

A

Report on Ecological and Conservation Status of *Dactylorhiza hatagirea* (D.Don) Soo in
Annapurna Conservation Area

(A Case Study from Lete Village Development Committee, Mustang District)



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Acknowledgments

It is my great honour to prepare the report on Ecological and Conservation Status of *Dactylorhiza hatagirea* (*D.Doon*) *Soo* in the Annapurna Conservation Area. Since *D.hatagirea* is an endangered orchid and many of the orchids of Nepal is in situation of extinct, this type of orchid needs to be conserved immediately.

D.hatagirea is a medicinal orchid which is listed in the CITIES appendix II and is also protected by the Forest Act, 1993 of Nepal. To conserve such orchid, all the concerned stakeholders must give an immediate response and carry out a conservation awareness programme on the places where this type of orchid is found. Although, few studies have been carried out about this orchid, a detail management plan is necessary to conserve such orchid. The laws and bylaws need to be reviewed and conservation should be made on participatory basis.

Some of the Government Organizations like Ministry of Forest and Soil Conservation, NGOs like National Trust for Nature Conservation (NTNC) are playing a crucial role in the conservation of the orchid. This type of orchid are traded illegally for its rhizome and sold to the international market. So, illegal trading of the rhizome must be stopped. Besides, payment for the conservationist in the local area should be made to conserve the orchid.

I am highly indebted to the Rufford Small Grants Foundation for providing grant to prepare the report on Ecological and Conservation Status of *Dactylorhiza hatagirea* in Annapurna Conservation Area. Similarly, I pay my due respect to the referees Professor Tom Hammet (Ph.D.) of Virginia Polytechnic Institute of USA, Professor Mohan Krishna Balla of IOF, Pokhara and Associate Professor Abadhesh Singh for their guidance and valuable suggestions. I am equally indebted to the people of Ghassa of Mustang district of Nepal which lies in the Annapurna Conservation Area for their tireless effort to carry out the conservation programs and inventory in the project area. Besides, Annapurna Conservation Area Project has played a crucial role to coordinate local people during the project period. Nepal Foresters' Association (NFA) and the Institute of Forestry, Pokhara itself has played an important role to disseminate the information in conservation awareness program of *D.hatagirea*.

At last but not the least, I am grateful to the IDEA WILD to support the instruments to carry out the inventory in the project area. Finally, I would like to urge all the people of world not only to conserve the endangered orchid but also the whole flora and fauna that seeks conservation for the future generations.

With Regards

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CHAPTER I

Introduction

“A medicinal plant is any plant which, in one or more of its organ, contains substance that can be used for therapeutic purpose or which is a precursor for synthesis of useful drugs.”(Sofowora, 1982). This definition of medicinal plant has been formulated by WHO (World Health Organization). The plants that possess therapeutic properties or exert beneficial pharmacological effects on the animal body are generally designated as “Medicinal Plants”. It has now been established that the plants which naturally synthesis and accumulate some secondary metabolites, like alkaloids, glycosides, tannins, volatiles oils and contain minerals and vitamins, possess medicinal properties.

Nepal constitutes a unique and enormous diversity of flora and fauna within a relatively small geographical area due to variations in topography, altitude and climate. In spite of being a small country, it possesses around 7000 species of vascular plants having 2000 species of medicinal plants (Shrestha and Shrestha, 1999). Baral and Kurmi (2006) have compiled and described 1792 medicinal plants. According to Bhattarai and Ghimire (2006), 49% of the trade medicinal plants are herbs, 29% tress, 14% shrubs and 8% climbers. So, Nepal is veritable treasure trove of medicinal plants (Phoboo *et al.*, 2008).

Most of the wild floras of Nepal are rich in medicinal and aromatic properties like antibacterial, antiviral, antihelminitic, anticancer, sedative, laxative, cardiotoxic, diuretic and others. They are important sources of bio-molecules, with application for the manufacture of pharmaceuticals and cosmeceuticals (Heinrich and Gibbons, 2001).

People have used medicinal plants in health care since the time of earliest human evolution. These are the major sources of medication for a wide range of ailments for the rural people of Nepal. More than 75% Nepalese still depends on the herbal plants as a local source of medicine. Local healers use various medicinal plants for primary health care (Devkota, 2001). Different type of bacterial infections such as dysentery, diarrhoea, fever, cough, bleeding, burning etc. are treated by traditional medicine in various forms especially under Ayurvedic, Homeopathic, Unani, Naturopathy etc. The medicines obtained from

plants boost our natural recovery power. This is because of the better cultural acceptability, better compatibility with the human body and fewer side effects.

Besides their importance in health care, MAPs, have high socio cultural and socio economic values, providing off-farm income and employment opportunities to local people. The incorporation of medicinal herbs into health foods, dietary supplements, herbal teas, cosmetics, massage oils, fragrances and dyeing agents have dramatically increased the international demand of medicinal plants.

During the last ten years, an interest in NTFPs has taken the world by the storm. Huge sums have been invested in exploring the potential of NTFPs (Wollenberg, 1999). Nepal is also not far from this condition. The Master Plan for Forestry Sector (1988) and the tenth five year plan (2003- 2008) has emphasis the development of MAPs as a priority programme for poverty alleviation. These show the concernment of the government for conservation and management of medicinal plants. Rare and high priced medicinal herbs are on the top priority for domestication, research and cultivation, processing and marketing.

Medicinal and aromatic plants of high altitude region are an invaluable resource not only to local communities and the nation, but also to the global community at large. They have high ecological values as well as poor rural communities are highly dependent on them for their health and economic benefit derived from harvesting for trade.

Out of many MAPs, *D. hatagirea* has been identified as the endangered species listed by CITIES and vulnerable species listed by CAMP. The government of Nepal has prioritized 30 important medicinal plants for research and management. Among these, 12 plants have been selected for agro-technology. *D. hatagirea* is one of them (DPR, 2006). According to Forest act 1993 and Forest Regulation 1995, Nepal Government has banned the rhizome of *D. hatagirea* to collect, trade and process.

The next fact, there are very fewer studies have been conducted especially regarding *D.hatagirea*. There is lack of management and conservation plan from the government side.

