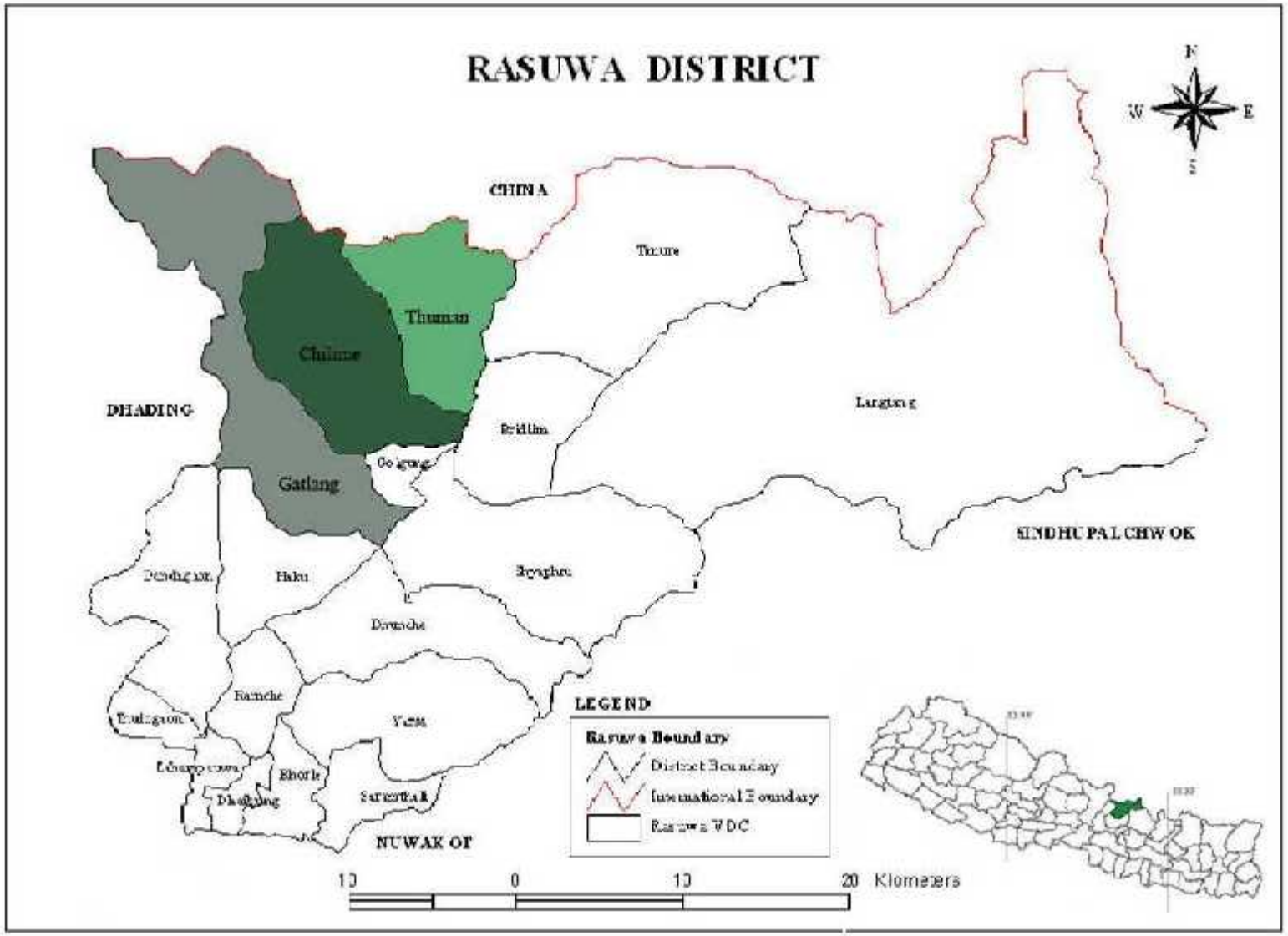


Fig 4. Land use pattern in the study area (*Source: HMG Nepal 2005*)



Map – 1. Rasuwa District highlighting Study areas

CHAPTER FOUR

4. MATERIAL AND METHODS

This research has been carried out in order to document the traditional knowledge of medicinal plants used in the study area focusing on the trade aspects and more on to the consensus of the ethnobotanical information. The following are the brief information of the research methods employed to obtain relevant data and to analyze them.

4.1 Selection of the research site

Due to time and other factors only suitable three specific study areas was chosen in the Rasuwa district. Before the data collection, the study site was selected on the basis of available information. Reconnaissance survey of the study area was undertaken in September 2006. The site was selected based on the information of the local people about accessibility, rate of exploitation and availability of plant resources especially medicinal plants. All three study area lies outside the Langtang National Park, keeping in mind that, as most of the research has been carried out in the National Park. Overall, on the basis of richness of plant diversity, extension, utilization and high trade of medicinal plants by residing community, and site outside the National park, the research site has been chosen.

4.2 Collection of Ethno botanical Information:

Ethnobotanical information was obtained primarily from the target VDCs that would be the basis for the exploratory, descriptive as well as comparative analysis of the study.

4.3 Literature Review

All the available Literature and research papers related to MAPs, status of MAPs, conservation status, dependency status, potential MAPs area and trade issues, traditional knowledge was reviewed prior to field visit so that the study could be focused clearly in the present study. Emphasis was given primarily to the literatures relating to ethno-botanical study in Rasuwa district and medicinal plants.

4.4 Methods of data collection

The primary information regarding the uses, values of plants towards the utilization pattern of plant resources were done during the empirical fieldwork in the study area. The fieldwork comprises two approaches i.e. survey technique and inventory technique (Martin, 1995; Cunningham, 2001). The survey technique included individual and in depth interviews and focus group discussion among the local plant users, community members and traditional faith healers, villager heads, traders etc. The inventory technique comprises the collection of different plant specimens from the study area and identification of their local names, part(s) used purpose of use, etc. with the participation of knowledgeable key interviewees/people as well as by transect walk (survey) with local people. So, for the collection of information, following methods were followed.

4.4.1 Field visits

The study area (Chilime, Gatlang and Thuman) was visited for four times during 2006-2007. First preliminary visit was made in September 6-13, 2006. In the first visit, survey of flora was undertaken in three VDCs in order to find out the potential MAPs area with the help of local healers and their conversational perception. The collection of plant was also done.

In the second visit, done in November 6-17, 2006, the community members were introduced about the research work. Meeting was conducted to make them familiar with the medicinal plants by showing the pictures (Display methods) and to know their knowledge about the medicinal plants, the way they use. Identification of plant materials, through displaying the plant photograph was done along with resource mapping.

In the third (May 5-15, 2007) and last visit (August 7-20, 2007), the primary information regarding plant use for selected 11 categories of ailments for the "informant consensus" was collected in three VDCs along with the information regarding the traded species. The field work comprised survey techniques by making use of questionnaire including RRA (Rapid Rural appraisal) and PRA (Participatory Rural Appraisal) among the local user, community members, healers and traders.

Photo 3. Meeting with community and resource mapping through display method at Chilime

4.4.2 Interviews and Questionnaires:

Surveys, personal interviews and group discussions as Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) were applied to reveal the specific information about traditional healing practice and ethno medicinal uses of plants (Martin 1995). The survey technique includes focus group discussion among the key informants, including local community members, local healers (*Dhami* and *Jhankri*), traders, herders, etc.

4.4.2.1 RRA (Rapid Rural Appraisal)

RRA, which is commonly described as a systematic but semi-structured activity out in the field by a multidisciplinary team and is designed to obtain new information was applied for the collection of data. It is a powerful methodology to formulate hypothesis about rural life. In this method review of secondary sources and aerial observation was done.

Data was collected with the help of questionnaire (Appendix I) by interviewing the key informants, and group interviews. Methods of cross-checking

information from displaying the plants were done. Resource mapping was also done with the help of group discussion to find the potential areas for MAPs distribution in the study areas.

4.4.2.2 PRA (Participatory Rural Appraisal)

PRA method was applied to collect information about collection, preparation and utilization of MAPs used for trade in that area. Group discussion sessions were conducted by gathering the informants having knowledge of traditional medicine practice and their use. Altogether 90-92 key persons were interviewed in three VDCs in which the female participation was least. Among 92 interviewees 50% were above the age of 50 and 50% were between the age 30-40 . People specially the herbs collectors and traders involved in trade were asked about the approximate amount of MAPs, collected and traded, market price, harvesting methods and their impacts. *Dhami* and *Jhakri* were also interviewed to obtain some information regarding the use of medicinal plants for particular diseases identified for this study.

The major objective of the PRA was to examine whether the recorded medicinal plants were used as mentioned by the local people or not, to know the correct local names, parts and forms of use and purpose of use as well as place of availability. Similarly, the plants that have already been collected in the field were shown to the people and asked different questions related to their use, diseases, distribution, habitat, vernacular name and question related to folk taxonomy and nomenclature, the same method was applied for the identification of plants in the field.

There was also the active participation of local expert group during the field visit. For the collection of the information the people were divided in different groups and separately questioned. The information obtained was crosschecked repeatedly with different groups of peoples within the community. During the time of information collection the local community user's group was enthusiastic to explain their knowledge related to the various aspects of plants.

Photo : Interview with a local healer at Thuman (*Courtesy:Aang Chiring Tamang*)

4.4.3 Specimen collection and identification

The specimen was collected from the potential areas of MAPs during the visit to different study site. During the collection, the local names were easily said by the local healers who accompanied in the field. The specimens were identified using standard botanical literatures (Hooker, 1872-1897; Hara *et al.*, 1978, 1982; Hara and Williams, 1979; Polunin and Stainton, 1987; Stainton, 1988; Rajbhandari 2001; Joshi and Joshi 2001; Grierson and Long (1983-2001). There was very limited collection due to the rare and threatened species, but they were stored in the form of pictures. The collected specimens were compared to voucher specimen at Tribhuvan University Central Herbarium (TUCH) and National Herbarium (KATH), Godawari. Each specimen were dried and mounted with standard Herbarium technique. The specimens are deposited at Tribhuvan University Central Herbarium (TUCH) which includes the most important of the total ethnomedicinal plant species.

4.4.4 Resource Mapping

Resource mapping was very important part of the study. It was done during the group discussion among the local Tamang people of different VDCs. During resource mapping they highlighted the potential area for medicinal plants that was

collected for domestic use and for trade. They also highlighted the potential medicinal plant of their area.

The Resource mapping of Thuman Village Development Committee (VDC) showed the following area as highly potential areas for MAPs. The location was Pyangtung, Jhyaung, Dupal, Jarokharka, Mishilbe, Pengdug, Meyu. Likewise the location for the Chilime was Gausang, Tetangche, Simbu, Gobre, Chupchung, Jyarsha,Garthali, and lastly for the Gatlang was Bremdang, Churtema, and surrounding areas.

