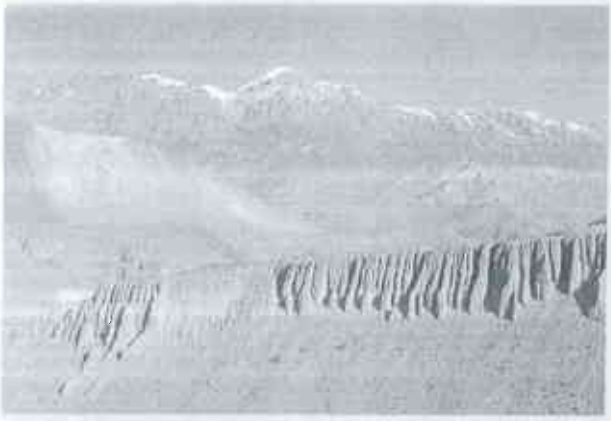
An Assessment of Rangeland and Pastoral Production Systems, Upper Mustang Nepal

A Project Paper submitted to Institute of Forestry for partial fulfilment of the requirement for Bachelor of Science in Forestry



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King Mahendra Trust for Nature Conservation/Upper Mustang
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Tribhuvan University
Institute of Forestry, Pokhara Campus, Nepal

February 2006

LETTER OF ACCEPTANCE

This is to certify that Ms. Anita Pokharel, a B.Sc. Forestry final year student of Institute of Forestry, Pokhara Campus has carried out the research work entitled ***"An Assessment of Rangelands and Pastoral Production Systems"*** in Upper Mustang under my supervision and guidance. The entire work is based on the fieldwork performed by the candidate and this work brings out useful findings in the concerned field.

The project paper has been accepted as a partial fulfilment of the requirement of Bachelor of Science in Forestry.

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DECLARATION

I hereby declare that this project paper entitled "***An Assessment of Rangelands and Pastoral Production Systems***" in Upper Mustang is my own work except otherwise as acknowledged. I have not submitted it or any part of it to any other academic institutions for any degree.

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ABSTRACT

The research "***An Assessment of Rangelands and Pastoral Production Systems***" was conducted in Lo Manthang VDC of Upper Mustang (during July and November, 2005).The study aimed at assessing the impact of grazing and the range resources.

Biomass, Importance Value Index (IVI), height, species distribution and phenology were compared between controlled plots (without grazing) and open plots (free grazing). Seasonal pasture types were identified and pasture units were delineated in topographic map. Various attributes corresponding to each pasture units were obtained by using various PRA tools. Map of the pasture was prepared using GIS soft wares. Finally potential areas for improvement were identified. Independent sample t- test was used at 95% probability level to test the differences in biomass.

Twenty species (17 belonging to 14 families: high-7, medium- 2, low – 6 and non palatable – 2 and 3 unidentified species) were recorded in the experimental plots. IVI of highly palatable species, *Kobressia* spp. is high in controlled than in open plots in both seasons. Medium palatable *Sassurea nepalensis* has higher IVI in open plots in both seasons. Species diversity showed that the open plots are more diversified than the controlled plots. Significant difference is found in the biomass of the species between controlled and open plots in July but not in November indicating that grazing has some impact upon the pasture of the area.

Forty four pasture units and ten seasonal pasture types have been found with total area of 257.75 sq. kms., summer pasture sharing the highest proportion (54.94%) followed by winter (21.27%). Plant species of 107 types belonging to 36 families is recorded from the pastures of which 6 are grass spp., 81 herbs spp., 16 shrub spp., 3 trees spp., and 1 fungus. Potential areas for pasture improvement have been proposed on the basis of the necessity of trial improvement, water hole construction, protection of medicinal plants, controlling dung collection, uprooting of bushes and shrubs and grazing pressure.

This study recommends management of the rangeland and a further research by coupling grazing with climatic and soil data to assess the health of rangeland.

Key-words: *Biomass, conservation, controlled and open plots, management, pasture categorization, rangeland*

ACKNOWLEDGEMENT

I would like to express gratitude to the King Mahendra Trust for Nature Conservation-Annapurna Conservation Area Project/Upper Mustang Biodiversity Conservation Project (KMTNC-ACAP/UMBCP) for providing me an opportunity to conduct the present study. My thank goes to my advisor, Chiranjibi Prasad Upadhyaya, Campus Chief, Institute of Forestry, who always inspired and guided me through out the study period. I am grateful to Madhu Chetri, National Program Manager, UMBCP for the logistic support he provided in field and the valuable instructions for conducting the research. I wouldn't have been able to conduct the study without his support either moral or physical in the isolated and harsh climatic area of Upper Mustang. My sincere thank goes to Nawa Raj Chapagain, GIS officer, KMTNC-ACAP for the instructions he provided for data collection. I must appreciate his continuous guide and encouragement while working with the tedious task of map preparation using GIS softwares. I would like to thank Keshav Dutt Awasthi, Associate Professor, Institute of Forestry, Pokhara for guiding me in laboratory operations for the determination of dry biomass.

It would not have been possible to complete the task without the support of the staff of Lo ManthangUnit Conservation Office (LMUCO) and Jomsom Unit Conservation Office (JUCO). Particular thanks are due to rangers Hira KC and Basu Dev Neupane, Horse care taker Tashi Angel B.K.,and motivator Riksang Gurung who cheerfully accompanied me through out the study period and shared many of their insights, and informations regarding the rangeland resources and their use in the area. I cannot forget the help Jagadish Hamal provided for ticket arrangement while coming down to Pokhara from Jomsom. I am equally indebted to Chhimmi Rinjin Gurung, secretary of Conservation Area Management Committee (CAMC) of Lo Manthangfor being with me in field and sharing his valuable knowledge on the subject matter and culture of the local people.

During the field visit I met many individuals and representative of local institutions - from the *Mustangi raja* to CAMC and sub-committee members, members of Pasture Management Sub-Committee, Amchis, school teachers, lamas of the local monasteries, lodge keepers, herders, nomads, local knowledgeables and so on - who unfailingly shared their versions of the problems encountered in pastures, pasture condition and possible ways to conserve the resources. To all of them I express sincere appreciation.

Last but not the least I am thankful to my family. I always cherish the love and encouragement that my parents and uncle have been providing since my childhood that has enabled me to be on right path. Thanks to my brothers and sisters for being with me whenever I needed. I hope I will not disappoint them.

ACRONYMS

ACAP	Annapurna Area Conservation Project
CAMC	Conservation Area Management Committee
CAMOP	Conservation Area Management Operation Plan
CITES	Convention on International Trade in Endangered Species
cm	Centimeter
E	East
GIS	Geographic Information System
HMG	His Majesty's Government
IUCN	The World Conservation Union
IVI	Importance Value Index
Km	Kilo meter
KMTNC	King Mahendra Trust for Nature Conservation
LRMP	Land Resource Mapping Project
m	Meter
N	North
No.	Number
NPWC	National Park and Wildlife Conservation
PRA	Participatory Rural Appraisal
sq.km.	Square kilometer
UMBCP	Upper Mustang Biodiversity Conservation Project
UMCAMP	Upper Mustang Conservation Area Management Plan
VDC	Village Development Committee

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1. INTRODUCTION

1.1. General background

Upper Mustang lies between 28°47'- 29°19' N and 83°28'-84°15' E in Mustang district which is one of the sparsely populated districts of Nepal. Upper Mustang with fragile landscape drained by the main Kaligandaki River and its tributaries is a high altitude Steppe. It falls in the rain shadow area of Dhaulagiri Himal and Annapurna massif and covers an area of 2,567 sq.kms. Upper Mustang consists of seven VDCs and thirty-one settlement areas. Much of the Mustang landscape is dominated by pastures but the prevailing harsh climatic condition doesn't permit to grow sufficient grasses in these lands (Kunwar, 2003). Grazing land comprises of 41.61% and 0.62% is shrub land (LRMP, 1986).

Agricultural production in the area is very limited due to scarcity of water, lack of proper irrigation, low temperature for longer periods and low rainfall. Only 1.7% land is cultivable and average landholding is 0.35 ha per person. Majority of the land is uncultivated and barren. Local production of food meets only 55% of subsistence needs and that only 8% of the 5,700 inhabitants of Upper Mustang are self sufficient in terms of grain (Thakali, 1994). Animal husbandry is the main source of income for the local people. The average number of animals reared between 1993 and 1995 in Upper Mustang is 49,963 (Blamont, 1996). Cattle, yaks, dzos, sheep, goats, horses, mules and donkey are reared. Goat and sheep trading from China is also a common practice among the local population.

The rangelands not only provides grazing lands for livestock but also supports large number of rare and endangered plants, animals and birds. Plant species such as *Caragana* spp., *Lonicera* spp., *Stipa* spp., *Carex* spp., *Kobresia pygmea*, *Kobresia felicina*, *Lagotis* spp., *Thymus linearis*, *Corydalis* spp., *Delphinium* spp., and *Meconopsis* spp. characterize the rangelands (Chetri and Gurung 2004). The rangelands also supports unique assemblage of rare and endangered species – Tibetan argali (*Ovis ammon hodgsonii)*, Tibetan gazelle (*Procapra picticaudata),* Kiang (*Equus kiang),* Blue sheep (*Pseudois nayaur)* and their predators - Snow leopard *(Uncia uncia)*, Lynx *(Lynx lynx isabellinus)*, Red fox (*Vulpes vulpes),* Himalayan brown bear (*Ursus arctos)* and Grey wolf *(Canis lupus).*

As animal husbandry is the main source of income, rangelands of Upper Mustang have socio-economic relationship with the lives of local people. Therefore, the proper utilization and management of this important rangeland is crucial for long term biodiversity conservation of the area.

1.2. Problem statement & Justification

Upper Mustang has its own significance in terms of socio-cultural biological and geomorphologic diversity. Economically the people of Mustang rely on agro pastoral system. However agricultural production being limited due to lack of sufficient water for irrigation and harsh climatic conditions (Kunwar, 2003), livestock grazing is the main source of earning livelihood. Grazing takes place throughout the year and little forage is conserved as hay in the agricultural land which only sustains for only one or two months or even less in some of the areas. So it is very important to assess the impact of grazing on the rangeland. Researchers have identified that overstocking (overgrazing) in the rangelands is the main factor causing deterioration of rangelands (Miller, 1996; Schaller and Gu, 1994; Wang *et al.*, 2002). Similarly it was also found that species diversity and productivity are maintained by livestock and wildlife grazing in many highland pastures (Carpenter and Klein, 1995; Richard *et al.*, 2000). This study was designed to assess how regularly grazed and totally un-grazed plots vary in species composition, diversity and biomass production. This unique rangeland ecosystem was relatively unexplored to make informed decisions about altering traditional pastoral production practices. It was essential to conduct systematic research before proposing any interventions in the name of progress (Goldstein and Beall, 1990). The categorization of the rangelands based on seasonal use and grazing pressure in the study area provides essential base line information for developing future management strategy. It is necessary to carry out the systematic ecological research to get better understanding of the dynamics of the ecosystem. Through this informed decisions about development planning (Miller, 1995) can be made so that heavily utilized natural pastures' pressure and forage scarcity especially during winter and early springs (Jackson *et al.*, 1996) can be lessened. In this study the various pasture features are systematically recorded based on which management interventions can be undertaken. Data base maintained using GIS will help anyone to obtain information effectively. Herders' knowledge regarding the condition, changes and management of the rangeland were utilized in the classification of the pastures. Floristic components are quantitatively analyzed and indigenous knowledge is studied for investigating the potential sites for pasture improvement which will be important tool for the project for managing the rangeland in a sustainable way. Findings of this study will be useful to

the researcher, project and all others who are interested in rangeland production systems as well as the local communities.