Similarly, lack of awareness of importance regarding *D. hatagirea* among rural villagers is leading towards the extinction of this valuable species. Although this is banned species, its unwise harvesting, unscientific use and illegal trading is being in practice. This is resulting improper use of *D. hatagirea* and also reducing the net income of the primary collectors and reducing national income.

Database on ecological status of *D. hatagirea* in the study area, documentation of creation of awareness about the in-situ and ex-situ conservation of *D.hatagirea* among the school students, villagers and communities and documentation on problems and solutions regarding the conservation of *D.hatagirea*, documentation of ethnobotanical uses of *D.hatagirea* in the study area and preparation of report on the Ecological and Conservation Status of *D.hatagirea* will be the main outputs of the research. The research findings will be helpful to the farmers, botanists, conservationists and to the planners of the conservation of *D.hatagirea* as well.

Objectives

General Objective:

- To assess the ecological and conservation status of *D. hatagirea* in Lete VDC of Mustang district.

Specific Objective:

- To assess the ecological status [Frequency distribution, Relative frequency, Population density, Relative density, Abundance] of *D. hatagirea* in the study area.
- To create awareness about the in-situ and ex-situ conservation of *D. hatagirea* in the study area
- To identify the problems and solutions regarding the conservation of *D.hatagirea* in the study area
- To prepare the report on “ *Ecological and Conservation Status of D. hatagirea* ”

CHAPTER II

Literature Review

This chapter attempts to review the relevant and available literatures related to the current study. Although *D. hatagirea* has been recognized well, no more specific research has been done yet in Nepal.

2.1 Ecology of *Dactylorhiza hatagirea* (D. Don) Soo

Syn. *Orchis latifolia* var. *indica*

Taxonomy Kingdom: Plantae

(Unranked): Angiosperms **(Unranked):** Moncots **Order:** Asparagales **Family:**

Orchidaceae **Subfamily:** Orchidoideae **Tribe:** Orchideae

Sub tribe: Orchidinae **Genus:** *Dactylorhiza* **Species:** *hatagirea*

It is also known as *Panch aunle*, *Hatajadi* (Nepali), *Aralu*, *Salap* (Sanskrit), *Ongu lakpa* (Sherpa) and *Lob* (Gurung) (Ranapal, 2009).

Distribution and Occurrence:

D. hatagirea is a Himalayan endemic medicinal orchid which is found in Hindu Kush Himalaya range. Its occurrence is sub-alpine and alpine zones from 2800-4200 m above from sea level (IUCN, 2004). Other than Nepal Himalayas, it occurs in the same altitudinal ranges of India, Pakistan, Bhutan and China also.

Flowering Period: June-July

Fruiting Period: August-September (Dutta, 2007)

Description:

It is a terrestrial, erect herb, up to 60 cm high, with palmately divided tuberoids. Leaves are broadly lanceolate or oblong-lingulate or elliptic. Flowers purplish-lilac, rose or rarely white, in many-flowered densely cylindrical inflorescence (Baral and Kurmi, 2006). The special character of this plant is that, it remains erect in excessive snowfall.

Uses:

Tubers are sweet, cooling, emollient, astringent, aphrodisiac, demulcent, rejuvenating and

nervine tonic. They are useful in diabetes, hemiplegia, dysentery, phthisis, chronic diarrhoea, seminal weakness, neurasthenia, cerebropathy, emaciation and general debility. A decoction of tuber is given in colic pain. Powder is used to relieve fever; it is sprinkled over wounds to check bleeding. Root is also used in urinary troubles; also used as farinaceous food (Baral and Kurmi, 2006).

Chemical Constituents:

Tubers contain a glycoside, a bitter substance, starch, mucilage, albumen, a trace of volatile oil and ash (Dutta, 2007). Chemically, dactylorhins A - E, dactyloses A and B and lipids etc. are found as major constituents.

Conservation Status:

According Forest Act 1993, and Forest Regulation 1995, the rhizome of *D. hatagirea* is banned to collect, trade and process. If the collection is done with the government authority, the government royalty is NRs. 500 per piece according to Forest Regulation 1995 and its amendment 2005. MFSC, Department of Plant Resources, Kathmandu has listed the plant under national priority species of medicinal herbs for cultivation and conservation. Convention on International Trade in Endangered Species (CITES) and Conservation Assessment and Management Plan (CMAP) have listed the plant under endangered and vulnerable species respectively (Kunwar, 2006).

Ex-situ Conservation:

It is propagated by seed and rhizomes. A gentle slope, open moist areas, humus soil, well drained sandy soil with high organic matters is suitable. The light humid, moist climate of alpine and subalpine is suitable. Collected seed are shown in nursery bed during April-May at the spacing of 40-60 cm for each seedling. The dried yield in natural condition is found to be 250-300 kg from a hectare (Shrestha and Shrestha, 2004). 5 kg of seed is required for one hectare of land for cultivation. 15-20 tonnes/ ha compost fertilizer is required for manure. During cultivation 3 to 4 hoeing and weeding is necessary. The germination percentage is 85-90% (Kunwar, 2006).

In-situ Conservation:

For sustainable harvesting, collection of rhizome is done only after flowering of plants (GoN, 2006). Collection of mother plant takes place by leaving 1 immature tubers by filling with layer of soil with the help of sharp *kuto* (a small spade like hand tool). Harvesting

period is September to November after seed ripening and fall. Proper care of the surrounding vegetation should be taken while rooting out the tubers of the *D. hatagirea*. Collection of plant should be done by applying rotating system. The rotation of the plant is 4-5 years for harvesting (Kunwar, 2006). Sustainable harvestable amount is 80% (Shrestha and Shrestha, 2004).

CHAPTER III

Research Methodology

Research Design

First of all the interested area of study was selected. Then the literature about the study area was collected and problem was identified. Appropriate methods and methodology was identified and site was selected for doing the research. Then primary data was obtained from the field survey while secondary data were collected from published and unpublished literatures. Then data was analysed using both primary and secondary data using statistical tools like SPSS 11.5 and Ms-Program like Ms-Excel. Interpretation was done after the analysis and report was prepared.