4.5 Data analysis

Initially, the information about the popular uses of the species collected, along with botanical information, was compiled into a database. The information was obtained by interviewing healers and local people about the medicinal plants from all the three study areas. The information was obtained on the use, preparation, application and properties of the plants as well as descriptions of illnesses and treatments. During the survey unstructured interviews and discussions on medicinal plants and the modes of treatment were done especially to healers. The information from the healers and local people for each species were summarized. The species were listed in alphabetical order by family, popular name in the region, medicinal use, part used.

This ethnobotanical research is based on the assumption that the more often a plant is reported to be useful the more often it is going to be used. Quantifying the data by evaluating each use-report (ur) of a species which allows one to estimate the relative importance of a plant in a socio-culture. Thus, culturally important plants are those that are used by a large number of healers preferably for the same category of indigenous use, while plants that are cited as useful by only one or two informants are considered to be of low cultural importance.

Trotter and Logan (1986) developed a method based on the concept of ‘informant consensus’ (ICF) for identifying potentially effective medicinal plants that shows which groups of plants require more in-depth studies which was later readapted by Heinrich (2000). The maximum ICF value possible is 1, when there is total consensus among the informants about the medicinal plants for a given category.

They compared the total case-number for each ailment (number of informants that reported a certain illness) with the number of separate remedies for an ailment. Compared with this, 'informant consensus factor' (F_{ic}) gives the relationship between the 'number of use-reports in each category (n_{ur}) minus the number of taxa used (n_t)' and the 'number of use-reports in each category minus 1'. Fic is thus calculated using the following formula:

$$F_{ic} = \frac{n_{ur} - n_{taxa}}{n_{ur} - 1}$$

where,

n_{ur} = number of use-reports in each category
n_{taxa} = number of taxa used

In this method, the involvement of local healers is very important for the safety, while walking in the remote forest areas for the plant collection. Later on, they were asked to identify the plant along with their uses and preparation. In this research, the frequency of the mention of a medicinal plant among the healers team was used to quantify the degree of confirmation of knowledge of medicinal plants. Here the analysis of the concept of "information consensus" using the method developed by Trotter and Logan (1986) was done, because the same plant could be used by each healer to treat different symptoms.

Thus, consensus methodology provides an estimate of the importance of each plant species in traditional knowledge. The methods used for quantification of consensus of local knowledge, which is recently described in the ethnobotanical literature, assumes that respondents are interviewed independently and their reports are treated as independent observations.

At the same time this method will help us to know how homogenous the ethno botanical information is for each category, the data were quantified by adding up the individual reports on the uses of each plant. A taxon may be listed in several categories of indigenous used; however, in terms of use-reports, each plant could be considered only once per healer in a single category. This means that if one informant used a plant to treat more than one disease in the same category, we considered it as one use-report. Then the number of use-report (n_{ur}) is compared to the number of species (n_{taxa}) in each category of use. The informant consensus factor (f_{ic}) was then calculated using the following formula as given by Trotter and Logan (1986) .

$$F_{ic} = \frac{n_{ur} - n_{taxa}}{n_{ur}-1}$$

The consensus method helps in identifying important and interesting species for future to use it in various researches eg. cultural or pharmacological research.

4.6 Terminology used in this method

For the purpose of this study, a single record of use from the interviews with the local user group or local healers is termed as “use-report”. “Usage” is defined as the use of a plant to maintain or improve health (to treat specific ailments). A “usage category” is a group of usages that improves or maintains the health of a particular system.

According to Cook (1995) there are 17 usage categories but in this research out of 17, only 11 usage categories are taken for the certification of 28 commonly known usage of the study area.

These usage categories are as follows in alphabetical order:-

1. Digestive system. Disorders (DIG)
2. Endocrine system disorders (END)
3. Genitourinary System disorders (GEN)
4. Infections (INF)
5. Injuries (INJ)
6. Muscular Skeletal system disorder (MOS)
7. Nervous system disorders (NER)
8. Nutritional disorders (NUT)
9. Respiratory System disorders (RES)
10. Sensory System disorders (SEN) and
11. Skin cellular tissue disorders (SKI)

4.7 Secondary Data:

The Secondary Data were obtained from different books, research reports (both national and international) journals, documents, and articles available in central library of Tribhuvan University, library of IUCN, WWF, DNPWC, and ESON etc. The social data of the district was obtained from District Development Committee, Rasuwa.

CHAPTER-FIVE

5. RESULT

Rasuwa and its adjoining area are rich with many flora and fauna. It is one of the major areas for collection and trade of medicinal plant and other forest product in central Nepal. The place is one of the remote areas in Central Nepal and has no access to modern facilities but the people have developed their own ways of living and struggling with the environment. The people are used to retain their traditional knowledge and practices to fulfil their daily needs. A large number of plants are utilized for different purposes i.e. food supplement, medicinal purposes, fuel wood etc. (Prasai, 2007).

The questionnaire was conducted among 92 respondents in the three VDCs. The knowledge of the elders was found to be high and very low in the youngsters (Table 1). This shows that the knowledge that is transferring from generation to generation is declining day by day. The declining rate may be due to the changing time factors. The people are migrating towards the city to fulfill their daily needs, to study, to earn, and many of them are out of the country to fulfill their household needs.

Table 1: Knowledge on medicinal plants of the respondents according to age group

Age group	No of informants	Known %	Unknown %
15-25	5	5.4	94.6
25-45	40	43.5	56.5
Above 45 (72)	47	51	49

Source: Field interview

5.1 Indigenous Use of Medicinal Plants

It is clear from the study that the floral diversity of the study area is very rich, as the traditional utilization pattern of plants and its parts is very high. The utilization of plant and plant parts has begun since the evolution of human civilization. The people of this study area are also forced to utilize these natural resources due to its

remoteness, lack of modern facilities, and health post they have retained their traditional knowledge for treatment of different ailments.

The common medicinal plant that were identified from the study area are listed alphabetically with their scientific name, local named and family name in parenthesis followed by the parts used, ailments, name of place and mode of use gathered from the local people (Table 2). These species are used for the treatment of 28 different ailments. There are altogether 53 plant species of ethnomedicinal uses belonging to 33 families and 48 genera. These represent 49 species of angiosperm (42 species of dicot and 7 species of monocot) two species of gymnosperm, one species of pteridophytes, one species of fungi and one species of lichen. On the basis of their habit these plant species can be grouped into tree (7 species), herb (37 species), shrub (5 species), climber (3 species) and one fungi . Among 33 families, Ericaceae, Polygoniaceae, are the dominant families having highest number of species followed by Ranunculaceae, Liliaceae, Gentianaceae, and Compositae (Fig. 5).

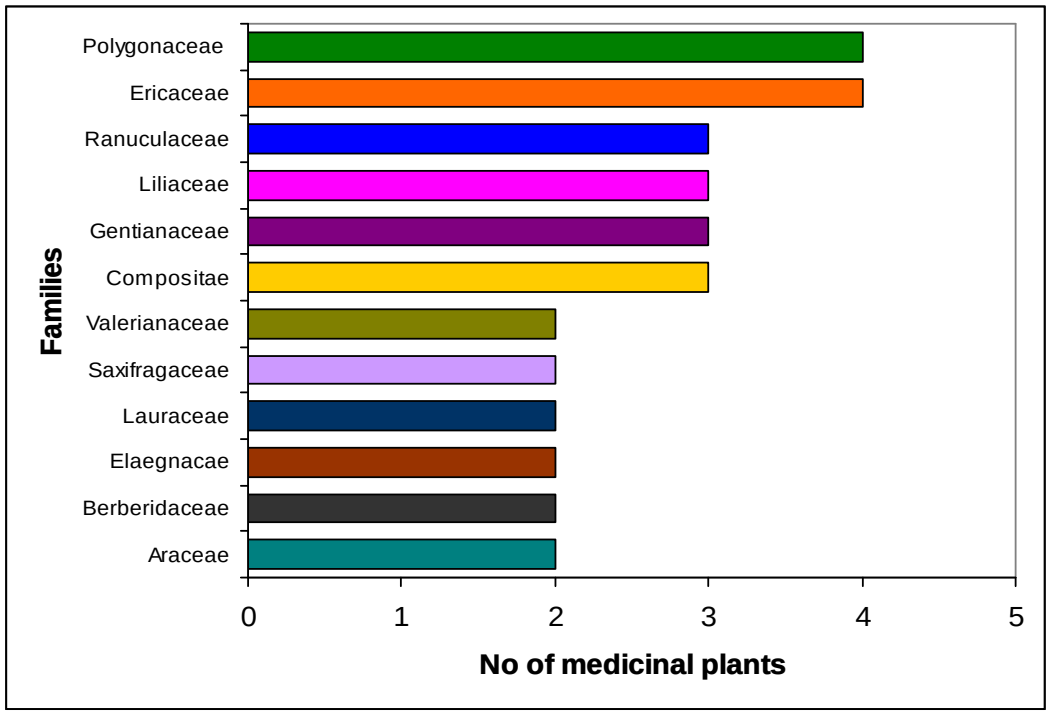


Fig. 5: Plants Species in Terms of Vegetation Type

Out of these medicinal plants *Aconitum spicatum Acorus calamus, Berginia ciliata, Cannabis sativa, Cordyceps sinensis, Cinnamomum tamala, Dactylorhiza hatagirea,* ***Delphinium himalayai, Ephedra geradiana****,* ***Juniperus recurva****,* ***Lyonia ovalifolia****, Neopicrorhiza scrophulariiflora, Rheum australe,* ***Rhodiola himalayensis****,*

Rubia manjith, Rhododendron arboreum, R. anthopogan, Swertia chirayita, Valeriana jatamansi, Vitex negundo, and Zanthoxylum armatum were especially common in three VDCs (Table 2).

The plant parts used for the medicinal preparations were root, whole plant, rhizome, tuber, bark, leaf and stem. (Table 2). The most frequently utilized plants parts (Fig. 6) are roots (38.7%) followed by stem (16.12%), and rhizomes (12.90%).

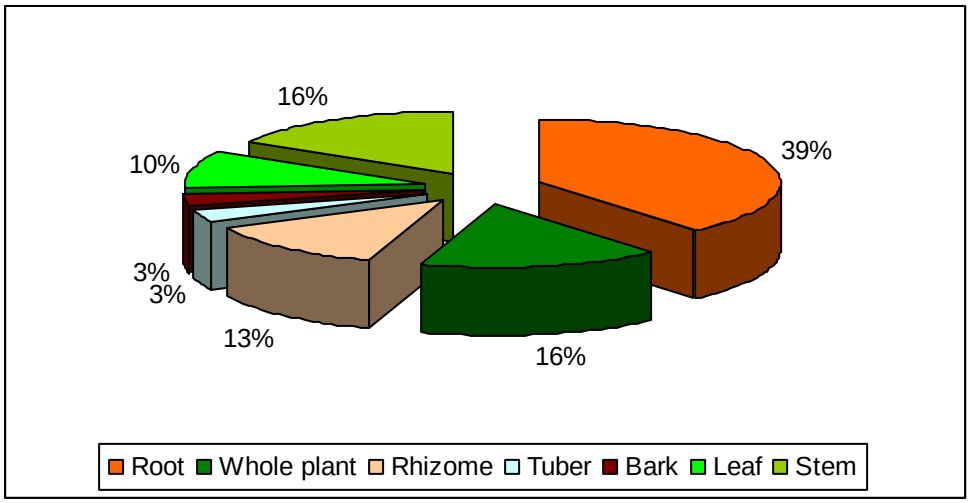


Fig. 6 : Percentage of the Plant Parts used

Table 2: Enumeration of Medicinal and aromatic plants found in three VDC of Rasuwa district.