1.3. Objectives

The main objective of the study was "to find the impact of grazing and assess the range resources of Lo Manthang VDC".

The specific objectives were:

1. Comparative assessment of the plant communities between controlled and open plots in order to measure impact of grazing,
2. Categorization of pastures of Lo Manthang VDC, and
3. Investigation of the potential sites for pasture improvement.

2. LITERATURE REVIEW

Grazing is a year round threat to many of the productive protected areas in the Terai whereas it id more of a seasonal threat in the high elevation pastures in the Himalayas (Heinen and Kattel, 1992).

Livestock overgrazing minimized the availability of forage to wildlife leading to degradation of grazing land (Kunwar, 2003).

The people of Upper Mustang have their own traditional system of pasture management but the management system tends to fall out side the carrying capacity concept (Craig, 1996).

Although more than 48% of the land area in the Himalayan region of Nepal along with its northern border with Tibet is occupied by natural grassland vegetation (LRMP, 1986), the high quality pasture in Upper Mustang is found in limited areas.

The grasslands not only support a large number of plant and animal species, they also provide a livelihood for mountain people. There are possibly 10 million people residing on the mountain grazing lands in the Himalayas and on the Tibetan Plateau who are dependent upon livestock for their livelihoods (Miller, 1995).In these areas grazing presents the only way at present to convert primary production to secondary products such as meat and milk products and non food products such as fiber, hide and manure – all important products for the subsistence livelihood in this region (Miller, 1995). Heavy livestock grazing is thought to lead to a decline in range condition; reducing or removing grazing pressure assumed plant succession processes would restore the range to its previous state (Miller, 1996).

In Upper Mustang both summer and winter pastures are suffering from overgrazing due to lack of pasture management plan (Kunwar, 2003). Researcher had also reported that grazing affects species composition and species diversity. Herbivores have pronounced effect on plant establishment, growth and reproductive success. They also have substantial effects on plant forms. Among the most conspicuous effects of large mammalian grazers upon grasslands is a drastic reduction of above ground biomass (Karki, 1997).

Despite their extent and importance the dynamics of the rangeland ecosystems in the Hindu-Kush Himalayan –Tibetan Plateau region are still poorly understood. Questions concerning how rangeland vegetation functions and the effect of grazing animals on the ecosystem in these mountain rangelands remain unanswered for the most part .The socio-economic dimensions of the pastoral productions are also not well known. This lack of information limits the proper management and sustainable development of rangelands (Miller, 1996).

Indigenous rangeland management activities are practiced in Upper Mustang like rotational grazing, levying of fines for herders caught grazing outside their designated village grazing areas. But the traditional management system alone is not adequate to produce more forage in overgrazed and overpopulated rangeland (Thapa, 1990).

Chetri and Gurung (2004) from Upper Mustang rangeland reported that monitoring of the cover and the height of the vegetation does not give a clear picture regarding the increase or decrease of the forage availability. For overall growth of the species other parameters should also be measured for example looking at the possibility of studying the biomass growth which is the basis of this study.

At small scales it's been seen that the species diversity has increased due to grazing (McIntyre *et al.*, 2003; Sternberg *et al.*, 2000) and at landscape scales it's decreased due to the elimination of species sensitive to grazing (McIntyre *et al.*, 2003).

Curtin (2002) reports that there is no relationship between above ground net primary productivity and grazing or between root mass and grazing and adds that soil characteristics, climate and other disturbances may have greater effects on plant species diversity than do grazing.

Since grassland ecosystems are sustained through the dynamic interaction of fundamental processes including climate, fire, grazing and human culture (Manning, 1995; Western, 1997; Frank *et al.*,1998; Keesing, 1998), for the accurate determination of ecological implications of grazing all the aforementioned processes should be controlled (Curtin, 2002).

Low range productivity and high livestock utility in the Himalayan region make the pastoralists maintain the largest possible herds (Goldstein and Beall, 1990).

Pasture lands cannot be managed through continuous grazing. For the management of forage growth controlled grazing should be employed (Beetz, 2001). By improving the forage conditions number of native prey species can be increased and thus livestock depredation can be lessened (Jackson *et al.*, 2002) Livestock depredation due to snow leopard in the study area is notable which can be lessened to some extent in aforementioned way.

Over grazing coupled with successive droughts and harsh winters in 2002 in Mongolia degraded grasslands leading to massive loss of livestock which in turn deprived many herders of their livelihood (Gyamtsho, 2005).

3. STUDY AREA

3.1. Physical description

Lo Manthang, also known as *Monthang* previously, is one of the seven Village Development Committees (VDCs) of Upper Mustang. It lies in the northern part of Mustang District approximately at 83° 45' to 84° E and 29° 04' 12" to 29° 18' N. It is known to the world as *The Walled City* since the settlement is surrounded by wall. To its North is Chhonup VDC, in South Surkhang VDC, in East Surkhang VDC and in West Ghami VDC (Map1). The altitude range of Lo Manthang VDC is 3,200m to 6,500m. There are altogether two permanent settlements in Lo ManthangVDC.

The climate of the area can be characterized as cold desert, desiccated by strong winds and high solar radiation. The climate is sub-alpine, and has a maximum and minimum temperature of 26.8°C and 9.9°C in July and 10.7°C and - 5.8 °C in November of 2005. The whole area remains under snow for 4 – 5 months from November to March. Total annual rainfall is less than 200 mm and more than half of the total precipitation occurs as snow during the winter months. The region falls under the Dhaulagiri–Annapurna mountain rain-shadow zone.

Most of the geology is Alluvial, Colluvial, Morainal Depositional Surfaces and steeply to very steeply slopping Mountain terrains (LRMP, 1987). Ammonites (*saligram*), fossilized molluscs, which are considered as key fossils from the evolutionary biology point of view and venerated by the Hindus are only found in the Upper Mustang area in the country.

3.2. Biological description

Upper Mustang is rich in trans-Himalayan biodiversity of common to rare and endangered status.

3.2.1. Habitat diversity

The habitat diversity mainly includes patches of forests (mainly of *Juniperus* spp., *Betula* spp. and *Populus ciliata*), dry alpine scrubland, alpine meadows and Tibetan desert steppe. In addition, agricultural lands, settlements, aquatic bodies, cliff and caves are significant habitats of the area (Shah, 2003). Cliffy areas are good habitat of Blue sheep (*Pseudois nayaur*).

3.2.2. Flora

The vegetation represents high altitude grasslands that are Tibetan in characters (Stainton, 1972). The natural forest is dominated principally by *Juniperus squamata*, *Juniperus wallichiana*, and *Betula utilis*. Plantations are carried out exclusively of *Salix* spp. and *Populus ciliata*. *Juniperus indica, Hippophae tibetana, Rhododendron lepidotum, Lonicera obovata, Ephedra gerardiana, Spiraea arcuata, Cotoneaster* spp., *Caragana* spp., *Berbaris* spp., *Artemisia* spp. are dominant plant species of the dry alpine scrubland habitat which lie between 2,900-4,000m throughout the area. All high altitude pastures above 4,000m consist of alpine meadows. Many herbs and grass species constitute vegetation of this habitat.

3.2.3. Fauna

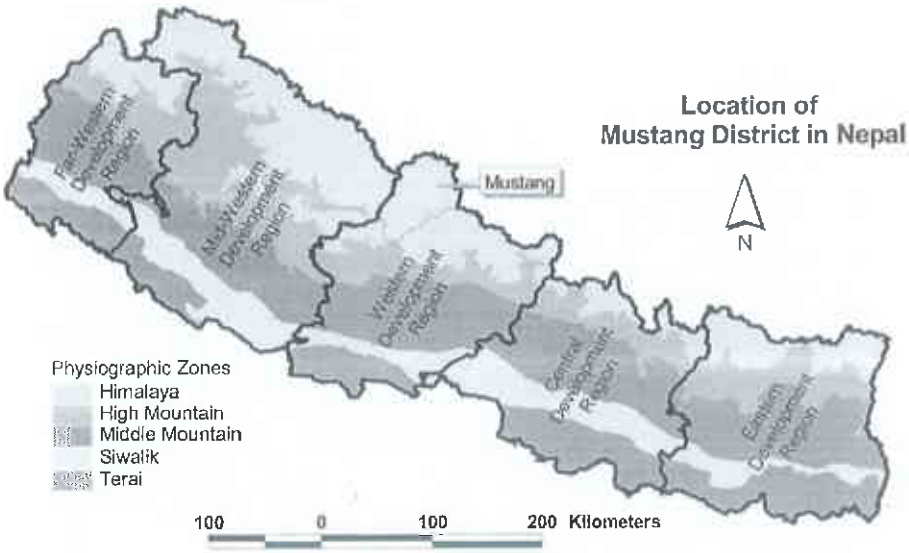
The pastures, besides serving as grazing ground for the livestock favours a number of rare and endangered trans himalayan wild animals. Surveys related to fauna of the area reviewed by Shah and Rayamajhi (2005) confirm the presence of 18 species of butterfly, single species of fish, 2 species of amphibian, 2 species of reptile, 99 species of bird, and 29 species of mammal.

Upper Mustang harbours 11 species of bird and 10 spp. of mammal listed in different appendices of the CITES. Six of the mammal spp. recorded from the area are protected by HMG Nepal, National Parks and Wildlife Conservation (NPWC) Act 1973 and 7 are included in different threat categories of the Red Data Book of IUCN. Five spp. of butterfly, extinct mollusca spp. (saligram), 2 spp. of frog, 1 spp. of reptile, 2 spp. of birds - Tibetan sand grouse, *Syrrhaptes tibetanus* and Eurasian eagle owl sub species, *Bubo bubo hemachalana* - and 7 species of mammal found in the area have so far not been recorded from any other part of the country (UMCAMP, 2005). The area also serves as corridor for many passage and trans-Himalayan migratory birds.