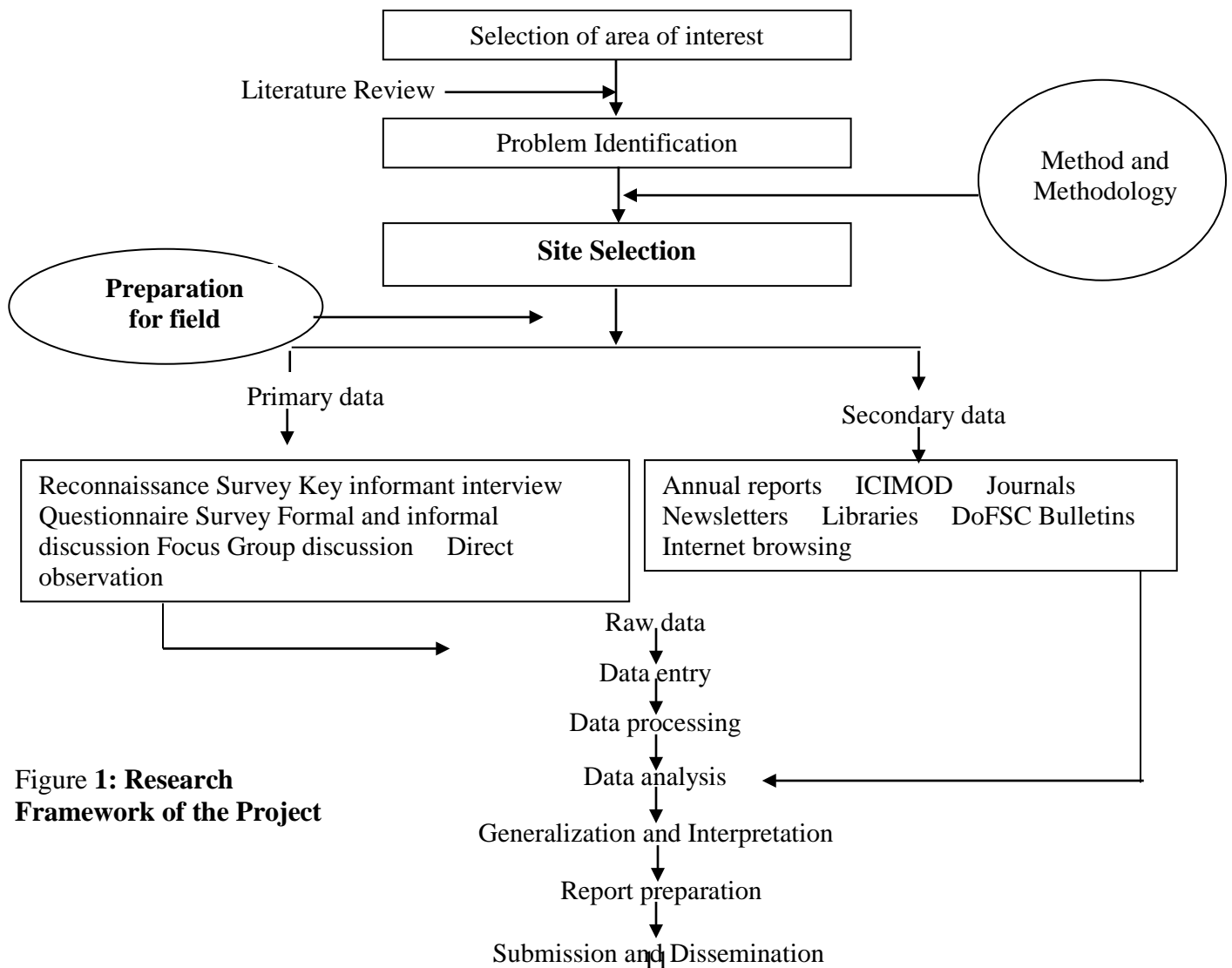


Figure 1: Research Framework of the Project

Study Area

The study was conducted in the Papekharka of Lete Village Development Committee (V DC) of Mustang District which lies in the Annapurna Conservation Area. The Annapurna Conservation Area was established in 1986, surrounded by high mountains and deep valley. It is the largest undertaking of National Trust for Nature Conservation (NTNC) and also the first and largest conservation area in Nepal, covering over 7,629 sq. km. Located in north-central Nepal, the ACA comprises an extremely diverse floral and faunal kingdom in a variety of interrelated ecosystems from subtropical to alpine grass lands. So, this area consists of various high altitudinal medicinal plants. The ACA harbours 38 species of orchids out of which *D. hatagirea* is one. The ACA presently incorporates 57 VDCs in the districts of Kaski, Myagdi, Manang, Mustang and Lamjung. Now, the ACA has been divided into seven Unit Conservation Offices (UCOs) to govern all the programs of ACAP (ACA, 2009).

Mustang District

Mustang district lies from 28° 24' to 29° 20' Northern latitude and 83° 30' to 84° Eastern longitude. The altitudinal range varies from 1372 to 8167 m representing sub-tropical, temperate and alpine types of climate (Ranapal, 2009).

Lete VDC

Lete VDC lies in Jomsom Unit Conservation Office (UCO) of Lower Mustang. Lower Mustang is a transition between trans-Himalaya and inner Himalaya. Lete VDC receives rainfall of 1545 mm/annum and per day 8.93 mm. The VDC consists deep gorges made by the *Kaligandaki* River. Papekharka is open grassland situated at high elevation of Lete VDC.