SN	Name of Species	Local Name	Family	Pants Used	Uses	Name of Place	Mode of Use
1.	***Aconitum ferox*** Wall.ex Seringe	Bikh (T)	Ranunculaceae	Root	Uric acid, orthopaedic use	Chilime Thuman	Paste
2.	***Arisaema flavum*** (Forssk.) Schott.	Sarpako	Araceae	Root tubers, flowers	Stomach pain	Chilime, Thuman	Paste and Juice
3.	***Anaphalis contorata***(D.Don)Hook.f.	Buki phul	Compositae	Flower, leaf	Chest pain, inner bleeding	Gatlang	Juice
4.	***Asparagus racemosus*** Willd.	Kurilo komo (T), kobi (T)	Liliaceae	Root	Fermentation, diarrhoea fever tonic	Chilime, Thuman	Paste
5.	***Astilbe rivularis*** Buch.-Ham.ex D.Don	Thuloausadi	Saxifragaceae	Root/leaf	Menstrual disorder	Chilime	Paste
6.	***Aconitum spicatum*** (Bruhl).Stapf.	Bikma, Bingma (T), Nyamen (T), Bishjara (T)	Ranunculaceae	Root	Poison, joint pain and stomach Disorder of animals, Fever	3 VDCs	Juice Paste
7.	***Artemesia indica*** Willd.	Titepati, Surchent (T)	Compositae	Leaf and stem	Fever, remove tape worm	Chilime, Gatlang	Juice
8.	***Acorus calamus*** L.	Seda (T)	Araceae	Rhizome, leaf	Cough/coal, insecticide	3 VDCs	Paste
9.	***Berberis asiatica*** Roxb.ex.DC.	Chutro, Yansingba (T)	Berberidaceae	Stem	Eye pain	Chilime	Powder
10	***Berberis aristata*** DC.	Yansingba (T)	Berberidaceae	Root	Fever	Thuman	Paste
	Berberis aristata DC.	Chutro	Berberidaceae	Stem	Swelling pain	Gatlang	Paste
11.	***Bergenie ciliata*** **(Haw.) Sternb.**	Pakhanved, Brasen (T)	Saxifragaceae	Stem root	Eye pain, cut and wounds of animal	3 VDCs	Paste

12.	***Boschniakia himalaica*** Hook.&Thomson ex Hook.f.	Thomasin, kangdol (T)	Orobanchaceae	Leaf	Gastric	Gatlang	Powder
13.	***Bistorta affinis*** (D.Don) Greene	Muakui (T)	Polygonaceace	Root leaf	Diarrhoea/ dysentery	Chilime	Paste
14.	***Cannabis sativa*** L.	Wang, Sima ganja (T)	Cannabaceae	Stem	Stomach pain	3 VDCs	Raw
15.	***Cordyceps sinensis*** (Berk.) Sace	Yarshagumba	Hypocereaceac	Whole plant	Tonic	3 VDCs	Juice/ Paste
16.	***Cinnamomum tamala*** (Buch.-Ham.) Nees &Eberm.	Singding (T)	Lauraceae	Leaf bark	Vomiting	3 VDCs	Paste
17.	***Dactylorhiza hatagirea*** (D.Don) Soo	Ompolakpa (T)	Orchidaceae	Root tubers	Heal wounds, cuts and burns, stomach pain	3 VDCs	Paste
18.	***Delphinium himalayai*** Munz	Bongmar (T), Nirmansi	Ranuculaceae	Root	Fever, headache, cough/cold	3 VDCs	Paste
19.	***Dioscorea deltoidea*** Wall.ex.Griseb.	Bhyakur	Dioscoreaceae	Root	Worm	Thuman	Paste
20.	***Ephedra geradiana*** Wall.ex.Stapf.	Somlata	Ephedraceae	Stem	Asthma	3 VDCs	Juice
21.	***Entada rheedei*** **Spreng.**	Pangram (T)	Mimosaceae	Whole plant	Pain relief of bone	Gatlang	Paste
22.	***Eupatorium adenophoum*** Spreng.	Banmara	Compositae	Leaf	Cuts/wounds	Gatlang	Juice
23.	***Fraxinus folribundan*** Wall.	Kipsil (T)	Oleaceae	Leaf	Body pain	Chilime Thuman	Juice
24.	***Frittelaria cirrhosa*** D. Don	Kakoli, bimo (T)	Liliaceae	Whole plant	Gastric/ stomach pain	Chilime	Paste
25.	Pteris biaurita L.	Ratounyu	Asclepediaceae	Root	Aaunpareko	3 VDCs	Paste
26.	***Geranium*** sp.	Gurije, sangmen (T)	Geraniaceae	Root	Cuts/ wounds	Gatlang	Paste
27.	***Gentiana capitata*** Buch.-Ham. ex	Pangennomta (T)	Gentianaceae	Whole plant	Poisoning and diarrhoea	Gatlang	Paste

	D.Don						
28.	***Hippophae salicifolia*** D.Don	Dalaechuk	Elaegnacae	Fruits	Cough, gastric, women menstrual disorder	Gatlang Chilime	Paste
29.	***Hippophae tibetana*** Schtdl.	Taru (T)	Elaegnaceae	Fruits	Diahorrea	Thuman	Paste
30.	***Juglens regia*** L..	Okhar	Juglandaceae	Nuts	Body fresh-up	Thuman Gatlang	Juice
31.	***Juniperus recurva*** Buch.-Ham ex D.Don.	Sukpa (T)	Cupressaceae	Fruits	Throat pain	3 VDCs	Juice
32.	***Lindera nessiana*** (Wall ex Nees) Kurz.	Kurum (T)	Lauraceae	Seed	Diahorrea	Thuman	Juice
33.	***Lonicera myrtillus*** Hook. f. &Thomson	Taktak (T)	Caprifoliaceae	Root	Fever	3 VDCs	Paste
34.	***Lyonia ovalifolia*** (Wall.) Drude	Tamasing (T)	Ericaceae	Leaf	Boils and wounds	3 VDCs	Paste
35.	***Momordica charantia*** L.	Bankarela	Cucurbitaceae	Fruit	Fever/skin disease	Thuman	Raw
36.	***Myrica esculenta*** Buck.-Ham ex D.Don	Namin (T)	Myricaceae	Bark	Heart disease	Thuman Chilime	Paste
37.	***Nardostachys grandiflora*** DC.	Pangpe (T), lahpe jatamanin	Valerianceae	Rhizome leaves	Headache, high altitude sickness	Gatlang	Paste
38.	***Neopicrorhiza scrophulariiflora*** (Pennell) Hong	Kutki	Scrophulariaceae	Rhizome Root	Fever, Cough Cold	3 VDCs	Juice
39.	***Paris polyphylla*** Smith	Satuwa, Kalchung (T)	Liliaceae	Root	Fever, Vomiting, Worms	Chilime	Paste
40	***Pieris formosa*** (Wall.) D. Don	Prapra (T)	Ericaceae	Leaf	Headache	Gatlang	Juice
41.	***Potentilla pendicularis*** D. Don	Bajradanti,Sangmen (T)	Rosaceae	Root	Gastric	Gatlang	Paste
42.	***Rheum australe*** D. Don	Padamchal, Chhurcha (T)	Polygonaceae	Root	Body pain relief,	Chilime, Gatlang	Paste

					Diarrhoea/fracture		
43.	***Rhodiola himalensis*** (D. Don) Fu	Mahaguru	Crassulaceae	Root	Fever stomach pain	3 VDCs	Paste
44.	***Rubia manjith*** Roxb.ex Fleming	Tiru (T), Majitho	Rubiaceae	Root	Scabies/ Skin Disease	3 VDCs	Paste
45.	***Rumex nepalensis*** Spreng	Halhale, Allpibi (T)	Polygonaceae	Root	Fracture of animals	Thuman	Paste
46.	***Rhododendron arboreum*** Sm.	Paramendo (T)	Ericaceae	Flower	Tonic	3 VDCs	Paste
47.	***Rhododendron anthopogan*** D. Don.	Sunpati	Ericaceae	Flower	Cause high altitude, High altitude sickness	3 VDCs	Juice
48.	***Swertia chirayita (***Roxb.ex Fleming) Karsten	Chiraito, Timda (T)	Gentianaceae	Whole Plant	Fever, headache	3 VDCs	Juice
49.	***Swertia multicaulis*** D. Don	Sarmaguru (T)	Gentianaceae	Whole plant	Fever, cut/wounds headache	3 VDCs	Paste
50.	***Taxus wallichiana*** Zucc.	Silding (T)	Taxaceae	Stem/leaf	Stimulant, Respiratory relief	3 VDCs	Paste, Juice
51.	***Valeriana jatamansi*** Jones.	Sugandhawal, Lungbe (T)	Valerianaceae	Rhicome	Cough/cold, Throat pain	3 VDCs	Paste
52.	***Vitex negundo*** L.	Simali	Verbenaceae	Seed	Worms relief	3 VDCs	Paste
53	***Zanthoxylum armatum*** DC.	Promo (T), Timur	Rutaceae	Fruit	Gastric	3 VDCs	Paste

5.2 Status and Distribution of Medicinal Plants

During the field visit, survey was also done to find the distribution pattern of MAPs around the study area. The most abundant species were *Lichen sp.* 60% and *Swertia chirayita* 53% but the distribution pattern of *Gerardiana diversifolia*, *Michelia champaca* and *Zanthoxylum armatum* was found to be very low (Table 3).

The categorization of high and low was done on the basis of community perception with the local people of the study area. When the species was found in maximum number they were indicated as high availability (H), and in case of species with very few numbers they were indicated as low availability (L). Comparison of the availability of MAPs in each VDCs showed that, the Tetangche of the Chilime VDC covered the highest percentage 67% (Table 3) of species. According to the local people, there is high distribution of *Aconitum ferox, Acorus calamus, Bergenia ciliata, Gerardiana diversifolia, Juniperus recurva, Nardostachys grandiflora, Rheum australe, Rhododendron* sp., *Rubia manjith* and *Swertia chirayita.* The overall comparison of three VDCs showed that the Chilime VDC bears the highest distribution for MAPs i.e. rich in floral diversity.

The inventory was done in all the three VDCs and found that the potentiality of MAPs was very much abundant in Tetangche of Chilime VDC in comparison to other two VDCs (Fig.7). From the survey it was found that the highest frequency of the species were of *Nardostachys grandiflora, Swertia chirayita, Neopicrorhiza scrophulariiflora* followed by *Paris polyphylla, Daphne bhoula,* etc. This shows that the data collected from the local people in finding out the potential area for the distribution of MAPs is relevant and similar with the information obtained from resource mapping.