3.3. Socioeconomic description

The population is exclusively of Tibetan ethnicity following Buddhism. Known as the *Loba* the population comprises of three caste or social groups - the Bistas, who comprise the Mustang royalty and the aristocracy, the Gurungs - who form the bulk of the population and the Biswakarmas, the lowest in the social rung are the occupational caste group. The *Loba* social life is represented by three institutions all of which lie outside the formal structure of local governance. These are the *Mustangi Raja*, the *Mukhiya* system and the monastery. Age old

Village Development Committees (VDCs) of Upper Mustang



Map 1. Location of the Lo Manthang VDC along with other VDCs in Upper Mustang

4. METHODOLOGY

4.1. Assessment of the plant communities between controlled and open plots

For long term assessment of the pastures and to measure the impact of grazing, the project has established three controlled plots (1.5mx1.5m, protected by gabion wire with iron poles at the four corners) during 2003 and 2004 at pasture of Lo Manthang VDC. From each main plot, a sub plot one in north and one in south direction of size 20x20 cm were taken for study (Figure 1). A 100 m transect was drawn systematically with the help of GPS towards the north of the controlled plots to locate the open plots. Open plots each of size 1.3x1.3 m was established corresponding to the controlled plots for comparing the data between grazed i.e. open and ungrazed plots i.e. controlled. Altogether, six subplots of controlled and six of open were studied during July and November 2005. The sub plots taken for study during November were just opposite to those taken during July with the assumption that the plots harvested for biomass calculation during July wouldn't grow to give good yield for the study during November.

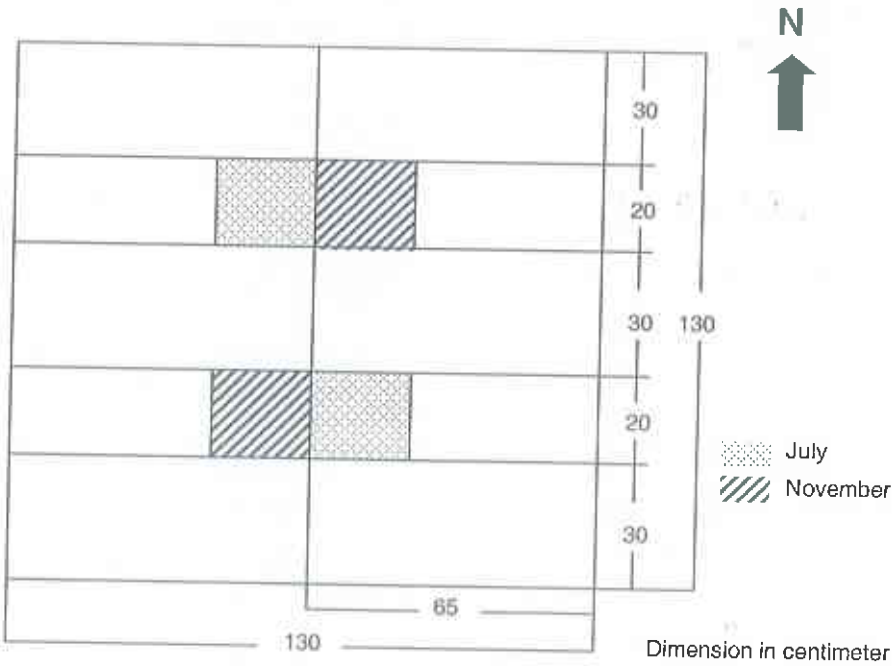


Figure 1. Lay out of the sub plots studied during July and November

4.1.1. IVI, cover, height and phenology

The floristic components in the controlled and open plots were studied and types of species were identified and categorized as high, medium, low and non palatable species based on previous records (Chetri and Gurung, 2004). The following quantitative characteristics of the vegetation were determined using the following formula given by Zobel *et al.*, (1987).

$$\text{Frequency} = \frac{\text{No. of plots with the individual species}}{\text{Total no. of plots studies}} \times 100$$

$$\text{Relative frequency (RF)} = \frac{\text{Frequency of any one species}}{\text{Total frequency of all species}} \times 100$$

$$\text{Density} = \frac{\text{Total no. of individual species in all plots}}{\text{Total no of plots} \times \text{area of plots}} \times 100$$

$$\text{Relative Density (RD \%)} = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

$$\text{Relative Coverage (RC)} = \frac{\text{Coverage of a species}}{\text{Total coverage}} \times 100$$

$$\text{Importance value index (IVI)} = RF+RD+RC$$

Height and phenological characteristics of the species encountered were recorded.

4.1.2. Indices of species diversity, richness and evenness

The Shannon diversity index (H´; Shannon and Weiner's, 1963),

$H' = 3.3219 \{N \log N - \sum ni \log ni/N\}$

was used to measure diversity between controlled and open plots, where N = total number of individuals of all species, and ni = total number of individuals of a species.

Richness was calculated as the number of species recorded (Stirling and Wilsey, 2001). For measuring evenness there are several indices available (Ricotta and Avena, 2000). In the

present study, the Pielou index (J´; Pielou, 1975) is used because it is one most frequently used. The Pielou index is described as J´ = H´/H max, where H´ is the Shannon diversity index and H´max is the maximum value of H´ (maximum possible diversity) in the community, if all the plant species are equally frequent.

Index of similarity gives the degree of similarity in terms of which species are present. It was calculated by applying formula given by Jaccard's (Zobel *et al.*, 1987):

IS_J = C/A+B-C x 100

Where A = total number of species in one sample, B = total number of species in another sample and C = total number of common species in both samples.

4.1.3. Biomass - controlled vs. open plots

Plant species were cut close to the ground surface, separated on the basis of palatability and collected in plastic zipper bag. Fresh weight of the species based on palatability was measured on the spot with the help of Digital Balance (Denver Instrument No: 98648-012-35). Unidentified species were clipped separately. A herbarium of the unidentified plant species was prepared for later identification. In order to reduce the moisture contents, the collected samples were air dried for 48 hrs and transported to Institute of Forestry, Pokhara for dry weight measurement. The samples were oven dried at 70°C for 24 hrs for dry weight measurement and the dry biomass percentage was calculated using the formula:

% dry Biomass = Dry weight/Fresh weight x 100 (Zobel *et al,*. 1987)

4.2. Categorization of pasture of Lo Manthang VDC

4.2.1. Pasture boundary delineation

The pasture units (patches of pasture with specific name given by locals) used by Lo ManthangVDC were identified by observing from the vantage points and the corresponding boundaries were delineated in the Topographic map (Topo sheet No. 2983.16, 2984.13 / 9) published by the survey department of HMG, Nepal in 2001. Local names of the units were recorded based on key informant's information. The information so obtained was cross checked with reference to 3-D model of the VDC prepared by the project.

4.2.2. Vegetation cover estimation

Total vegetation cover, grassland cover and shrub land cover of the pasture units was estimated by taking ground truth data. Plant transect of 100m length were laid in 15 pasture units randomly. It couldn't be laid in all the units because of snow. Five vegetation plots of 1m×1m size were incrementally placed at 20 m interval along the transect length. Species were identified and the corresponding cover, life form and phenology were recorded.

The data from project taken during 2004-05 were also used. Finally they were cross checked with the information given by the technical staffs of UMBCP who have been working in the study area.

4.2.3. Pasture condition determination

Pasture condition was determined by giving score to the following attributes corresponding to each of the pasture units:

- Water availability: No = 1 and Yes = 2
- Vegetation cover: 1 for 0-5%, 2 for 6-25%, 3 for 26- 50 %, 4 for 51- 75%, 5 for 76- 95% and 6 for 96- 100% (Gurung, 2004). Cover was estimated as described in 4.2.2.
- Grazing pressure: High = 1, Medium = 2 and Low = 3

The ranking is done on the basis of animal density grazing in the pasture units as follows: High – 250 to 300 / sq.km, Medium – 45 to 55 / sq. km and Low- 25 to 30 / sq. km.

- Accessibility to the pasture units from settlement: Easy= 3,
  Manageable = 2 and Difficult = 1

  For water availability, vegetation cover and accessibility, information was obtained from Focus Group Discussion as described in 4.2.4.

Finally pasture units are ranked according to score as follows: 6 = very poor, 7 to 8 = poor, 9 to 10 = medium and 11 to 12 = good.

4.2.4 Participatory Rural Appraisal (PRA) Techniques

For the Pasture categorization following PRA tools were used (Jackson *et al.*, 2001).

Seasonal Calendar: Seasonal calendar was prepared to assess the seasonal availability of forage. This was then linked with livestock herding pattern in the pastures.

Preference Ranking: This tool was used to collect herders/villagers knowledge regarding pasture quality, important forage, medicinal plants, and wildlife and livestock depredation hot spots.

Focus Group Discussion: Herders/Nomads of Lo manthang were interviewed in-group regarding the rangeland resources, livestock population and wildlife depredation.

Discussion with key informant (N = 20): Individual discussion was carried out with *Mustangi Rajasaheb,* villagers and stakeholders (VDC Chairperson, Conservation Area Management Committee chairperson, Amchis, Traders) in relation to options for improvement of rangelands of the study area, status of medicinal plants and other range resources.

4.2.5. Map preparation

Map of the pasture units used by Lo Manthang VDC is prepared using the GIS softwares; cartalinx and Arc view 3.2. In the map pasture units, seasonal pasture types, pasture condition and the pasture with conflicts are shown. The boundary of the pasture units delineated on topographic map in field was digitized on screen using the digitized topographic map of the area from secondary source in Arc view 3.2. It was then imported in Cartalinx and the map was edited and finalized. Again by exporting it to Arc view 3.2, the attributes of each of the pasture units gathered in field were joined and area calculation was done.

4.2.6. Statistical Analysis

Independent sample t-test was used at $p<0.05$ in order to test the differences in biomass between the controlled and the open plots. SPSS version 13.1 was used to analyze the data.

4.3. Investigation of the potential sites for pasture improvement

Potential sites for pasture improvement were identified using the following criteria: existing pasture condition, occurrence of economically valuable floral resources, accessibility, and management interventions. The data for these criteria was obtained as under:

- The condition of the pastures units are ranked as mentioned in 4.2.3.
- Pasture units with important Non-Timber Forest Products (NTFPs) and Medicinal and Aromatic Plants (MAPs) were also identified from focus group (Amchis) discussion.
- Accessibility is ranked based on time required to reach the pasture and the easiness of the route.

- Management interventions necessary for the conservation of pasture and its resources were obtained from literature review and group discussion. Their effectiveness were assessed by field visit and discussion with the local people.

5. RESULTS AND DISCUSSION

5.1. Assessment of the plant communities between controlled and open plots

First field survey was done during 8 to 24 July 2005 and the second during 6 to 29 November 2005 in Upper Mustang. During the study period, the experimental plots established by the project at Lo Manthang pasture were surveyed. Data from six open and six controlled subplots were taken.