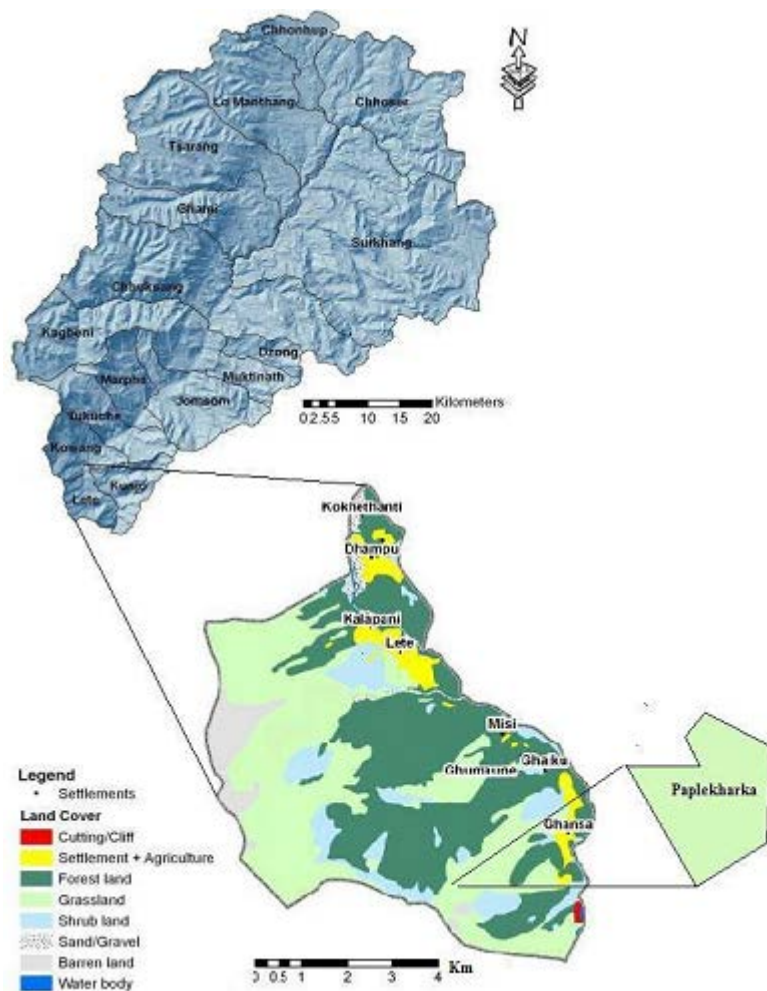


Figure 2: Map of the Study Area (Source: Ranapal, 2009)

Methods

Sampling Design

The total area of the study area was 5.4 hectares. 21 m grid was laid on the map and 100 plots were made. Among 100 plots, plants were found in 34 plots only. The sampling intensity chosen was 5.55%.

Data Collection

- **Primary Data Collection :**

The primary data was collected through reconnaissance survey, key informant interview, questionnaire survey, formal and informal discussion; focus group discussion, herb inventory and audio-visual aids.

- i **Reconnaissance Survey:** It was carried out for rapport building; general field observation of location where *D. hatagirea* will be found and sketch map was prepared for each working.
- ii **Key Informant Interview:** To develop further idea of the study site, informal discussion and interview with key informant was done. Model farmers, teachers, villager elders, social workers, herb collectors, herb traders and other knowledgeable persons were taken as the key informants. The interview was focused about the information on ex-situ and in-situ conservation of *D. hatagirea* and problems and solutions associated with conservation of *D. hatagirea*.
- i **Questionnaire Survey:** More than 50% of the households were selected so that they represented all ethnic groups, caste, occupation, literacy etc. The questionnaire survey was focused on obtaining social data and ethno-botanic uses of *D. hatagirea*.
- ii **Herb Inventory:** Generally, 1 m × 1 m sample plot is used for inventory of herbs. As *D. hatagirea* is a low abundant herb, 25 square meter circular sample plots was designed as recommended by Ravindranath and Premnath (1997). All the number of *D. hatagirea* and its associated species were counted within the sample plots. All of *D. hatagirea* and its associates were selected in a plot and their mean height, mean collar diameter and mean age were measured. Similar measurement was repeated in all plots where *D. hatagirea* and its associates were found. Global Positioning System (GPS) coordinates of the grid was to locate the plots. Vernier calliper was used to find out the collar diameter of the herb, a 5 feet steel tape to find the height of the herb and 20m reel tape was used to measure the radius of the plot.
- iii **Formal and Informal Discussion:** Checklist was prepared and group discussion was carried out with different ethnic group and in different tole.
- iv **Focus Group Discussion:** Discussion was held with men and women groups to triangulate the information obtained from household survey.
- v **Audio –visual Aids:** Audio –visual aids like posters, pamphlets, and documentary show

was used in the schools and communities to disseminate the information about the in-situ and ex-situ conservation of *D. hatagirea*.

- **Secondary Data Collection:**

Secondary data was obtained from annual reports, newsletters, bulletins and relevant articles and ACAP libraries and information office, Department of Forest and Soil Conservation (DoFSC), IOF library, International Centre for Integrated Mountain Development (ICIMOD), journals, articles, thesis, publications, maps, etc.. Internet browsing was done for the additional information.

Data Analysis and Interpretation

All the quantitative data was entered in the Statistical Package for Social Science (SPSS). Microsoft-Excel and SPSS Program was used for data processing, analysis and interpretation of the information collected through questionnaire survey and interview. The results were then represented in the form of tables, graphs, charts and pictorial devices. The information obtained from the questionnaire was analysed by using SPSS software. The quantitative data was analysed as follows:

A. Frequency = $\frac{\text{No. of plots where } D. \textit{hatagirea} \text{ occurs} \times 100}{\text{Total no. of plots}}$

B. Relative Frequency = $\frac{\text{Frequency of } D. \textit{hatagirea} \times 100}{\text{Sum of all frequency}}$

Sum of all frequency

C. Density = $\frac{\text{No. of } D. \textit{hatagirea} \text{ in all plots} \times 10,000 \text{ m}^2}{\text{Total no. of plots} \times \text{area of plot}}$

D. Relative Density = $\frac{\text{No. of } D. \textit{hatagirea} \text{ in all plots}}{\text{Total no. of individuals of all species}} \times 100$

Total no. of individuals of all species

E. Abundance = $\frac{\text{No. of } D. \textit{hatagirea} \text{ in all plots}}{\text{No. of plots in which } D. \textit{hatagirea} \text{ found}} \times 10,000 \text{ m}^2$

No. of plots in which *D. hatagirea* found \times area of plot

(Ravindranath and Premnath .1997)

The qualitative data was analysed descriptively.