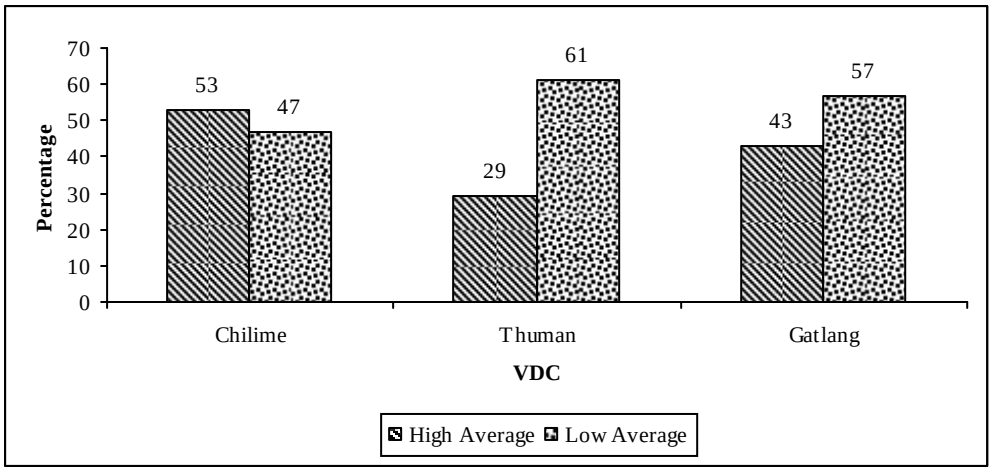


Fig. 7: Abundance of Medicinal Plant in Different VDCs

Table 3: Availability of Medicinal Plant through Resource Mapping

S.N.	Place	Chilime					Thuman					Gatlang					Total		
		Chupchung	Tetanghe	Simbu	Gaisang	Garthali	Jorokharka	Belepsang	Dupaal	Misilbe	Meyu	Ridar	Lumbri	besi	Bhayang	Pengdube	High	Low	% of High
1	*Aconitum Spicatum*	L	H	H	L	L	L	L	H	H	L	H	L	L	L	L	5	10	50
2	*Acorus calamus*	L	H	L	L	L	L	L	H	L	L	L	L	L	L	H	3	12	20
3	*Bergenia ciliata*	L	H	L	H	L	H	H	L	L	L	H	L	L	L	L	5	10	50
4	*Dactylorhiza hatagiera*	L	L	L	H	H	H	L	L	L	L	L	L	L	L	L	3	12	20
5	*Delphinium himalayai*	L	L	H	L	L	H	L	H	L	L	L	L	H	L	L	4	11	27
6	*Gerardiana diversifolia*	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	1	14	7
7	*Juniperus recurva*	H	H	L	L	L	L	L	H	L	L	L	H	L	L	L	4	11	27
8	*Michelia champaca*	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	1	14	7
9	*Nardostachys grandiflora*	L	H	H	H	H	H	L	L	L	L	L	L	L	L	L	5	10	50

10	*Neopicrorhiza scrophulariiflora*	L	L	L	L	H	H	L	L	L	L	L	H	L	L	L	3	12	20
11	*Rheum australe*	H	H	L	H	H	H	L	L	L	L	L	L	L	L	L	6	9	40
12	*Rhododendron anthopogan*	H	H	L	L	H	L	L	L	L	L	L	L	L	L	L	3	12	20
13	*Rubia mangith*	H	H	L	L	L	L	H	L	L	L	H	H	H	L	L	5	10	50
14	*Swertia chirayita*	H	H	H	H	H	H	L	L	L	H	L	L	L	L	L	8	7	53
15	*Valeriana jatamansii*	L	L	L	H	H	H	L	L	L	L	L	L	L	L	L	3	12	20
16	*Paris Palyphylla*	L	L	L	H	L	L	L	L	H	L	L	L	L	L	L	3	12	20
17	*Zanthoxylum armatum*	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	1	14	7
18	*Lichen sp.* (Parmelia)	H	H	H	L	L	H	H	L	L	H	L	H	H	H	L	9	6	60
		6	12	5	8	7	9	3	4	2	3	4	2	5	1	1			
		33%	**67%**	27%	44%	39%	50%	17%	22%	10%	17%	10%	27%	6%	6%	6 %			
		High Average 53%					High Average 29%					High Average 43%							
		Low Average 47%					Low Average 61%					Low Average 57%							

5.3 Indigenous Knowledge and Consensus

The indigenous people of the study areas have traditional beliefs, taboos or avoidances, which are practiced by them for conservation and preservation of the biological resources with their sustainable use. The people live in close vicinity of forests and have several beliefs and myths related to their ambient vegetation. Many beliefs associated with the plants have a significant influence on the management of plant resources. Since, the communities are mainly the traditional type of community depending on agriculture and forest resources for their livelihood and daily needs from their environment.

Initially, the enumeration of medicinal plant from three VDCs, Chilime, Thuman and Gatlang was done followed by quantitative ethnomedicinal comparison using Trotter's and Logan's (1986) "Informant consensus factor". From the enumerated species a total of 45 species belonging to 28 families and 42 genera were identified (Table 4) to be used to treat various ailments selected for consensus.

Table 4: Major categories of use (DIG to SKT) and the number of medicinal plant species used for each specific usage.

SN	Specific usage	No of MAPs	Medicinal plant species used	Family	Habit
1	**Digestive system disorder (DIG) - 20**				
	Vomiting	**2**	*Cinnamomum tamala*	Lauraceae	T
			Paris polyphylla	Liliaceae	H
	Constipation/Gastric	**5**	*Boschniakia himalaica*	Orobanchaceae	H
			Frittelaria cirrhosa	Liliaceae	H
			Hippophae salicifolia	Elaegnaceae	S
			Potentilla peduncularis	Rosaceae	H
			Zanthoxylum armatum	Rutaceae	S
	Diarrhoea	**5**	*Asparagus racemosus*	Liliaceae	H
			Bistorta affinis	Polygonaceae	H
			Gentiana capitata	Gentianaceae	H
			Lindera nessiana	Lauraceae	T
			Rheum australe	Polygonaceae	H
	Dysentry	**1**	*Bistorta affinis*	Polygonaceae	H

			Fern spp.	Asclepidiaceae	H
	Worm	**3**	*Vitex negundo*	Verbenaceae	H
			Dioscorea deltoidea	Dioscoreaceae	C
			Artemesia indica	Compositae	H
	Stomach pain	**5**	*Arisaema flavum*	Araceae	H
			Aconitum spicatum	Ranunculaceae	H
			Connabis sativa	Cannabaceae	H
			Dactylorhiza hatagiva *Frittelaria cirrhosa*	Orchidaceae Liliaceae	H H
2	**Endocrine system Disorders (END) - 1**				
	Diabetes	**1**	*Taxus wallichiana*	Taxaceae	T
3	**Genitourinary System disorders (GEN) - 4**				
	Menstrual disorder	**3**	*Astilbe rivularis*	Saxifragaceae	H
			Hippophae salicifolia	Elaegnaceae	S
			Bergenia ciliata	Saxifragaceae	H
	Inner bleeding	**1**	*Anaphalis contorta*	Compositae	H
4	**Infection (INF) - 14**				
	Fever	**12**	*Asparagus racemosus*	Liliaceae	H
			Momordica charantia	Cucurbitaceae	C
			Aconitum spicatum	Ranunculaceae	H
			Neopicrorhiza scrophulariiflora	Scrophulariaceae	H
			Artemesia indica	Compositae	H
			Paris polyphylla	Liliaceae	H
			Berberis aristata	Berberidaceae	S
			Rhodiolo himalayensis	Crassulaceae	H
			Delphinium himalayai	Ranunculaceae	H
			Swertia chirayita	Gentianaceae	H
			Lonicera myrtillus	Caprifoliaceae	S
			Swertia multicaulis	Gentianaceae	H
	Infection	**1**	*Acorus calamus*	Araceae	H
	Swelling	**1**	*Dioscorea deltoidea*	Dioscoreaceae	C
5	**Injuries (INJ) - 5**				
	Burns	**1**	*Dactylorhiza hatagirea*	Orchidaceae	H
	Cuts	**4**	*Bergenia ciliata*	Saxifragaceae	H
			Swertia multicaulis	Gentianaceae	H
			Eupatorium adenophorum	Compositae	H

			Geranium sp.	Geraniaceae	H
6	**Muscular-Skeletal System Disorders (MUS) - 2**				
	Fracture	**2**	*Rumex nepalensis*	Polygonaceae	H
			Aconitum spicatum	Ranunculaceae	H
7	**Nutritional Disorders (NUT) - 2**				
	Loss of appetite/ Tonic	**2**	*Cordyceps sinensis*	Hypocereaceae	P
			Rhododendron arboreum	Ericaceae	T
8	**Nervous System Disorders (NES) - 5**				
	Headache	**5**	*Delphinium himalayai*	Ranunculaceae	H
			Swertia multicaulis	Gentianaceae	H
			Swertia chirayita	Gentianaceae	H
			Pieris Formosa	Ericaceae	S
			Nardostachys grandiflora	Valerinaceae	H
9	**Respiratory System Disorder (RES) - 7**				
	Cough	**5**	*Acorus calamus*	Araceae	H
			Delphinium himalyai	Ranunculaceae	H
			Hippophae salicifolia	Elaegnaceae	S
			Neopicrorhiza scrophulariiflora	Scrophulariaceae	H
			Valeriana jatamansii	Valerinaceae	H
	High altitude sickness	**2**	*Rhododendron anthopogan*	Ericaceae	S
			Nardostachys grandiflora	Valerinaceae	H
10	**Sensory System Disorder (SEN) - 2**				
	Eye Pain	**2**	*Berberis asiatica*	Berberidaceae	S
			Bergenia ciliata	Saxifragaceae	H
11	**Skin cellular Tissue Disorder (SKI) - 2**				
	Allergy	**1**	*Rubia manjith*	Rubiaceae	C
	Boils	**1**	*Lyonia ovalifolia*	Ericaceae	S

On the basis of their habit these plant species can be grouped into tree (4 species), herb (29 species), shrub (8 species), climber (3 species) and parasite (1 species) (Table 4; Fig. 8). Among 32 families, Ericaceae, is the dominant family having highest number of species followed by families like Polygonaceae Liliaceae, Gentianaceae, and Compositae (Fig. 9).