5.1.1. IVI, cover, height and phenology

Table 1 a & b represents the IVI of the species in July and that in November is represented by Table 1 c & d. Among the highly palatable species in both controlled and open plots in July, *Kobressia* spp. has the highest Importance Value Index of 122.425 and 89.22. A comparison of the medium palatable species *Saussurea nepalensis* showed that open plots have higher IVI (7.410) compared to controlled plots (1.941). *Saxifraga* spp. which is rarely used by the livestock has higher IVI (27.619) in the open plots. This species is licked by yaks especially in winter during the time of scarcity of grasses. When similar species were compared between controlled and open plots, the result indicates that IVI value of the species is higher in the controlled plots during July. In November also *Kobresia* spp. has the highest IVI in both controlled (133.726) and open (112.204) plots. Likewise medium palatable *Saussurea nepalensis* has IVI 6.698 in controlled and 7.578 in open and low *Saxifraga* spp. has 14.736 in controlled and 11.399 in open plot. The difference in IVI is not consistent even with the different species of highly palatable group; species wise response to grazing is different.

Table 1. Frequency and IVI of the species in controlled and open plots during July and November 2005

a. Controlled plots- July 2005 (N=6)

SN.	Species	Palatability	Relative frequency	Relative density	Relative cover	IVI
1	*Carex* spp.	High	0.129	13.115	4.853	18.097
2	*Gentiana ornata*	Low	0.065	4.098	0.511	4.674
3	*Kobressia* spp.	High	0.194	60.929	61.303	122.425
4	*Lancea tibetica*	Low	0.129	4.645	1.149	5.923

5	*Penisetum* spp.	High	0.129	6.831	22.989	29.948
6	*Potentilla plurijuga*	High	0.097	3.005	2.299	5.401
7	*Potentilla* spp.	High	0.097	4.645	2.043	6.785
8	*Saussurea nepalensis*	Medium	0.065	1.366	0.511	1.941
9	*Saxifraga* spp.	Low	0.097	1.366	4.342	5.805

b. Open plots- July 2005 (N=6)

SN.	Species	Palatability	Relative frequency	Relative density	Relative cover	IVI
1	*Anaphalis* spp.	High	9.756	7.885	3.580	21.222
2	*Anaphalis triplinervis*	High	4.878	2.523	1.432	8.833
3	*Androsace* spp.	Low	4.878	0.631	2.864	8.373
4	*Bistorta* spp.	Low	2.439	0.315	0.477	3.232
5	*Carex* spp.	High	12.195	16.402	10.024	38.621
6	*Cortia depressa*	Low	2.439	1.893	0.955	5.286
7	*Euphorbia estachyei*	Non	2.439	0.946	1.432	4.817
8	*Kobressia* spp.	High	14.634	39.743	34.845	89.222
9	*Lancea tibetica*	Low	12.195	5.362	2.148	19.705
10	*Pedicularis* spp.	Non	2.439	0.315	0.239	2.993
11	*Penisetum* spp.	High	4.878	15.455	16.706	37.040
12	*Potentilla plurijuga*	High	2.439	0.631	0.477	3.547
13	*Potentilla* spp.	High	7.317	1.893	1.432	10.642
14	*Saussurea nepalensis*	Medium	4.878	1.577	0.955	7.410
15	*Saxifraga* spp.	Low	4.878	1.262	21.480	27.619
16	Unidentified spp.I	Low	4.878	2.839	0.716	8.433
17	Unidentified spp.II	Low	2.439	0.315	0.239	2.993

c. Controlled plots- November 2005 (N=6)

SN.	Species	Palatability	Relative frequency	Relative density	Relative cover	IVI
1	*Anaphalis* spp.	High	2.778	0.440	0.482	3.700
2	*Androsace* spp.	Low	2.778	0.220	0.241	3.239
3	*Carex* spp.	High	13.889	17.838	8.675	40.402
4	*Kobressia* spp.	High	16.667	56.818	60.241	133.726

5	*Lancea tibetica*	Low	11.111	8.369	4.337	23.817
6	*Pennisetum* spp.	High	16.667	8.589	15.904	41.159
7	*Potentilla plurijuga*	High	8.333	2.422	2.169	12.924
8	*Potentilla* spp.	High	8.333	2.643	1.687	12.663
9	*Saussurea nepalensis*	Medium	5.556	0.661	0.482	6.698
10	*Saxifraga* spp.	Low	8.333	1.101	5.301	14.736
11	Unidentified spp.	Low	5.556	0.881	0.482	6.918

d. Open plots- November 2005 (N=6)

SN.	Species	Palatability	Relative frequency	Relative density	Relative cover	IVI
1	*Anaphalis* spp.	High	8.823	11.983	9.896	30.702
2	*Bistorta* spp.	Low	2.941	0.218	0.521	3.680
3	*Carex* spp.	High	11.765	20.697	9.375	41.837
4	*Kobressia* spp.	High	17.647	39.869	54.688	112.204
5	*Lancea tibetica*	Low	11.765	4.139	3.646	19.550
6	*Pennisetum* spp.	High	2.941	0.871	1.042	4.854
7	*Potentilla plurijuga*	High	5.882	3.268	2.604	11.754
8	*Potentilla* spp.	High	8.823	2.614	4.167	15.605
9	*Saussurea nepalensis*	Medium	5.882	0.654	1.042	7.578
10	*Saxifraga* spp.	Low	5.882	1.089	4.427	11.399
11	*Thalictrum* spp.	Low	2.941	0.218	0.521	3.680
12	Unidentified spp. I	Low	2.941	0.218	0.260	3.419
13	Unidentified spp.	Low	11.765	14.161	7.813	33.738

The comparison of average cover of the highly palatable species viz. *Carex* spp., *Kobressia* spp. and *Penisetum* spp. shows that the average cover is higher in controlled plots than in open in both the months (Table 2). Plant cover allows a rapid assessment of plant community health and, as such, it would be a better indicator given that rapid response is a desirable feature of sensitive indicators (Meyer and Garcý´ a-Moya, 1989).

Table 2. Mean cover of the species in controlled and open plots during July and November 2005

SN	Species	July 2005		November 2005		Palatability
		Controlled	Open	Controlled	Open	
1	*Anaphalis* spp.	-	1.88	2.00	6.33	High
2	*Anaphalis triplinervis*	-	1.50	-	-	High
3	*Androsace* spp.	-	3.00	1.00	-	Low
4	*Bistorta* spp.	-	1.00	-	1.00	Low
5	*Carex* spp.	4.75	4.20	7.20	4.50	High
6	*Cortia depressa*	-	2.00	-	-	Low
7	*Euphorbia estachyei*	-	3.00	-	-	Non
8	*Gentiana ornata*	1.00				Medium
9	*Kobressia* spp.	40.00	12.17	41.67	17.50	High
10	*Lancea tibetica*	1.13	0.90	4.50	1.75	Low
11	*Pedicularis* spp.	-	0.50	-	-	Non
12	*Penisetum* spp.	22.50	17.50	11.00	2.00	High
13	*Potentilla plurijuga*	3.00	1.00	3.00	2.50	High
14	*Potentilla* spp.	2.67	1.00	2.33	2.67	High
15	*Saussurea nepalensis*	1.00	1.00	1.00	1.00	Medium
16	*Saxifraga* spp.	5.67	22.50	7.33	4.25	Low
17	*Thalictrum* spp.	-	-	-	1.00	Low
18	Unidentified spp.	-	-	1.00	3.75	Low
19	Unidentified spp.I	-	0.75	-	0.50	Low
20	Unidentified spp.II	-	0.5	-	-	Low

The comparison of mean height of the highly palatable species viz. *Carex* spp., *Kobressia* spp. and *Penisetum* spp. (Table 3) shows that the mean height of *Carex* spp. and *Kobressia* spp. is higher in open plots than in controlled plots in July. This is just opposite in November for *Carex* spp. and *Kobressia* spp. However mean height of *Penisetum* spp. is higher in controlled plots in both the months.

Table 3. Mean height (cm) of the species in controlled and open plots during July and November 2005

SN	Species	July 2005		November 2005		Palatability
		Controlled	Open	Controlled	Open	
1	*Anaphalis* spp.	-	1.25	2.00	1.00	High
2	*Anaphalis triplinervis*	-	1.25	-	-	High
3	*Androsace* spp.	-	3.00	1.00	-	Low
4	*Bistorta* spp.	-	3.00	-	3.00	Low
5	*Carex* spp.	3.00	4.80	6.20	4.00	High
6	*Cortia depressa*	-	3.00	-	-	Low
7	*Euphorbia estachyei*	-	7.00	-	-	Non
8	*Gentiana ornata*	1.75	-	-	-	Medium

5.1.2. Indices of species diversity, richness and evenness

Table 5 represents plant species diversity (H´ diversity, maximum possible diversity, evenness and species richness) in the controlled and open plots in July and November. In the open plots during July and November, H´ diversity, maximum possible diversity, evenness and species richness was higher in comparison to controlled plots. The species richness based on palatability of the species is also different; higher numbers of palatability types are in open plots (Figure 2). The findings of the present study is in agreement with the generalization made by McIntyre *et al.*, 2003 and Sternberg *et al.*, 2000 that grazing increases the species diversity at small scale. But Pyeyo *et al.*, 2006 reported that the plant community structure analysis is more sensitive than the diversity indices to grazing treatments. The overlap of species in the controlled and the open as measured by Jaccard's index was 44% in July and 71% in November. The high degree of overlap indicates that the controlled and open plots share many of the same species.