CHAPTER IV

Results and Discussion

Ecological Status of *Dactylorhiza hatagirea*

1. Distribution of *D.hatagirea*

A total of 9 herbs were found in the project site with dominance of *D.hatagirea*. The altitudinal range of habitat distribution of *D. hatagirea* in the study site was 3200 to 3600 meter above sea level (Ranapal, 2009).The aspect of habitat distribution of *D.hatagirea* in the study site was South-West.

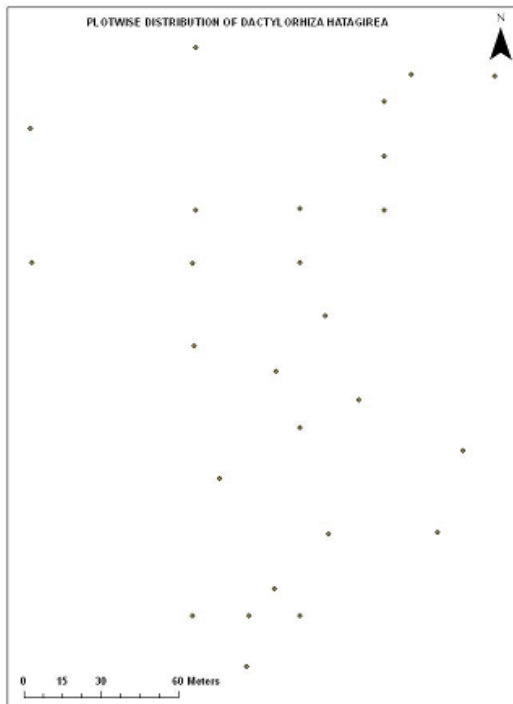


Figure 3: Plotwise distribution of *D.hatagirea* in the project site

2. Mean height, Mean Collar diameter, mean no. of leaves, mean age

The height, collar diameter and age of a single *D. hatagirea* was measured in each plot in which *D.hatagirea* was found. 69 *D.hatagirea* out of which only 26 *D.hatagirea* was measured which were found in 26 plots and the no. of plots in which *D.hatagirea* was absent was 15 (other herbs were present) excluding barren, forest and rocky and stiff area. Similarly, out of 100 plots, 20 plots include barren area, 16 plots include forest area and 23 plots include rocky and stiff area in which inventory was not possible.

From the inventory, it was found out that the mean height of *D.hatagirea* was 91.08 cm which is greater than studied done by Ranapal, 2009 (41.97cm) and Dutta, 2007(60cm), mean collar diameter 1.63, mean age 2 years and mean no. of leaves was 5. The difference in height might be due to methodology, age, topographic factor, soil factor and climate factor. The greater number of *D.hatagirea* was distributed in SW aspect. The inventory was carried out in shrawan (Jun/July) during which it was rainy season.

3. *Dactylorhiza hatagirea* and its associates

The scientific name of *D.hatagirea* and *Rheum australe* was identified while rest of other 8 associated species were not identified.

Table 1: List of herbs found in the project site

SN	Local	English Name	Scientific Name	Family	Nature of
1	Panchaunle	Orchid	<i>Dactylorhiza hatagirea</i>	Orchidacea	herb
2	Padamchal		<i>Rheum australe</i>	Polygonace	herb
3	Helmino*				
4	Halhale*				
5	Dungdunge				
6	Dhokai*				
7	Bhusket*				
8	Bhakkano*				
9	Dhongau*				

Note: * means scientifically unidentified

4. Frequency of *D.hatagirea* and its associates

Frequency is the number of sampling units in which the particular species occur, thus express the dispersion of various species in a community. It refers to the degree of dispersion in terms of percentage occurrence (Ranapal, 2009). According to the study, the occurrence of *D.hatagirea* in plots was 26 %. However, Ranapal 2009, has indicated the occurrence of *D.hatagirea* in Papekharka as 71%. Similarly, *Rheum asustrale* has occurrence of 7% and according to Ranapal 2009, it is 65%.

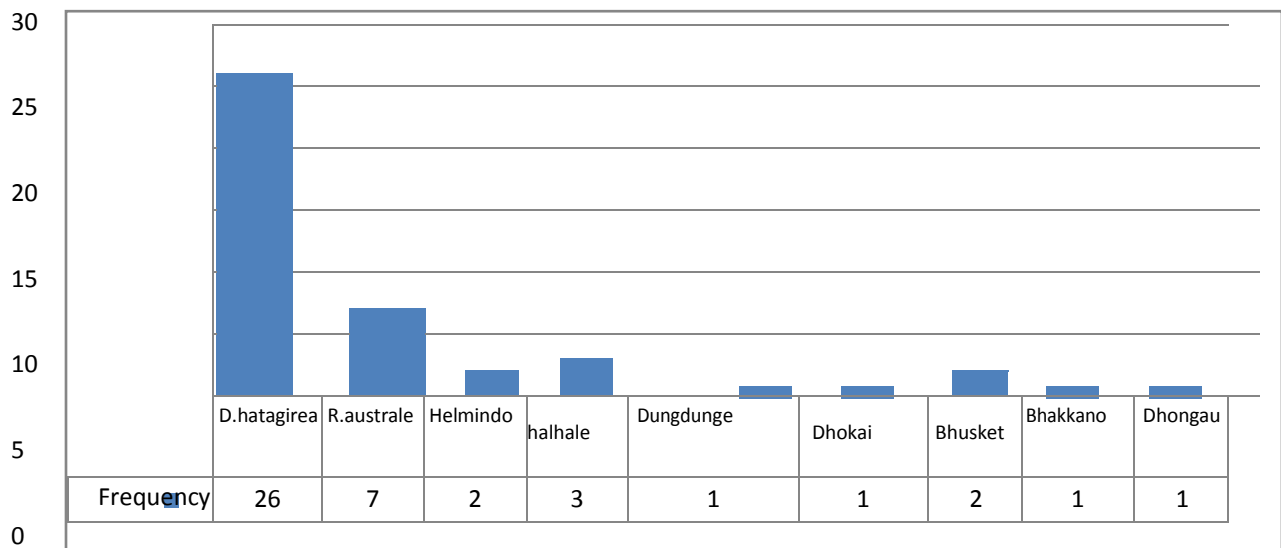


Figure 4: Frequency of *D.hatagirea* along with its associates

5. Relative frequency of *D.hatagirea* and its associates

Relative frequency is frequency of a species in relation to other species (Ranapal, 2009). The relative frequency of *D.hatagirea* was more (60%) compared to other associates. However, according to Ranapal 2009, it was 17%. The species have lowest frequency were dhongau, bhakkano and dungdunge.