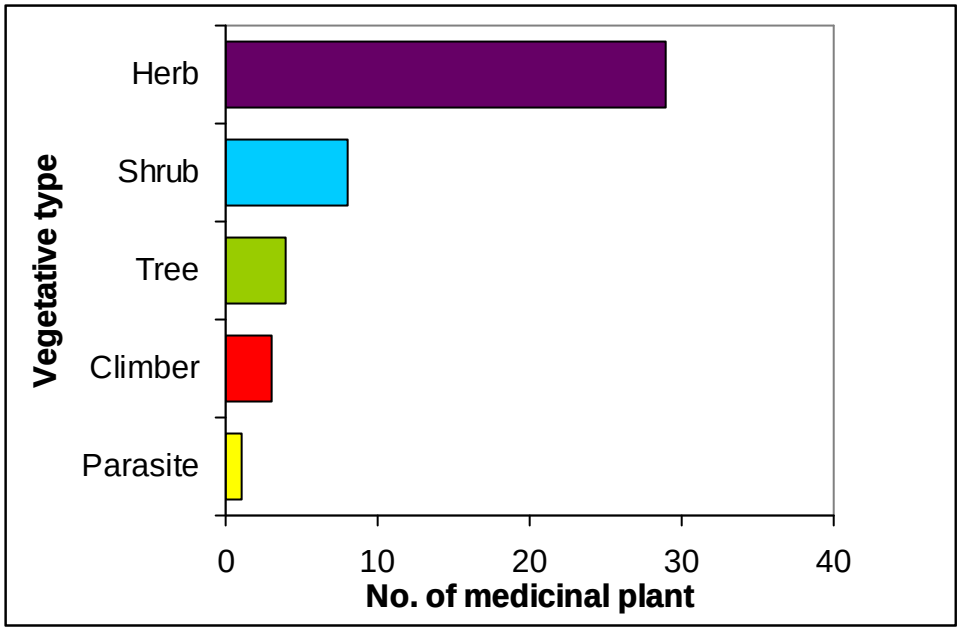


Fig. 8: Plants Species in Terms of Vegetation Type

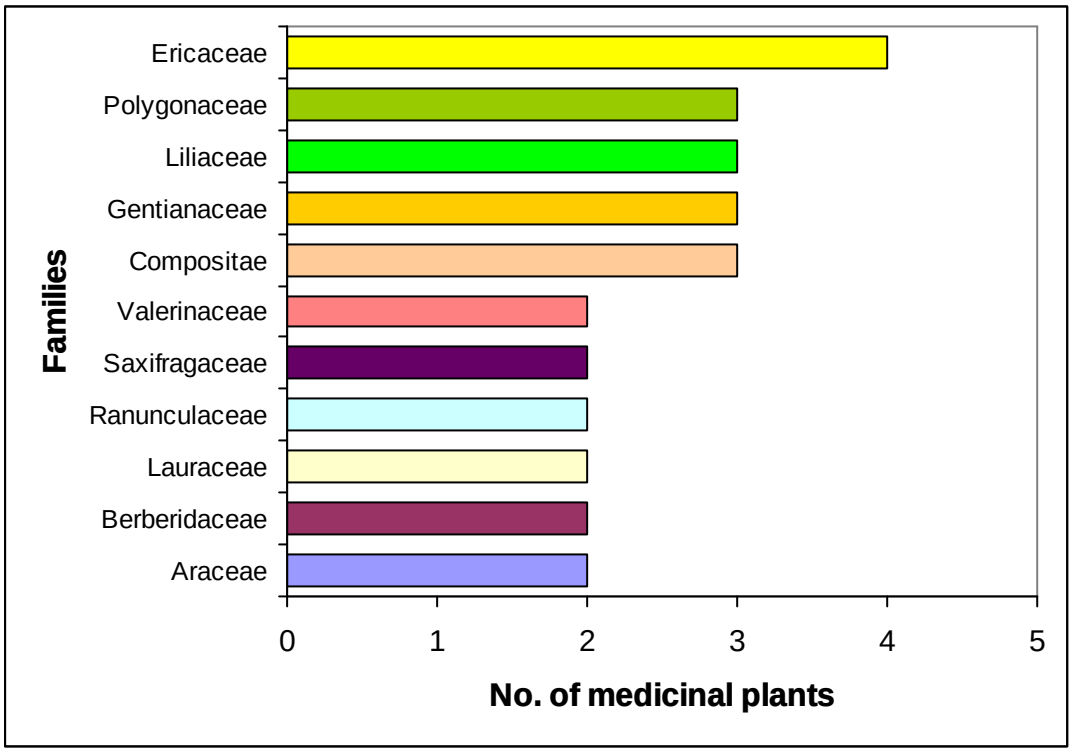


Fig.9: Most Frequent Plant Families among 48 Medicinal Plants

The data related to the consensus was collected in several visits .Out of the total medicinal plants (53 species), 45 species belonging to 30 families and 43 genera

were reported from the study area. The plants that were used for the treatment of different ailments were categorized into 11 categorizes. In some cases, specific mentions of the plant species were not included to respect the 'informants' wishes not to have this information to be made public. The number of mentions in each usage category (n_{ur}) and the number of taxa used in each usage category was collected in three VDCs. There was overlapping of many common species used in several mentions in different study area.

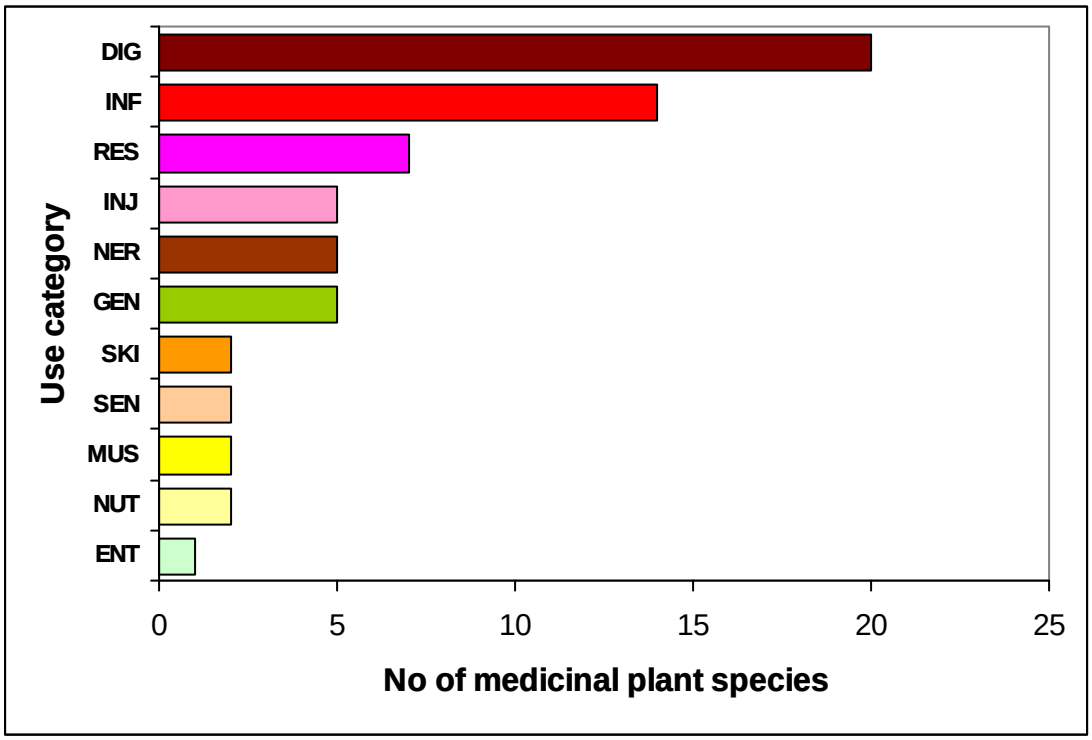


Fig.10. Distribution of medicinal plant species among the 11 usage categories. Those designated ‘‘high frequency’’ include ‘‘digestive system disorders’’ (DIG), ‘‘infections’’ (INF), and ‘‘respiratory system disorders (RES)’’.

Figure 10 shows the number of medicinal plant species used for each of the usage categories. The usage category distribution reveals the type of usages that were of most concern in the study areas. The first category ‘‘digestive system disorders’’ (DIG) makes up the ‘‘high frequency’’ usage category. The ‘‘infections’’ (INF) and the ‘‘respiratory system disorders’’ (RES), categories also are quite frequent followed by ‘‘injuries’’ (INJ), ‘‘nervous system disorders’’ (NER) and ‘‘genitourinary system disorders’’ (GEN). While other use categories like ‘‘skin/subcutaneous cellular tissue disorders’’ (SKI), ‘‘sensory system disorders’’ (SEN), ‘‘muscular-skeletal system disorders’’ (MUS), ‘‘nutritional disorders’’ (NUT), and "endocrine system disorders"

(ENT) are of ‘‘medium or low frequency’’ categories. From this it can be assumed that the usage categories which received the highest number of mentions are the most prevalent in the communities and also of the greatest importance to people living in the villages of the study area.

Table 4 shows the specific usages, which are listed under their corresponding usage category with the number of medicinal plant species used to treat them. A summary of major aliments (Table 5) with no of medicinal plant species being used and usages that were mentioned more often by the people and healers. The common disease that occurred quite frequently in the study area are found to be fever, constipations, dysentery, diarrhoea, cough, allergy and cut as they are mentioned by the healers and the local people. To take the analysis to the level of disease category the informant's consensus factor (Fic) was calculated for each category (Table 5). In this case, 7 of the 11 categories show a factor > 0.75 which represents a high level of consensus. As the maximum ICF value possible is 1, when there is total consensus among the informants about the medicinal plants for a given category.

Table 5: Informants consensus factor (F_{ic}) for each category of uses.

SN	Usage category (group of illness)	No. of Taxa	No. of Use reports	F_{ic}.
1.	Endocrine system disorders (END)	1	1	0
2.	Infection (INF)	14	34	0.60
3.	Genitourinary system disorders (GEN)	5	11	0.60
4.	Nervous system disorders (NER)	5	14	0.69
5.	Nutritional disorders (NUT)	2	5	0.75
6.	Digestive system disorder (DIG)	20	80	0.75
7.	Injuries (INJ)	5	19	0.78
8.	Muscular–skeletal system disorder (MUS)	2	10	0.88
9.	Respiratory system disorders (RES)	7	48	0.87
10.	Sensory system disorder (SEN)	2	14	0.92
11.	Skin tissue cellular disorder (SKI)	2	16	0.93

5.4. Collection and Trade

Medicinal plants are widely harvested for local use as well as for trade both inside and outside the country. About 65% of the total collections are exported to

India (Chaudhary, 1998). The value of Nepal's non-timber forest products is large, but the potential of value adding opportunities is largely unrealized. It is important because of their value as a perennial source of income to the society and to conserve biodiversity (Chaudhary, *et al.* 2001). Since the time of immemorial trade of MAPs has being a traditional occupation with the involvement of rural people in collection and sale. It is not only supporting the household economy of collectors but also the middlemen and wholesalers (Kunwar and Duwadee, 2006). According, to many informants some illegal trade practices are also found through northern border of Tibet, as the northern part of all the three study area of the Rasuwa district lies attached to the Tibetian border.

Besides the use of medicinal herbs for the treatment of local health care, some of the species that are of high commercial value are in trade in the area. From the general survey through PRA, RRA and interview with the healers, local people and traders, a list of highly traded species was obtained (Table 6). Among the traded species *Neopicrorhiza scrophulariiflora, Delphinium denudatum, Lichen sp., Swertia chirayita* and *Nardostachys grandiflora* are the top five species collected by almost every household of the study area. *Rhododendron anthopogon* is the least collected species. Medicinal herbs, thus, contributes a lot to the upliftment of the economic condition of the local people at the study areas.