Table 5. Diversity index, species richness and index of similarity

	July					November				
Plot type	H´	Hmax	SR	J´	IS_J	H	Hmax	J´	SR	IS_J
Controlled	2.01	3.17	9	0.63		2.01	3.46	0.58	11	
Open	2.79	4.09	17	0.68	44%	2.49	3.70	0.67	13	71%

Note: H´= Shannon diversity index; Hmax = Maximum possible diversity; SR=Species Richness; J´ = Pielou index and IS_J = Jaccard index of similarity

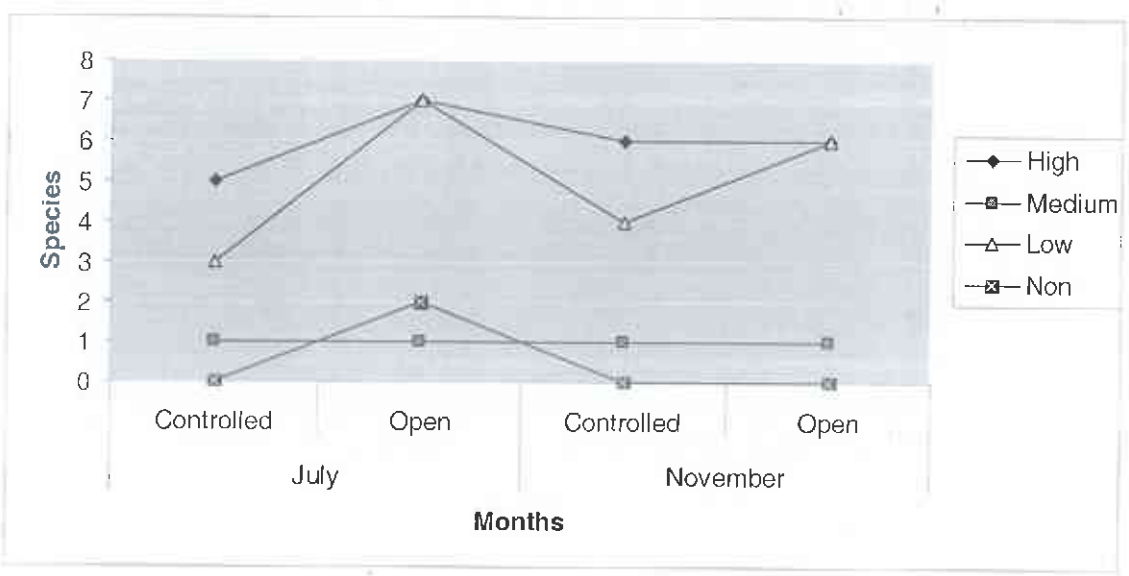


Figure 2. Species richness based on palatability

5.1.3. Biomass - controlled vs. open plots

In July percentage biomass of high, medium and low palatable species is greater in controlled plots than in open (Figure 3). Non palatable species was recorded only in open plots. However in November the percentage biomass in controlled and open plots didn't vary in less and medium palatable species but is greater in open of highly palatable species.

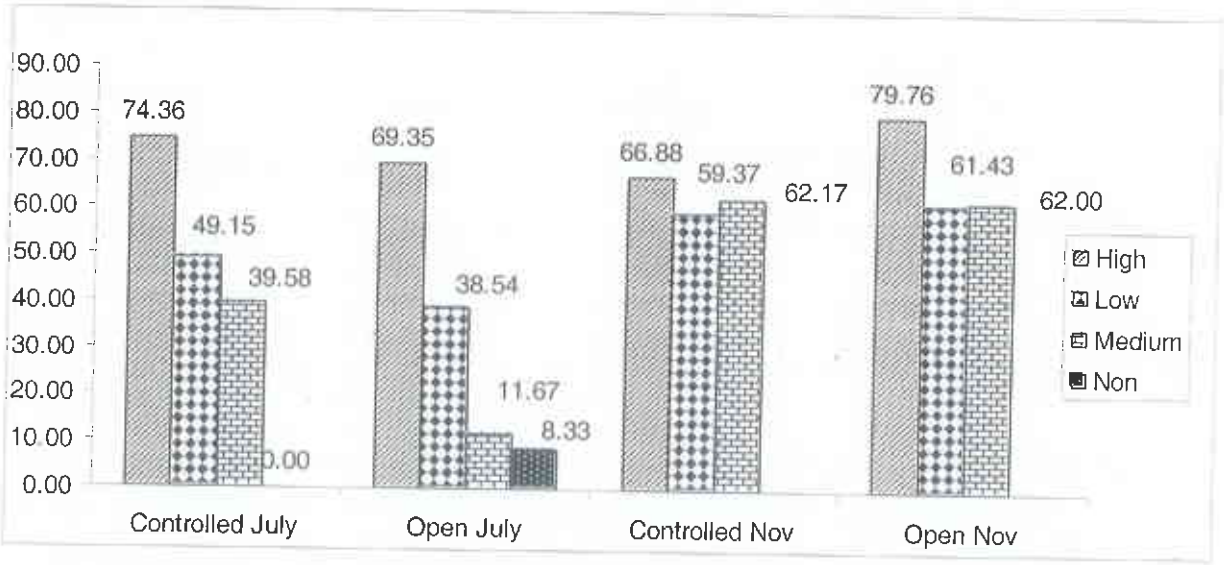


Figure 3. Mean percentage of dry biomass in the controlled and open plots based on palatability

Independent sample t-test showed a significant difference in dry biomass between the controlled and open plots in July but no significant difference was found in November (Table 6). The unexpected heavy snowfall during October has affected the vegetation composition of the pastures. Samples were taken after twenty one days when snow melted from the experimental sites. Thus actual biomass is underestimated and t-test failed to detect the differences between the compared plots. Detailed species wise biomass percentage is given in Annex I.

Table 6. Result of Independent sample t-test – biomass controlled vs. open

Months	F	Sig.	t	df	Sig. (2 tailed)
July	11.697	0.002	2.681	22	*0.014
November	0.772	0.389	-1.067	22	0.298

Note: * Significant difference, $p<0.05$

5.2. Categorization of pasture of Lo Manthang VDC

Pastures of Lo Manthang are an important for nomads for sustaining their livelihood. The nomads have been using these pastures throughout the year with only short distance migration. Livestock such as horse, lulu cow, yak, dzos, sheep, goat, mule and donkey are reared by the people of Lo Manthang VDC (Figure 4). Altogether 7,043 heads were recorded (CAMOP draft., 2005). Average livestock density is 27.32/km^2 in the pastures.

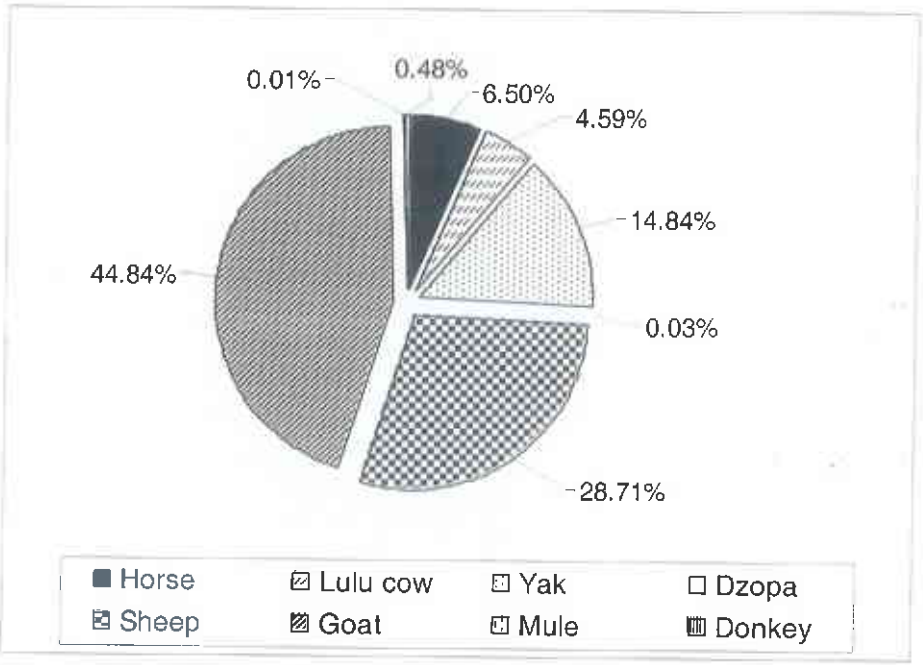


Figure 4. Livestock composition of Lo Manthang VDC

Animal husbandry is the major source of income for the majority of the people of Lo Manthang VDC. Horse, lulu cow, yak, dzopa, sheep, goat, mule and donkey are the animals reared by the people. Bulk of the population of livestock comprises of goat and sheep (45 and 29%, Figure 4).

Altogether 44 pasture units (Map 2, Table 7) and 10 seasonal pasture types (Map 3) have been identified with the total area of 257.753 sq kms (Map 3, Table 8). Summer pasture shares the highest proportion followed by winter. These pastures are used by Nomads on rotational basis but villagers do not follow rotational grazing. As a result pressure is high in the pastures. Herders informed that grasses from these pastures are sufficient for only 4-5 months in a year to feed the livestock. Forage scarcity is a great problem during winter and spring season.

The pasture units with code no. 39, 41, 42, 43 and 44 (see Map 2) lie in the political boundary of Chhoser VDC, however nomads of Lo Manthang VDC have been using these areas. *Mustangi*

Raja informed that case was filed by Lo Manthang and Chhoser VDC for these areas during *Panchayati* rule and finally decision was made in favour of Lo ManthangVDC. Since then these pastures are counted under Lomanthang's pasture but still conflict exists in case of no. 44 (Dhalung) pasture with Chhoser VDC.

The distribution of grazing pressure is high in 29, medium in 12 and low in 3 pasture units. Thirty pasture units are easily accessible from the settlement, 8 are manageable while 6 are very difficult. Likewise livestock movement within 20 pastures is easy, manageable in 8 and difficult in 16. Although the area is very dry, thirty two pastures have water availability and 12 are suffering due to water scarcity since they don't have the source. Vegetation cover class is 6-25% in 3 units, 26-50% in 21 units, 51-75% in 16 units and 76-95% in 4 units. Along with the aforementioned features, plant species, livestock, and wild animals, no of corals, herding camps and all other details obtained during the field study of the pasture units are systematically represented during the present study (Annex II).

Eight pasture units (about 38.5% of the total area) are found to be in good condition, 22 (39 % of the total area) in medium, 13 in bad (22% of the total area) and 1 (0.5% of the total area) in very bad condition (Map 4, Table 9). In almost all the pastures problem of dung collection and uprooting of bushes was seen. Pasture units on both side of the trade route are facing more pressure due to traders' herds. There is high difference in livestock density in the pastures, areas lying near the settlement are facing high pressure of 250 – 300 animals/sq. km and the distant pastures have low grazing pressure of 25 – 30 animals/sq. km. If the livestock were uniformly distributed through the pasture the density would have been 27/sq. km. which in turn will reduce the high pressure in the rangelands.

Five pasture units (Map 5) have boundary conflict with other VDCs .These units are facing more pressure since the conflicting VDCs use the areas for grazing livestock and collecting animal dung.

Pasture units no.13 – Kekyap (see Map 2) is religiously restricted pasture. Herders are not allowed to take their herds to this pasture once fields are cultivated till the harvesting time. It is believed that if the Kekyap pass is crossed during this period, God gets angry and in turn disasters like draught, wind occur leading to the total crop failure. Villagers informed that such total crop failure had occured for the last time in 2001. Anyone caught crossing the pass is fined heavily ranging from Rs. 15,000 to 20,000.

Map 6 shows the pasture units in which habitat are overlapping between livestock and wildlife. More than 26% of the total area of pastures is overlapping with blue sheep (*Pseudois nayaur*) followed by 13.2% with Tibetan gazelle (*Procapra picticaudata*).