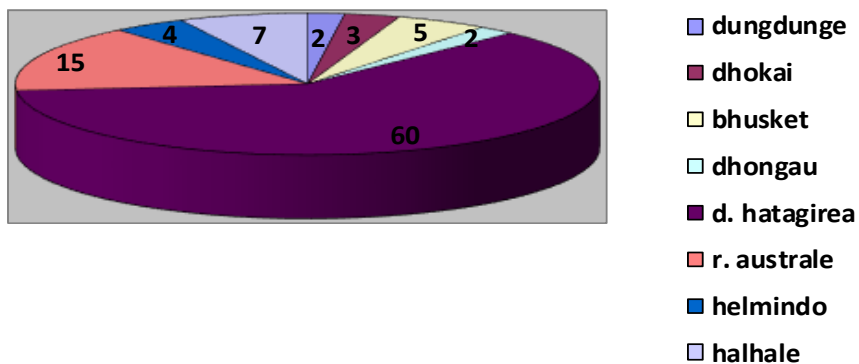


Figure 5: Relative frequency of *D.hatagirea* along with its associates

6. Density per hectares of *D.hatagirea* and its associates

Density expresses the numerical strength of the presence of species in a community. It is the number of individuals per unit area and is expressed as number per hectare. Based on the 25 m² square plots, analysis of density of different species per hectare, *D.hatagirea* has highest density per hectares whereas the plant number of *D.hatagirea* was found 6900/hect which was comparatively higher than indicated by Ranapal 2009(1671/hect) as the density per hect of *D.hatagirea*. The least number was that of Dhongau having 100/hect. This might be due to least distribution in the plot and heavy grazing pressure. The density of *D. hatagirea* was reported to be 0.2 ind/m² in Samar Lek, Upper Mustang (Chhetri and Gupta, 2006) which was comparatively less than 0.7ind/m². The next reported density of *D. hatagirea* is 2.66 ind/m² in grazed sites and 3.2 ind/m² in ungrazed sites at Tungnath, India (Nautiyal et al. 2004). Bhatt et al (2005) also reported 2.02-2.19 ind/m² density in protected area and 1.13-1.64 ind/m² in unprotected area in west Himalaya for *D. hatagirea*. The low density in unprotected areas may be due to heavy grazing pressure.

Table 2: Density per hectares of *D.hatagirea* along with its associates

SN	Species	Density/hec
1	<i>D.hatagirea</i>	6900
2	<i>R.australe</i>	3900
3	Helmino	1600
4	halhale	2000
5	dungdunge	1100
6	Dhokai	600
7	Bhusket	200
8	Bhakkano	500
9	Dhongau	100

7. Relative Density of *Dactylorhiza hatagirea* and its associates

Relative density is the density of a species with respect to the total density of all species (Ranapal, 2009). Table 3 shows that *D.hatagirea* has the highest relative density compared to the relative density of other associates. However, study done by Ranapal in 2009 has reported the relative density of *D.hatagirea* to be 9% i.e. 0.09. The difference might be due to the area of the project site.

Table 3: Relative Density of *D.hatagirea* along with its associates

SN	Species	Relative Density
1	<i>D.hatagirea</i>	41.32
2	<i>R.australe</i>	23.35
3	Helmino	9.58
4	halhale	11.98
5	dungdunge	6.59
6	Dhokai	3.59
7	Bhusket	1.20
8	Bhakkano	2.99
9	Dhongau	0.60

8. Abundance per hectare and its associates

Abundance refers to the number of individuals of each species present in the total population. It is a component of species diversity (Ranapal, 2009). Table 4 shows that dungdunge has the highest abundance ie.4400 per hac and D.hatagirea has 1061.54 per hac. However, the abundance per hectare of D.hatagirea reported by Ranapal 2009 is higher than this study i.e. 2367per hac.

Table 4: Abundance per hectare of D.hatagirea along with its associates

SN	Species	Abundance/hac
1	D.hatagirea	1061.54
2	R.australe	2228.57
3	Helmino	3200.00
4	Halhale	2666.67
5	Dungdunge	4400.00
6	Dhokai	2400.00
7	Bhusket	400.00
8	Bhakkano	2000.00
9	Dhongau	400.00

Conservation Status of *Dactylorhiza hatagirea*

1. Education Status of the respondents

The study found that 62.5% of that area was literate and remaining 37.5% were illiterate.

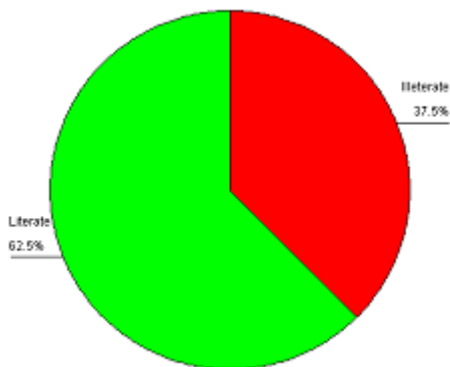


Figure 6: Pie chart showing the education status of the respondents

2. Perception on knowledge about *D.hatagirea*

According to the study, above 80% of the respondents knew about *D.hatagirea* while rest of others was unaware about it.

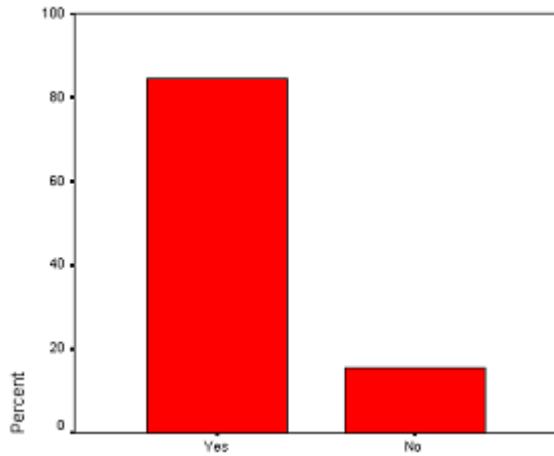


Figure 7: Bar diagram showing the perception on knowledge of respondents

3. Perception on conservation of *Dactylorhiza hatagirea*

According to the study, 71.9% of the respondents reported to conserve the *D.hatagirea* while rest others denied it.