Photo : Local people selling *Swertia chirayita* to local trader at Chilime

Nardostachys grandiflora

Swertia chirayita

Neopicorrhiza scrophulariiflora

***Aconitum* sp.**

***Lichen* sp.**

Out of the 25 species reported in trade 14 species which are highlighted and marked with * in Table 6 and 7 are those species which have been found to be highly used for the treatment of various ailments selected for consensus as well. This shows that the exploitation of medicinal plant is very high in the study area both by the collection for trade as well as for the use of domestic purpose..

Table 6: Highly Traded Medicinal Plants

S.N	Botanical name	Name of MAPs	Family	Tamang name	Parts used
1	***Aconitum spicatum**	Bisma	Ranunculaceae	Bingma	Root
2	*Acorus calamus*	Bojo	Araceae	Seda	Rhizome
3	*Asparagus racemosus*	Kurilo	Liliaceae	Ralima	Root
4	***Berginia ciliata**	Pakhanveda	Saxifragaceae	Brajimendo	Stem
5	*Boschniakia himalaica*	Gamdoljara	Orobanchaceae	Gamdol	Root
6	*Cinamomum tamala*	Tejpat	Lauraceae	Pachyar	leaf
7	***Cordyceps sinensis**	Yarsagumba	Hypocreaceae		Whole plant
8	***Dactylorhiza hatagirea**	Paanchaule	Orchidaceae	Wangpalampo	Tuber
9	*Daphne bholua*	Lokta	Thymelaceae	Syo-syo	leaf
10	***Delphinium dedatum**	Nirmansi	Ranunculaceae	Bongmar	Root
11	*Ephedra gerardiana*	Somlata	Ephedraceae	Chhebungba	Stem
12	*Frittelaria cirrhosa*	Bomo	Lilaceae	Bimo	Root
13	*Juniperus recurva*	Dhupi	Cupressaceae	Suppa	leaf
14	*Lichen*	Jhyau		Pe	Whole plant
15	***Nardostachys grandiflora**	Jatamansi	Valerianaceae	Pangpe	Rhizome
16	***Neopicorrhiza scrophulariiflora**	Kutki	Srophulariaceae	Kutki	Rhizome
17	***Paris polyphylla**	Satuwa	Liliaceae	Kalchung	Root
18	***Rhododendron anthopogan**	Sunpati	Ericaceae	Warrlu	Flower
19	***Rheum australe**	Padamchaal	Polygonaceae	Chyungparin	Root
20	***Rhodiola himalayensis**	Sarmaguru	Crassulaceae	Sarmaguru	Root
21	***Rubia manjith**	Majitho	Rubiaceae	Tiru	Root
22	***Swertia chirayta/S. multicaulis**	Chiraito	Gentianaceae	Timda	Whole plant
23	*Taxus wallichiana*	Lothsalla	Taxaceae	Singing	Stem
24	***Valeriana jatamansi**	Sughandawaal	Valerianaceae	Lungbe	Rhizome
25	*Zanthoxylum armatum*	Timur	Rutaceae	Promo	Fruit

Similarly, while comparing the collection of MAPs in the three VDCs, the people from Chilime is highly involved in the collection followed by Gatlang and least collection is done in Thuman. The local people of Chilime are highly activate in the collections of MAPs that goes in trade in comparison to other two VDCs. From this, it becomes clear that people from Chilime VDC are highly dependent on MAPs to raise their economic status then other two VDCs (Table 7).

Table 7: Number of household of three VDCs involved in collection of medicinal plants

S.N.	Botanical Name	Tamang Name	Family	No. of household engaged in the collection of MAPs			
				Chilime Total household 325	Gatlang Total household 325	Thuman Total household 325	Total
1	***Aconitum Spicatum***	Bikma, Bisma	Ranuculaceae	45	5	5	55
2	*Acorus calamus*	Seda	Araceae	55	4	3	62
3	***Bergenia ciliata***	Brajimendo	Saxifragaceae	40	12	5	57
4	***Delphinium himalayai***	Gamdol	Orobanchaceae	35	-	-	35
5	***Dactylorhica hatagiera***	Ompolakpa	Orchidaceae	52 (illegal)			52
6	*Daphne Bholua*	Syo-Syo	Thymelaecaceae	42	15	5	62
7	***Delphinium dedatum***	Bongmar	Ranunculacceae	51	12	8	71
8	*Gerardiana diversifolia*	Pachyar	Urticaceae	38	12	2	52
9	*Juniperus recurva*	Suppa	Cupressaceae	-	-	-	-
10	*Lichen sp.*	Pe		48	15	8	71
11	***Nardostachys grandiflora***	Pangpe	Valerianaceae	60	2	5	67
12	***Neopicrorchiza scrophulariifolia***	Kutki	Scrophulariaceae	58	14	3	75
13	***Paris polyphylla***	Kalchung	Liliaceae	40	-	-	40
14	***Rheum allustrale***	Chyungparin	Polygonaceae	48	-	-	48
15	***Rhododendron anthopogan***	Warrlu	Ericaceae	40	-	-	40
16	***Rubia mangith***	Tiru	Rubiaceae	45	14	5	64
17	***Swertia Chirayita***	Timda	Gentianaceae	51	12	8	71
18	***Valeriana jatamansi***	Ungbe	Valerianaceae	58	0	0	58
19	*Zanthoxylum armatum*	Promo	Rulaceae	-	-	-	-
				Average 43 household	Average 7 household	Average 3 household	Average 52 household

CHAPTER-SIX

6. DISCUSSION

6.1 Indigenous Use of Medicinal Plant

The study areas has unique type of plant diversity inhabiting from subtropical zone to alpine zone (Shrestha and Shrestha 2007). People here have retained their traditional knowledge and practices to fulfill their daily needs. During several field visits the traditional knowledge relating to ethnomedicinal purpose was collected from the study area i.e. Chilime, Gatlang and Thuman.

This study has identified a total of 53widely used medicinal plant species belonging to 33 families and 48 genera used for different medicinal purposes. The analysis of information and data reveals that more than 25 different types of diseases/disorders are treated and cured by using these 53 medicinal plant species, either in single form or in mixed complex form. The disease which seems to occur most frequently in the study area is fever, stomach-ache, gastric, vomit, cuts/wounds, diarrhoea/dysentery, eye infection. The mode of use is paste in high percentage and root is the plant part which is frequently used.

There were many overlapping of the use of plant species for same ailments in the three VDCs but in some cases the use value in three VDC was uncommon, for e.g. in Chilime and Thuman, *Aconitum spicatum* was used to treat the joint pain and stomach disorder of animal but the same plant in Thuman was used for the treatment of fever. Treating this species for fever is similar with the findings of Prasai (2007) done inside the Langtang National Park.

Likewise the use of *Berberis aristata* for the treatment of fever in Thuman and the use of same plant for the treatment of swelling pain in Gatlang also varied. Comparing the usage pattern of this plant in the western Nepal Dang shows that the root bark is used for malarial fever and stem-bark for eye, infection (Acharya, 1996; Bhattarai, 1992a; Coburn 1994; Manandhar, 1991). Similarly, the nuts of *Juglans regia* which is known as "Tangsarkado" is used to freshen up the body (for refreshment) while in Karnali zone stem bark of it is used for anthelmintic property

and in Makwanpur district, stem-bark is used 'in toothache. (Bhattarai, 1991, 1992 a&b; Pohle, 1990). The fruits of *Juniperus recurva* are used in throat pain in the study area but according to Kirtikar and Basu (1980), smoke from green wood is powerful emetic that produces long and continued vomiting, so all three information can be considered as new information.

From the enumeration data, it clearly indicates that local people have been using wild plants for fulfilling their subsistence needs and treating diseases since time immemorial. Highest number of species has contributed in treating or healing various ailments. Especially, the plants listed in the table have played an integral role for the rural community (Kunwar *et al.* 2006). Since, the rural community of Himalaya are far away from hospitals they still practice towards the utilization of natural resources.

The observations from the present survey need to be substantiated with pharmaco-chemical studies in order to evaluate the effectiveness of herbs and preparations used. However, there is evidence in the literature that the mode of use by the local people is likely to be effective for some species. Application of *Berberis asiatica* root extract in eye infection coincides to the pharmaco-chemical properties because of the berbamine (Sabir and Bhide, 1971). The wide application of *Acorus calamus* in cough/cold might be due to presence of ethanolic extract in stem and rhizome (Devkota *et al.* 1999).

6.2 Status and Distribution of MAPs

Rasuwa being a mountainous district, is a least developed and remote area which lies in the central part of Nepal. It has high altitudinal variation from sub-alpine to alpine leading to the distribution of various floras within it. Medicinal and aromatic plant survey had been carried out in different areas of Langtang National Park, but this study was performed outside the park area.

During the study, conversation perception with the local community members was made to identify the highly potential area for the distribution of MAPs, through the tool of resource mapping. In the other hand, field survey was also done for the confirmation of the data obtained. According to the local community and healers of three VDCs, Chilime was found to bear the highest distribution of MAPs in

comparison to the other two VDCs i.e. Thuman and Gatlang that coincided, with the field visit.

In all the three areas there is very high distribution of medicinal plants mainly like *Neopicrorhiza scrophulariiflora, Swertia chirayita, Valeriana jatamansi, Bergenia ciliata, Nardostachys grandiflora, Paris polyphylla, Dactylorhiza hatagirea, Delphinium denudatum* and *Aconitum* sp. which is abundant in Tetangche of Chilime. The reason might be the climatic factor and physiography. There is a high rainfall in Chilime in comparison to the other two VDC. The Chilime VDC lies in between the north eastern and north western slope and its land pattern is of rocky type. This rocky type of land has led to the growth of many medicinal plants like *Neopicrorhiza scrophulariiflora, Swertia chirayita, Berginia ciliate,* etc. But there is less area for the cultivation purpose because of the steep slope.

Chilime VDC lies in between the north eastern and north western slope and Thuman and Gatlang in Eastern slopes. Because of this physiography there is heavey rainfall occurring in Chilime VDC then in compassion to other two VDCs, But, there is less area for the cultivation purpose because of the steep slope. These might be the reason for the high distribution of MAP in Chilime area.

6.3 Indigenous Knowledge and Consensus

Consensus analysis was carried out to estimate the importance of each plant species in traditional knowledge. It was accompanied by the comparison of number of use-report (n_{ur}) to the number of species (n_{taxa}) in each category of use. Values for the factor range from 0 to 1. Where value of 1 indicates few taxa are used by informants thus inferring a high degree of consensus and a well defined medicinal plant tradition (Heinrich *et al.* 1998).

The questionnaire was conducted within 92 informants to obtain the data for the study in the three VDCs. Forty five species of medicinal plants was utilized for twenty three different ailments. There were 11 usage categories in which Skin tissue system disorder (SKI) had the largest number of mentions for the use of only two taxa in comparison to other ailments where no of reort are also high as well as number of taxa use is also equally high (Table 5). This data is very reliable data because the

more the number of informants to mention disease by making the use of less taxa the more reliable the information obtained is according to Trotter and Logan 1986,and also to Moerman (2007). In Skin tissue system disorder (SKI) the diseases are allergy and boils where only two taxa are used by almost all the informant asked. The SKI is followed by Sensory system disorder (SEN), Respiratory system disorders (RES) etc. The main reason behind suffering from such diseases might be due to lack of proper knowledge about hygiene and sanitation. Also the people are much engaged in the cultivation and collection of MAPs and lease bother about health. Fever is also most frequently occurring in children as well as adults.