The pastures have diversified species composition. From the pasture units 107 plant species belonging to 36 families (6 grass spp., 81 herbs spp., 16 shrub spp., 3 trees spp. and 1 fungus) are recorded (Annex III). The pasture is also home to several rare, endangered and common mammalian species unique to the region.

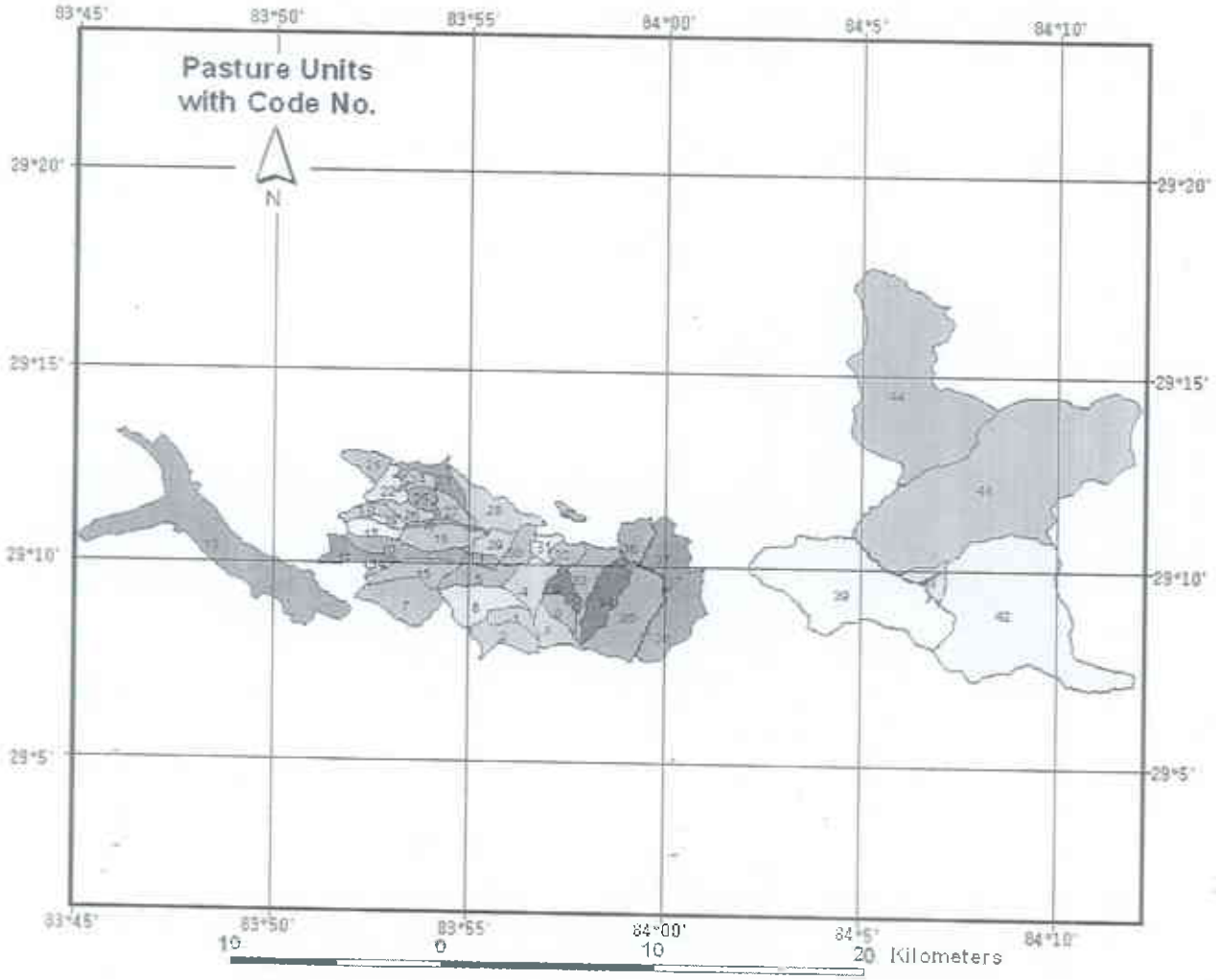
Table 7. Pasture types according to seasonal use and units

Season	Sp	Su	W	A	C	Su+W+Sp	Su+A	Su+A+Sp	Su+W	W+Sp
Unit code no	43	17	13	23	40	2	24	27	38	8
		44	37		9		25		35	34
		22	36		28		26		1	6
		12	33		5					3
		14	39		32					4
		19			31					
		18			20					
		41			29					
		21			11					
		7			30					
		15								
		10								
		42								
		16								
Total	**1**	**14**	**5**	**1**	**10**	**1**	**3**	**1**	**3**	**5**

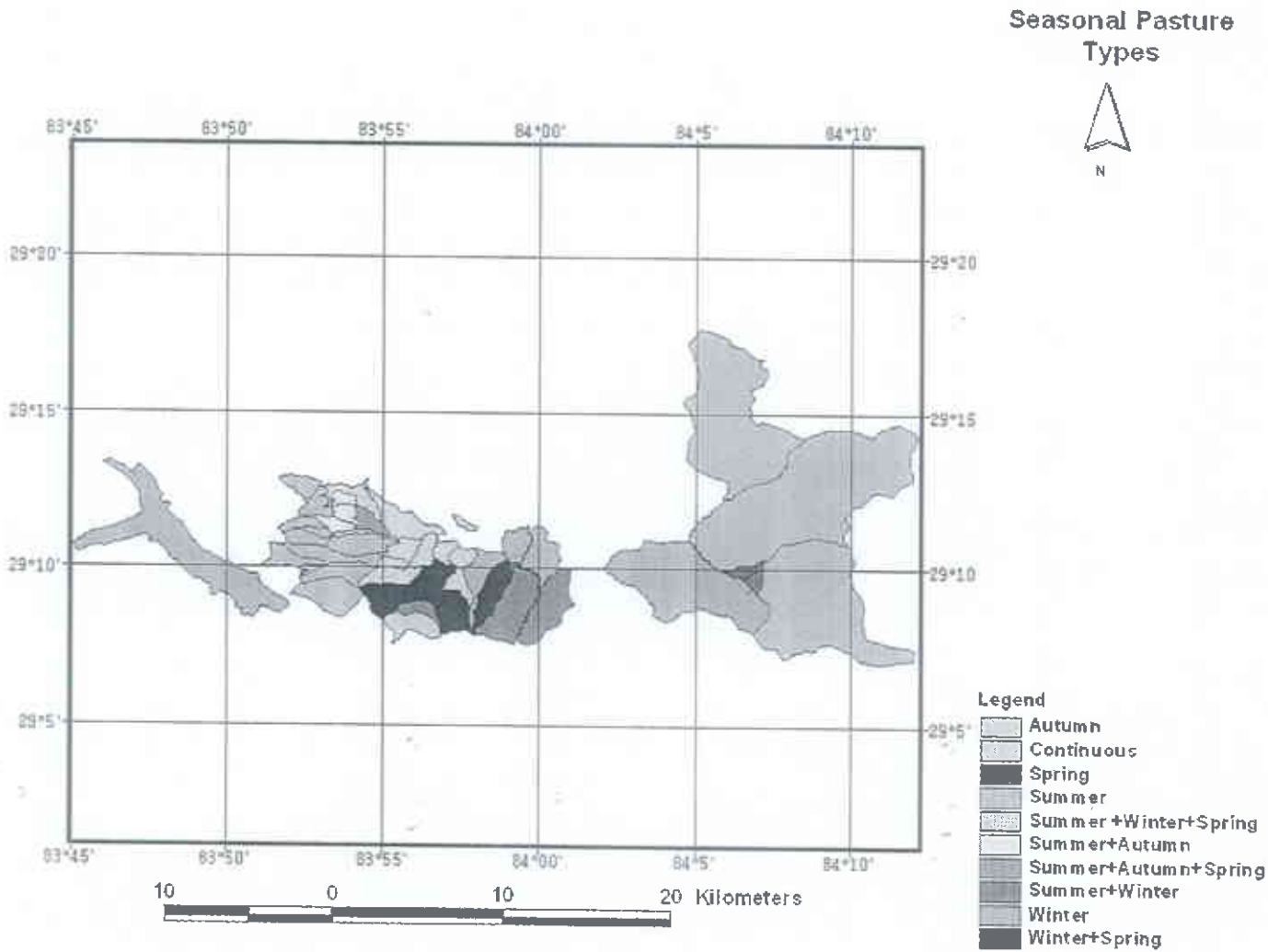
Note: Sp= Spring, Su= Summer, W= Winter, A= Autumn and C= Continuous