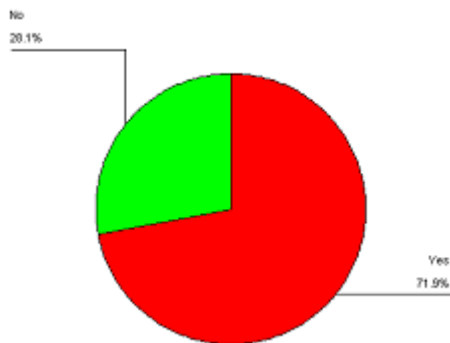


Figure 8: Pie-chart showing the perception on conservation of D.hatagirea

4. Perception on knowledge about in-situ and ex-situ conservation

Figure 9 shows that 71.9% of the respondents knew about the in-situ and ex-situ conservation while rest 28.1% was unknown about it.

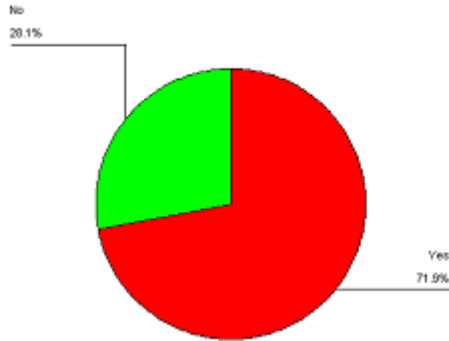


Figure 9: Pie chart showing perception on in-situ and ex-situ conservation

5. Types of Problems in conservation of *D.hatagirea*

During the survey, it was found that the major problems in conservation of *D.hatagirea* was unsustainable harvesting of *D.hatagirea* (50%) followed by lack of awareness programs (46.9%) and illegal trading (3.1%).

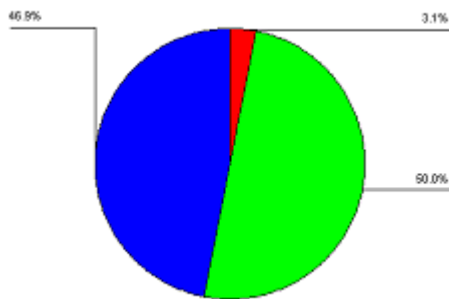


Figure 10: Pie chart showing the problems in conservation of *D.hatagirea*

6. Perception on knowledge of forest policy

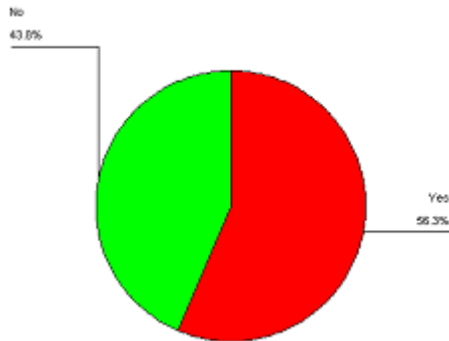


Figure 11: Pie chart showing the perception on forest policy

The above figure showed that 56.3% of the respondents knew about forest policy whereas rest 43.8% was unknown about it.

7. People's perception on solutions for conservation of *D.hatagirea*

The figure 12 showed that 43.8% of the respondents there should be incentive to people for conservation program, 34.4% told that there should be regular monitoring and evaluation and rest 21.9% reported there should be regular monitoring and evaluation for the conservation of *D.hatagirea*.

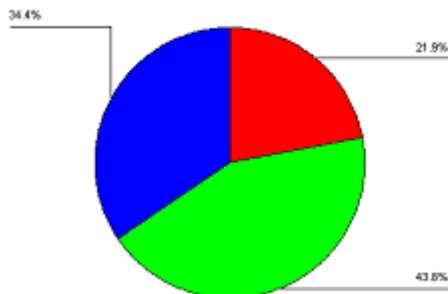


Figure 12: Pie chart showing perception on solutions for conservation of D.hatagirea

CHAPTER V

Conclusion and Recommendations

- The distribution of the *D.hatagirea* in the project site was south western aspect.
- *D.hatagirea* has highest frequency, relative frequency, density/hect & abundance/hect.
- The major problems for the conservation of *D.hatagirea* were unsustainable harvesting, lack of in-situ and ex-situ awareness programs and illegal trading of rhizome of *D.hatagirea*.
- The solution for the problem is to create awareness on in-situ and ex-situ conservation of *D.hatagirea*.
- Awareness on forest policy should be made and incentive should be given to the people who conserve *D.hatagirea*.
- Regular monitoring and evaluation of *D.hatagirea* should be done to stop illegal trading.

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ANNEXES

ANNEX 1: List of Questionnaire

A. Household Data

SN.....

Date

V.D.C.....

Ward No.....

Tole.....

Name of the respondent:

Sex:

Male..... Female..... Occupation.....

Household Size:

Age (Yrs.):

less than 10..... /10-20..... /21-40..... /41-50..... /50+.....

Education:

Illiterate..... / 1-5 grades..... /6-10 grade..... / Intermediate..... /Bachelor.....

Religion:

Hindu..... Buddhist..... Muslim.....

Christian..... Other..... Family Occupation /Income Source

Agriculture..... Tourism and Business..... Remittance..... Others.....

B. About the D. hatagirea (Panch Aule)

1. What type of NTFPs is found in your village area? Would you please tell them?

Species Name	Parts used	Uses

2. Do you have any knowledge about *D. hatagirea* (Panch aunle)?

a) Yes b) No

If yes,

Where is it found?