While calculating the informant's consensus factor (F_{ic}) for each category in Table 5, 6 categories out of 11 showed > 0.75 which represents a high level of consensus. This level of consensus is higher than that reported by Heinrich (2000) for Yucate Maya in Mexico where only one of 9 comparable use categories had a F_{ic} > 0.60. This type of consensus analysis has not been carried out so far in Nepal.

The 45 species of medicinal plants were analyzed according to the most frequently used medicinal plant families **(**Fig**. 9)** and the vegetation type. Among these the most frequently used families are the Ericaceae (4 species), Compositae, Liliaceae, Polygonaceae and Ranunculaceae (3 species). This also shows that the distribution of these families in the Himalayan belt is high. Most of the medicinal plants used in the study area are shrubs, herbs, or climbers (Fig. 8) with very few species of trees. This is perhaps because shrubs, herbs, and climbers are more accessible and the roots, rhizomes and leaves, which are the most frequently used part of the plant to treat diseases, are easier to reach. They also have a faster rate of growth and renewal, which is correlated with the production of bioactive secondary metabolites rather than digestibility reducers.

The study in the three VDCs among the Tamang healers show that the knowledge among the community people is based on a well defined traditional good consensus, which means that the uses of these plants are well known among the Tamang healers of three VDCs i.e. Chilime, Gatlang and Thuman. They also might be predicted to be very effective in treating diseases. A previous study found that the good consensus of Kenyah healers in Borneo on antimalarial plants was indicative of high activity in laboratory antiplasmodium assays (Leaman *et al.* 1995). From a

scientific point of view, these high census species are good candidates for investigation of phytochemistry and pharmacology, which in turn could be useful in the development of evidence based phyto-medicines for the region or in rare instances, identification of substances in new drug. This well defined traditional knowledge would also be reliable knowledge which is transferred from generation to generation.

The top 15 medicinal plant species highlighted in table 5 and 6 were mentioned by the people in many usage categories, were also collected from most of the household and traded from the area. This irrational collection of plants may led to the declination of usage pattern and also a high threat to the consensus knowledge finally leading to the loss of traditional knowledge that are adapted from generation to generation. So, for the prevention of floral diversity and long lasting of the traditional knowledge the conservation efforts should also be made.

A threat is there for the consensus knowledge because the plants that are listed for the different ailments are mostly in trade. The irrational collection of these plants may lead to the declination of usage pattern. For the long lasting of the traditional knowledge the conservation efforts should also be made.

6.4 Collection and Trade

Medicinal plants provide accessible and culturally relevant sources of primary health care to a majority of the population in Asia. Marginalized people who are unable to finance and logistically access formal health systems are especially dependent on herbal medicines (Karki and Williams, 1999). Large distribution of herbs, shrubs along with NTFPs i.e. the main source of Rasuwa district have made the local community people to be partially or wholly dependent on it.

Medicinal plant that are regarded as a free commodity to be collected from nature are the major source of traditional medicines and also include all goods of biological origin (Subedi, 1997). These NTFPs, especially the medicinal and aromatic plants have been deeply associated with the Nepalese. Socio-economic conditions, particularly in rural areas (population).

The harvesters usually are less concerned about conservation and future production. They only think about the present context and income. They are always in

hurry to collect the plants in maximum amount to get maximum price. As a result, of which they make collection in immature state. During the survey of the site it was observed the unscientific collection: at what time, how much quantity and how it should be harvested. The MAPs are being randomly collected due to lack of local control over the resources, rural poverty, and social and cultural traditions. The result of over exploitation and premature harvesting which is due to lack of awareness and knowledge of sustainability has led to decline of both quality and quantity of natural resources (Kunwar and Duwadee, 2003).

If we compare the household collection of three VDCs (Table 7), then, average household of Chilime VDC is more than the other (43 household). Mostly herders, local healers cover the main collection. Ethnicity also plays an important role in the collection of MAPs and ethnic tribes derive a large portion of their annual per capita income from the collection of MAPs. All the family members including the children are engaged in the collection due to the lack of proper knowledge on collection and marketing of these resources, they get low price by the middlemen.

The scarcity of fertile land might be the reason which forced the people of Chilime VDC for the collections of Medicinal plants. Comparing between three VDCs, Thuman has best land for the cultivation so people very often go for the collection. They spent much time for the cultivation itself and depend on it. Gatlang is the most developed among the three VDCs. They are also much more engaged in cultivation, practices of potatoes, cereals, beans etc. (USC Nepal, 2006).

The larger the distribution pattern of MAPs the more will be the collection for trade to uplift the economic status. The highly traded species from the study area are listed in Table 7. *Neopicrorhiza scrophulariiflora* is the most collected species, whereas the *Paris polyphylla* and *Rhododendron anthopogan* is least collected. According to the secondary data *Cordycep sinensis* was the most valuable one but it was not disclosed by the local people during the study. *Neopicrorhiza scrophulariiflora* is found abundantly in the Himalayan belt. The high distribution might be that this species grows in very high altitude in tight clumps and is deeply rooted in relatively compact and stony of substrates and the total harvest of rhizomes is almost impossible (Ghimire *et al.* 2005) which led to its conservation and large distribution. Due to the abundant distribution it has become the highly traded species from the study area and this data coincides with the trade data of Dolpa district (Kunwar, 2002).

6.5 Management Practices

There are several factors threatening the survival of ecologically and economically important species and reducing the quantity and quality of MAPs such as unsustainable harvesting, population pressure an increasing and expanding market, held for cash, lack of an appropriate and practical regulatory mechanism (Jayaswal, 2000).

Number of natural resources is reducing each year due to over exploitation. MAP has been extensively extracted from the study area and their role in rural and forest economies is immense. From the study it is clear that the people in Chilime are highly engaged in collection of MAPs. Specially, large quantity of *Swertia chirayita* plant is harvested from study area without any sustainable harvesting plan. It is great threat for the population of *Swertia chirayita* in the study area. Instead of sustainable harvesting, everybody is in rush to collect those items, which have high market value, before maturing and flowering.

Every year large quantity of *Rheum australe* (Padamchal), *Neopicrorhiza scrophulariiflora* (Kutki), *Nardostachys grandiflora* (Jatamansi), *Valeriana jatamansi* (Sugandhawal), *Swertia chirayita* (Chiraito), *Cordycep sinensis* (Yarshagumba), etc. are collected and traded. Local people by collecting this can earn effective money but the problem is that they are not well paid by the traders. There are no specific methods, time and proper management for sustainable harvesting and collection and thus every day the highly priced MAPs are at the alarming rate. The people should be engaged in other practices such as cultivation of MAPs which has great demand in pharmaceutical industry.

The cultivation practices are not so rapidly adapted by the people of these VDCs. This might be due to lack of knowledge of cultivation .Only two household are engaged in the cultivation of *Swertia chirayita* currently in Tetangche of Chilime VDC. According to Prasain (2007) the cultivation of Swertia, Sugandhawaal, and *Paris polyphylla* is frequently done inside the National Park area i.e Thulo Syabru by number of households.

CHAPTER-SEVEN

7. CONCLUSION

The study area is rich in variety of flora and especially the medicinal herbs. These resources are important part of biodiversity as well as significant contributors to local economy. Therefore, the conservation of medicinal plants is not only vital to the livelihood of local people but also has immense cultural significance to them.

The present status of MAPs shows that the area is potentially important for economic benefit for the livelihood of local people especially in Chilime VDC. The potentially availability of MAPs should be maintained to maintain the traditional knowledge which is found to be very valuable. The high consensus obtained among the three VDCs underlines their well-defined tradition and could be important for the selection of plants for further phytochemistry and bioactivity analysis with respect to anthropological aspects of the study of indigenous medicinal plants.

Study reveals that harvesting practices of MAPs of this area is being increasingly driven by commercial demand, which is unscientific, unsystematic and unsustainable. Forests bear's commercially exploitable medicinal species, which if managed properly can serve as sustainable income sources for local communities. Therefore, an urgent need for conservation of medicinal plant species and their habitats and indigenous knowledge is required. Ethnoecological knowledge, plantlife forms and growth pattern are imperative to consider for management of Himalayan medicinal herb.

CHAPTER-EIGHT

8. Recommendation

Based on the findings, following recommendations were made for the sustainable management of MAPs and conservation of indigenous ethnomedicinal knowledge of ethnic community.

- Farmers should be encouraged to cultivate threatened/highly economic important plants in their private and wasteland/marginalized land by providing them skills, knowledge, seedlings, technologies and assurance of market and market links.
- Sustainable harvesting practice should be carried allowing the product for further propagation and regeneration.
- Government should manage loan for farmers without interest so that they could be active in domestication and cultivation of NTFPs.
- Community based participatory conservation practice should be initiated to conserve the depleting of forest resources.
- Participation of poor and women should be increased in benefit sharing program.
- The knowledge of Lama, Jhakri and old people about the importance of MAPs in caring the human health should be recorded or tapped and documented for coming generation.
- Re-awakening and greater interest in cultural matters should be given by healer's association (which is recently formed) with the participation of younger individuals, so that it will be the promising development for the future in that society.

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Appendix I

Questionnaire

1. Name of respondent.....Sex.....Age.....
2. Community forest.....
3. Main occupation: Agriculture/Official work/MAPs collection/other
4. Yearly income: Below 10,000/10,000-20,000/Above 20,000
5. Do you know about medicinal plants?

   (a) Yes (b) No
6. Do you collect medicinal plant?

   (a) Yes (b) No
7. How many family members are involved in Medicinal plant collection?
8. Name of medicinal plant that you bring?

   (a) (c) (e)

   (b) (d) (f)
9. Name the nearby area where the medicinal plants are mostly dominated.

   (a) (c) (e)

   (b) (d) (f)
10. How long do you spend for the collection of MAPs ?

    (a) 1 week (b) 2 weeks (c) 1 month (d) 1-2 months
11. Do you cultivate the medicinal plant?

    If yes which plants do you cultivated?

    ----
12. Do you sell the medicinal plants or use for home purpose?
13. If you sell it? Where?

    If yes which plants do you cultivated?

    ----
14. What are the names of highly traded MAPs ?

    (a) (c) (e)

    (b) (d) (f)
15. Which plants price is high? And which is low?