Table 8. Area of the seasonal pasture types

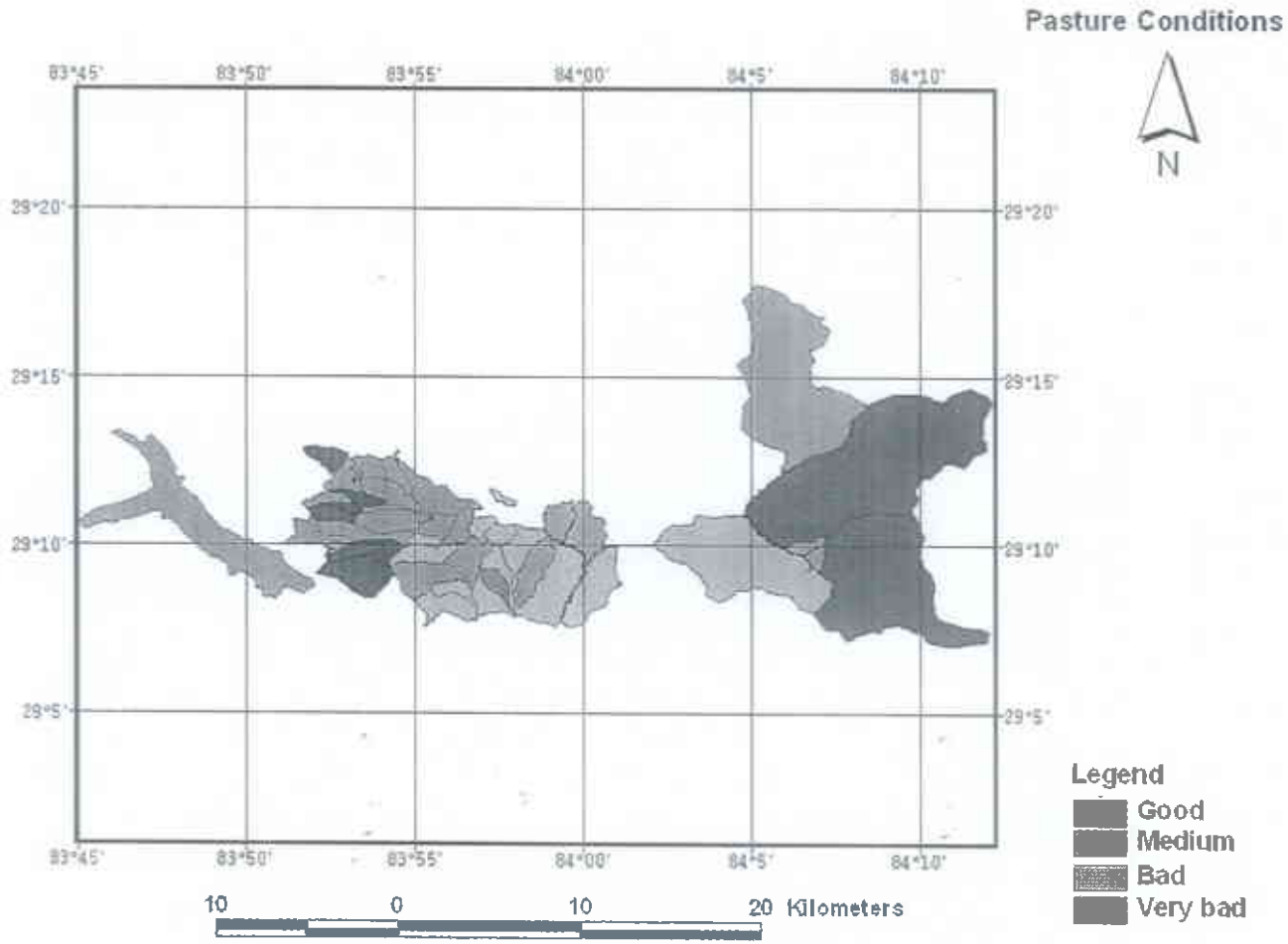
Pasture Type (Season)	Area (Km^2)	% of Total area
Autumn	2.155	0.836
Continuous	16.425	6.373
Spring	1.743	0.676
Summer	144.189	55.941
Summer +Winter+Spring	3.071	1.191
Summer+Autumn	3.477	1.349
Summer+Autumn+Spring	1.520	0.590
Summer+Winter	15.200	5.897
Winter	54.848	21.279
Winter+Spring	15.126	5.868
Grand Total	**257.753**	**100.000**



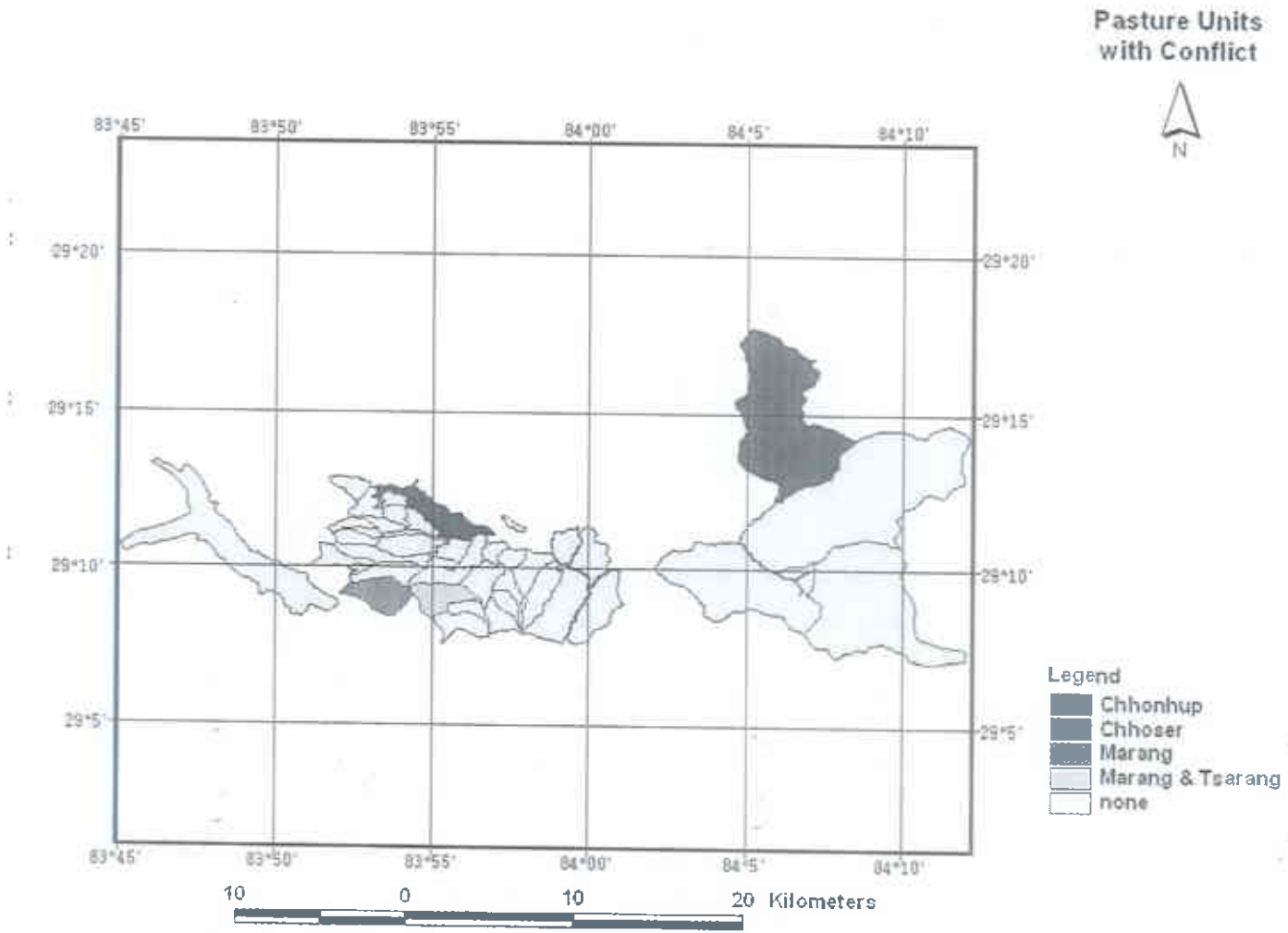
Map 2. Pasture units of Lo Manthang VDC with codes



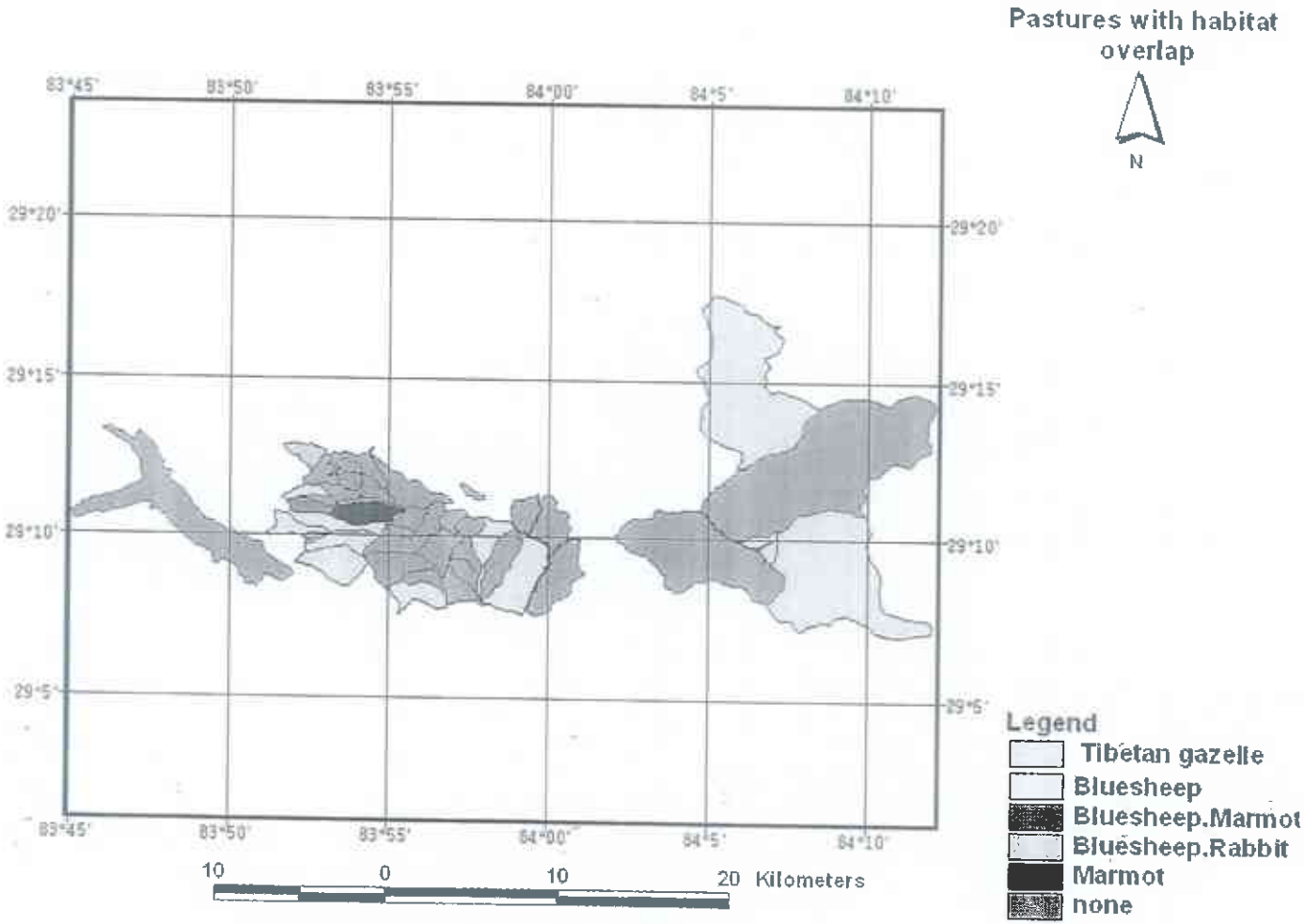
Map 3. Seasonal pasture types of Lo Manthang VDC



Map 4. Conditions of pasture units of Lo Manthang VDC



Map 5. Pasture units with conflict



Map 6. Pastures with habitat overlap of wildlife with livestock

5.2.1. Nomads and Pastoralists

Nomadism is an age old practice existing in the high altitude pastures of Upper Mustang. Presently 9 families of nomads are residing in the area. Total population is 44 with an average household size of 5. Their livelihood is entirely dependent upon animal husbandry. Total number of livestock owned is 2,548 which comprises of yak (530), horse (13), and goat & sheep (2,005). They move to different pastures in different seasons (figure 5).