3. Do you use it?

a) Yes b) No

4. If yes, which part?

And for what purpose a) b) c)

5. Which month does it germinate?

a) b) c)

6. Which month does it sprout?

a) b) c)

7. Which month does the flowering and fruiting occur?

a) b) c)

8. What are the means of propagation of *D. hatagirea* (Panch Aule)?

a) Seed b) Rhizome c) Vegetative parts d) others

9. When did you harvest it?

a) b)

10. What is the rotation age of *D. hatagirea* for collection?

a) b)

11. What types of tool are used for harvesting?

a) b)

C. Conservation

1. Do you know anything about conservation? a) Yes b) No
If yes give your view:
a)
b)
2. Are there any Conservation activities about Panch Aule in your area ?
a) Yes b) No
3. If yes, what are those activities?
a) b)
4. Do you know about in-situ and ex-situ conservation? a) Yes b) No
If yes, please tell about it?
a)
b)
5. Have you heard about the gene bank?
a) Yes b) No
6. Have you heard about the seed bank?
a) Yes b) No
7. Do you collect the seeds of *D. hatagirea* (Panch Aule) ?
a) Yes b) No
8. Have you heard about establishing botanical gardens for conservation of threatened species?
a) Yes b) No

9. Is it possible to establish botanical gardens of *D. hatagirea* in your area?

- a) Yes b) No

10. Do you know anything about bio-technological method of conserving the threatened plant species?

- a) Yes b) No

11. Do you have any knowledge about in-vitro conservation of endangered plant species?

- a) Yes b) No

12. Do you see any problems in conservation of *D.hatagirea* (Panch Aule) ?

- a) Yes b) No

If yes, what are those problems?

a)

b)

13. Do you know that Government has banned for the collection, sale and distribution and export of *D. hatagirea* (Panch Aule) ? a) Yes b) No

14. Have you heard about the illegal trading of *D. hatagirea* (Panch Aunle) in your area? a) Yes b) No

If yes, at what price (in NRs.) do they sell the *D. hatagirea* (Panch Aunle)?

- a) b) c)

15. What might be the possible solutions to conserve the *D. hatagirea* (Panch Aule) in your area?

ANNEX 3: Plot Coordinates

Plot No	X (Latitude)	Y(Longitude)
5	756638	3,164,210
9	756626	3,164,064
12	756616	3,164,032
18	756606	3,164,210
32	756595	3,164,157
33	756595	3,164,178
34	756595	3,164,200
44	756585	3,164,084
48	756574	3,164,031
49	756573	3,164,116
52	756563	3,164,158
53	756563	3,164,137
55	756563	3,164,073
58	756563	3,163,999
59	756553	3,164,010
60	756553	3,164,095
70	756543	3,163,999
71	756542	3,163,980
73	756531	3,164,053
74	756521	3,163,999
77	756521	3,164,105
78	756521	3,164,137
79	756522	3,164,157
81	756522	3,164,221
99	756458	3,164,189
100	756459	3,164,137

ANNEX 4: Grid Coordinates

Grid Number	X(Latitude)	Y(Longitude)
1	756,646	3,164,042
2	756,647	3,164,042
3	756,647	3,164,053
4	756,639	3,164,063
5	756,638	3,164,200
6	756,626	3,164,210
7	756,627	3,164,200
8	756,626	3,164,105
9	756,626	3,164,084
10	756,627	3,164,064
11	756,627	3,164,053
12	756,616	3,164,042
13	756,616	3,164,032
14	756,616	3,164,053
15	756,617	3,164,073
16	756,616	3,164,095
17	756,616	3,164,126
18	756,606	3,164,210
19	756,606	3,164,210
20	756,606	3,164,189
21	756,605	3,164,168
22	756,604	3,164,148
23	756,606	3,164,127
24	756,605	3,164,106
25	756,605	3,164,063
26	756,595	3,164,031
27	756,595	3,164,031
28	756,595	3,164,052
30	756,595	3,164,073
31	756,595	3,164,094
32	756,595	3,164,116
33	756,595	3,164,136
34	756,595	3,164,157
35	756,595	3,164,178
36	756,595	3,164,200
37	756,584	3,164,220
38	756,585	3,164,221
39	756,585	3,164,200
40	756,584	3,164,178
41	756,585	3,164,147
42	756,585	3,164,125
43	756,585	3,164,105
44	756,585	3,164,084
45	756,584	3,164,063
46	756,585	3,164,042
47	756,585	3,164,022
48	756,574	3,164,031
49	756,573	3,164,116
50	756,564	3,164,221
51	756,563	3,164,189
52	756,563	3,164,158

53	756,563	3,164,137
54	756,563	3,164,105
55	756,563	3,164,073
56	756,563	3,164,052
57	756,564	3,164,031
58	756,563	3,163,999
59	756,553	3,164,010
60	756,553	3,164,095
61	756,542	3,164,242
62	756,542	3,164,220
63	756,542	3,164,210
64	756,542	3,164,189
65	756,542	3,164,157
66	756,542	3,164,137
67	756,542	3,164,104
68	756,542	3,164,073
69	756,542	3,164,031
70	756,543	3,163,999
71	756,542	3,163,980
72	756,542	3,163,958
73	756,531	3,164,053
74	756,521	3,163,999
75	756,520	3,164,031
76	756,521	3,164,074
77	756,521	3,164,105
78	756,521	3,164,137
79	756,522	3,164,157
80	756,522	3,164,190
81	756,522	3,164,221
82	756,521	3,164,240
83	756,521	3,164,252
84	756,501	3,164,242
85	756,501	3,164,220
86	756,501	3,164,189
87	756,501	3,164,158
88	756,501	3,164,137
89	756,501	3,164,105
90	756,501	3,164,074
91	756,500	3,164,052
92	756,480	3,164,074
93	756,480	3,164,105
94	756,479	3,164,137
95	756,479	3,164,157
96	756,480	3,164,188
97	756,481	3,164,220
98	756,459	3,164,221
99	756,458	3,164,189
100	756,459	3,164,137
101	756,460	3,164,151

ANNEX 5: Photos taken during the project work



Left: Campus Chief of IOF delivering speech Pokhara. Right: Photo session at IOF



Left: Photo Session at Nepal Foresters' Association. Right: Awareness Program at Ghasa, Mustang



Figure 17: Researcher taking interview height



Figure 18: Researcher measuring the height



Figure 19: A group of *Dactylorhiza hatagirea* plants