Appendix II
Plants used in traditional medicial practices

S.N	Local name	Tamang name	Ailments	Mode of preparation	Parts used	Habit

Appendix-III

Climatic data of Rasuwa (2001-2005)

Year 2001

Month	Tmax(°C)	Tmin(°C)	RH(%) 8:45	RH(%)17:45	Preceipitation (mm)
Jan	12.8	DNA	62	63	8.2
Feb	16.1	1.4	50.8	48.5	13.1
Mar	17.3	4.8	42.8	46	8.2
Apr	22.3	6.9	42.1	41.9	65.0
May	22.6	9.7	73.7	71.7	144.6
Jun	24.5	10.9	81.9	81.7	239.5
Jul	25.4	14.3	78.8	81.9	320
Aug	22.8	16.3	89.2	89.5	296.8
Sep	24.4	15.5	82.7	86.1	203.7
Oct	23.5	12.9	83.1	85.7	47.0
Nov	19.7	9.0	78.2	79.9	19.0
Dec	16.9	2.9	66.5	66.5	27.0

Year 2002

Month	Tmax(°C)	Tmin(°C)	RH(%) 8:45	RH(%)17:45	Preceipitation (mm)
Jan	15.5	1.8	53.8	57.4	31.0
Feb	15.3	3.7	63.2	64.7	0.0
Mar	20.3	7.8	60.9	58.2	14.3
Apr	22.8	12.0	75.3	76.1	34.0
May	23.8	14.2	64.5	76.4	136.6
Jun	23.8	16.9	84.0	87.6	299.5
Jul	23.9	15.6	85.7	86.5	388.9
Aug	24.4	16.1	82.1	91.5	505.0
Sep	22.6	14.3	79.2	88.6	255.3
Oct	22.6	11.2	72.1	82.3	41.3
Nov	19.8	6.5	59.2	79.1	24.0
Dec	16.5	2.9	67.3	75.9	0.0

Year 2003

Month	Tmax(°C)	Tmin(°C)	RH(%) 8:45	RH(%)17:45	Preceipitation (mm)
Jan	15.6	2.1	77.6	78.7	72.0
Feb	14.5	2.5	64.1	67.7	87.2
Mar	17.8	6.4	59.2	60.6	104.7
Apr	23.9	11.5	59.2	74.4	76.6
May	23.9	12.2	62.3	73.5	65.0
Jun	23.6	16	78.7	86.5	235.2
Jul	23.7	16.5	86	82.9	635.2
Aug	23.7	16.5	87.1	84.4	524.2
Sep	23.5	15.3	83.7	88.9	493.6
Oct	22.5	12.7	68.1	85	13.0
Nov	19.5	6.7	64.8	71.3	0.0
Dec	15.7	3.6	63.7	65.6	38.6

Source: Department of Hydrology and Meteorology, Babarmahal

Year 2004

Month	Tmax(°C)	Tmin(°C)	RH(%) 8:45	RH(%)17:45	Preceipitation (mm)
Jan	14.1	1.9	68.6	75.9	54.1
Feb	15.5	3.2	66.2	70.5	1.8
Mar	21.6	8.9	58.7	60.9	0.0
Apr	21.6	10.6	62.9	75.5	153.8
May	23.6	12.9	68.8	68.5	159.8
Jun	24.3	14.8	81.8	88.3	359.2
Jul	24	15.9	89.6	87.4	575.0
Aug	24.8	16	81.8	87.4	511.8
Sep	24.3	14.9	86.3	89	189.8
Oct	22.7	8.7	67.7	69.6	104.4
Nov	20.2	6.4	67	77.1	0.0
Dec	18.4	4.7	68.9	76.8	0.0

Year 2005

Month	Tmax(°C)	Tmin(°C)	RH(%) 8:45	RH(%)17:45	Preceipitation (mm)
Jan	15.1	2.5	68.6	81.6	96.0
Feb	17.0	5.0	61.7	76.1	16.0
Mar	20.4	8.9	62.9	71.4	80.0
Apr	23.3	11.6	65.5	74.6	85.8
May	24.1	12.6	58.1	78.6	43.2
Jun	26.8	16.3	66.8	83.6	105.4
Jul	24.7	16.7	85.8	88.7	622
Aug	24.5	16.8	89.2	91.5	487.4
Sep	24.5	16	79.5	84.6	132.6
Oct	22.9	11.5	75.9	82.5	118.4
Nov	18.9	6.7	75.6	78.2	0.0
Dec	17.8	4.0	84.2	84.5	0.0

Source: Department of Hydrology and Meteorology, Babarmahal

Appendix IV

1.1Population size of three VDCs.(source statistical year of Nepal,2005 HMG)

S.N	VDC	Total household	Total population	Total Population		Population in %
				Male	Female	Male	Female
1	Chilime	325	1521	812	709	53.38	46.61
2	Thuman	366	987	536	451	54.30	45.69
3	Gatlang	222	1739	900	839	51.75	48.24

1.2 Ethnic composition of 3 VDCs

Total population	VDC	Kami	BArae	Tamang	Other	Magar	Gurung	Sherpa	Newar	Chhetri
1521	Chilime	14	5	1405	12	7	18	6	15	5
	%	9.2	3.2	92.37	7.88	4.60	1.18	3.94	9.86	3.2
987	Thuman			923	9		50			
	%			93.5			57.47			
1739	Gatlang	32		1660	15					
	%	1.84		95.45	0.86					

1.3 Landuse in Percentage

Land use	Chilime	Thuman	Gatlang
Total area	99.86	154.62	132.81
Major part (waste/barren)	32.55	78.51	65.75
Forest land	31.46	23.36	32.28
Grassland	18.8	18.15	16.58
Cultivated land	10.28	2.45	6.42
Bush/shrub land	4.32	17.73	4.42
Glacier part	0.41	9.86	4.93
Water bodies	2.12	4.56	2.43

Appendix V

Table 5: Informants consensus factor (F_{ic}) for each category of uses.

SN	Usage category (group of illness)	No. of Taxa	No. of Use reports	Calculation	F_{ic}.
1.	Endocrine system disorders (END)	1	1	1-1/1-1=0	0
2.	Infection (INF)	14	34	34-14/34-1=0.60	0.60
3.	Genitourinary system disorders (GEN)	5	11	11-5/11-1=0.60	0.60
4.	Nervous system disorders (NER)	5	14	14-5/14-1=0.69	0.69
5.	Nutritional disorders (NUT)	2	5	5-2/5-1=0.75	0.75
6.	Digestive system disorder (DIG)	20	80	80-20/80-1=0.75	0.75
7.	Injuries (INJ)	5	19	19-5/19-1=0.78	0.78
8.	Muscular–skeletal system disorder (MUS)	2	10	10-2/10-1=0.88	0.88
9.	Respiratory system disorders (RES)	7	48	48-7/48-1=0.87	0.87
10.	Sensory system disorder (SEN)	2	14	14-2/14-1=0.92	0.92
11.	Skin tissue cellular disorder (SKI)	2	16	16-2/16-1=0.93	0.93

Methodology

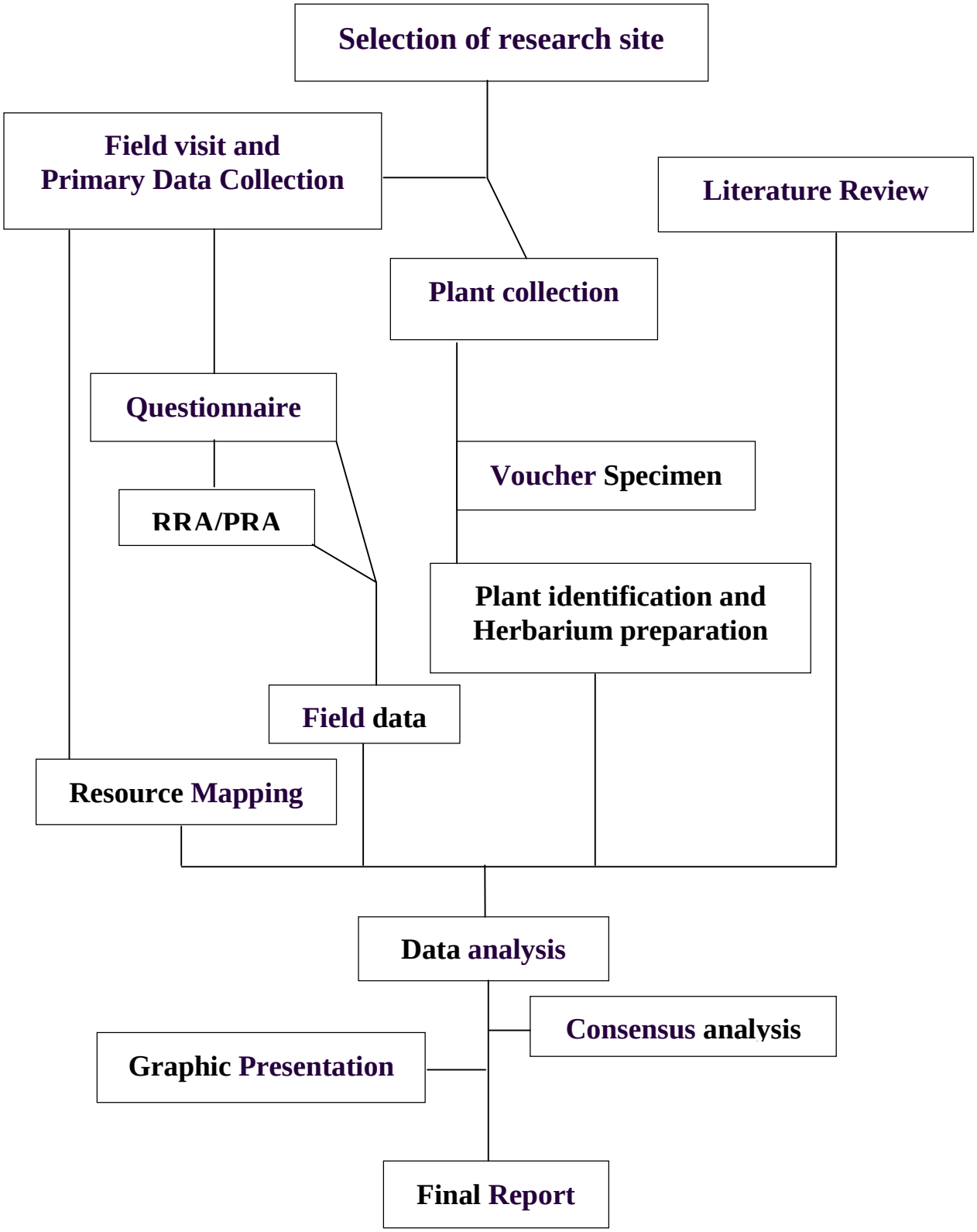

Photo Plate 1

Aconitum spicatum (Bruhl).Stapf.

Delphinium himalayai Munz

Nardostachys grandiflora DC.

Fritillaria cirrhosa D.Don

Photo Plate 2

Paris polyphylla Smith

Rhododendron anthopogan D. Don

Zanthoxylum armatum DC

Daphne bholua Buch-Ham. ex D. Don

Taxus wallichiana Zucc.

Rheum australe D. Don

Photo Plate 3

During the field visit to Tatopani, Chilime VDC

Cultivation of *Swertia chirayita* at Tetangche at Chilime VDC

Collection of *Rhododendron anthopogon*

Drying rhizomes of *Nardostachys grandiflora* at Chilime

Locals carrying collected medicinal herbs for selling

Trader weighing medicinal herbs brought by the locals from Gatlang VDC