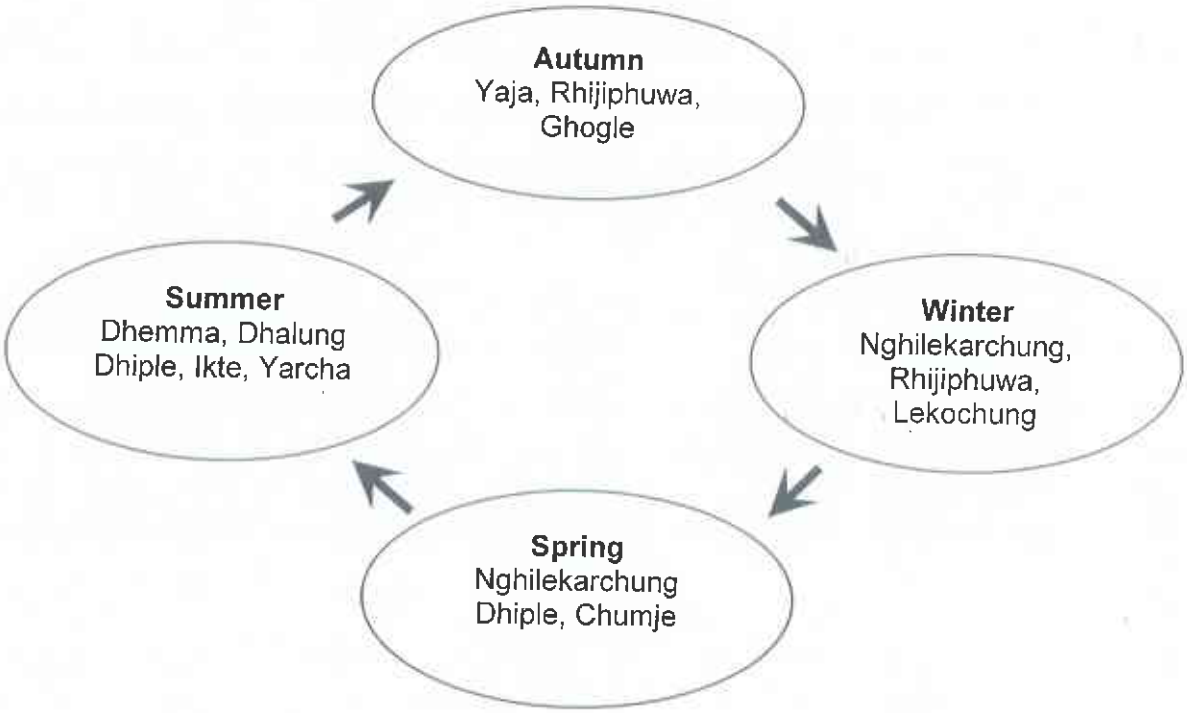


Figure 5. Mobility pattern of Nomads

Nomads don't have to pay any tax to the VDC for using the rangeland but they are not allowed to use winter pasture.Their livestock freely roam in the pastures without any herders and are monitored at least once in a month. The female yaks are brought home for milking in the evening. Main source of earning is Yak selling. Additional money is generated by selling dung to the villagers. Rate is fixed by the VDC at Rs.50, as per the weight that can be carried by one horse.

Nomads are surviving in very harsh environment. They have to face several problems like severe cold in the winter, lack of health facilities, and loss due to depredation of their livestock by wild animals. Unpredicted snowfall sometimes ended in great economic loss in the high

altitude winter pasture. During December of 2004, 130 yaks have been killed in Kekyap pasture due to heavy snow fall (Chhimi Rinjin Gurung, *pers. comm.*).

5.3. Investigation of the potential sites for pasture improvement

Thirteen pasture units are in bad condition and 1 in very bad (see table 6). Pasture Management Sub Committee should give priority to these 14 units while implementing pasture improvement programs.

Medicinal plants are found through out the pasture units however 3 areas have been found which are extremely rich in invaluable medicinal plants through discussion with the Amchis. These three areas Ghyagatyo (pasture code no. 22), Kokche, Chumja (pasture code no. 18 and 19) should be exclusively protected for medicinal plants. Amchis were of the opinion that medicinal plant ***Tyanko*** (*Dracocephalum tanguticum*) is found only in Mustang however research on this aspect is lacking.

Water availability is problem in 12 pasture units (see Annex II). Animals cannot graze in these areas without water so it is very important to explore the possibility of water holes construction which will ultimately increase grazing areas and thus decrease grazing pressure in other areas.

Trials from the settlement to the pasture units should be improved for 6 units where accessibility is very difficult and that should be improved in 16 pasture units (see Annex II) where movement within the units is very difficult.

Livestock depredation is very high in pasture no.35 (Muri) and 39 (Rhijiphuwa), coral should be constructed in these areas. Four corals in pasture no.36 (Marchung/ Sakau) were improved by the project in 2004, herders reported that this improvement has relieved from the loss of livestock mainly due to Snow leopard (*Uncia uncia*). Likewise pilot testing of electric fencing of the coral in pasture unit no.41 (Chhujung) has been very effective in safeguarding the livestock against wildlife.

6. CONCLUSION AND RECOMMENDATIONS

Plant communities' assessment showed that *Kobressia* spp. a highly palatable species is dominating both the controlled and open plots. This species has higher Importance value index in both controlled and open plots during July and November. Among the medium palatable species *Saussurea nepalensis* have higher importance value index. Similarly *Saxifraga* spp. which is rarely grazed by the livestock has higher IVI in the open plots. The comparison of average cover of the highly palatable species viz. *Carex* spp., *Kobressia* spp. and *Penisetum* spp. shows that the average cover is higher in controlled plots than in open in both the months. Similarly mean height of *Penisetum* spp. is higher in controlled plots in both the months. Phenology of the species showed that July is the peak growing season where as most of the species reach dormancy during November. Species diversity showed that the open plots are more diversified than the controlled plots. In July percentage biomass of high, medium and low palatable species is greater in controlled plots than in open. A significant difference is detected by t-test in July but not in November. This indicates that the pasture has some impact due to livestock grazing.

Forty four pasture units with ten seasonal pasture types have been identified with the total area of 257.753 sq kms. Summer pasture shares the highest proportion followed by winter. Majority of the pastures have high grazing pressure. Of the total pasture units identified during the present study grazing pressure is high in 66.0%, medium in 27.2% and low in 6.8%. Likewise livestock movement within 45.5% pastures is easy, manageable in 18.1% and difficult in 36.4%. More than 55.5% pasture units have vegetation cover less than 50%. There is high difference in livestock density in the pastures. Areas lying near the settlement are facing high pressures and the distant pastures have low grazing pressure. Five pasture units have boundary conflict with other VDCs .These units are facing more pressure since the conflicting VDCs use the areas for grazing livestock and collecting animal dung. Kekyap is the only pasture found in the study area which is religiously restricted. This restriction eventually avoids competition and habitat overlap with wildlife during the summer season.

Analysis of grazing pressure, access, water availability and vegetation cover showed that 13 pasture units is in bad condition and one is in very bad conditions which require urgent attention for its management and conservation. Lo Manthang VDC pasture has diversified floristic composition and is home to many endangered wildlife. Therefore management and conservation of the pastures is important and equally challenging.

Based on the findings of the present study following recommendations are proposed for the conservation and management of Lo Manthang VDC pastures.

- Forage scarcity is a great problem during winter and spring season. To minimize this problem some of the areas which are grazed during summer and throughout the year be restricted for scarce period. Restriction for areas should be developed through participatory discussion with all the villagers, herders and nomads.

- Nomadism is still in practice in Upper Mustang. Altogether nine families of nomads are using the Lo Manthang VDC pasture. Rotational grazing is still in practice among the nomads' families but is found very weak among the villagers. So it is necessary to encourage villagers to follow the traditional rotational grazing practices which eventually avoids overflow of livestock in the pasture.

- Some of the pasture units are suffering from high grazing pressure and some others have lower number of grazing animals due to inaccessibility and scarcity of water. To make the pressure uniform it is recommended that management interventions be undertaken as required.

- Dung collection and uprooting of the bushes (*Caragana* spp.) and shrubs (*Lonicera* spp.) should be discouraged. These problems exist in almost all the pasture units. Areas near the settlement are seen without any bushes. Result would be same in all the pasture units too if the problem is not controlled on time. Dung and roots are used for fuel so use of alternative source of energy like solar should be encouraged.

- Traditional cultural beliefs existing in the area should be promoted as an opportunity for conservation of the rangeland.

- Some villagers are of the opinion that their range resource will always remain the same. They even opined that overgrazing is just rumor. So range conservation education should be organized for the villagers.

- The area has very limited livelihood options. One important option could be farming of medicinal plants for economic upliftment. Despite the richness in medicinal plants, local

people are not able to derive economic benefit through them. To achieve this farming of medicinal plants should be encouraged and at the mean time market should be sought.

- The pastures lying on both side of traders' route are getting more pressure because of the herds brought from China. Some control mechanism like levying tax should be developed.

- Pasture area management sub-committees needs further strengthening to implement the activities mentioned in its action plan.

- Establishment of additional controlled plots at different altitudes, slope and aspect will help in overall assessment of the range conditions in Upper Mustang. Future research on vegetation dynamics linked with climate data and soil properties and other human disturbances in order to find out how various parameters affect range condition is thought essential. The outcome of such study will provide a basis for policy formulation in rangeland management in Nepal.

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Annex I. Percentage dry biomass recorded during July and November in the study plots

Plot No/Site	Plot type	Palatability	Fresh wt (gm) July	Dry wt (gm) July	% Dry biomass July	Fresh wt (gm) Nov	Dry wt (gm) Nov	% Dry biomass Nov
1N	Controlled	High	0.70	0.38	54.29	12.00	5.04	42.00
1N	Controlled	Medium	0.20	0.09	45.00	1.00	0.31	31.00
1N	Controlled	Low	8.20	5.84	71.22	15.00	7.44	49.60
1N	Controlled	Non	0.00	0.00	0.00	0.00	0.00	0.00
1N	Controlled	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
		Total	9.10	6.31	69.34	28.00	12.79	45.68
1S	Controlled	High	2.90	2.55	87.93	4.10	2.71	66.10
1S	Controlled	Medium	0.10	0.06	60.00	0.30	0.28	93.33
1S	Controlled	Low	2.90	2.24	77.24	0.25	0.15	60.00
1S	Controlled	Non	0.00	0.00	0.00	0.00	0.00	0.00
1S	Controlled	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
		Total	5.90	4.85	82.20	4.65	3.14	67.53
2N	Open	High	1.50	1.11	74.00	1.60	1.23	76.88
2N	Open	Medium	0.10	0.03	30.00	0.10	0.07	70.00
2N	Open	Low	29.00	19.10	65.86	4.70	3.39	72.13
2N	Open	Non	0.00	0.00	0.00	0.00	0.00	0.00
2N	Open	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
		Total	30.60	20.24	66.14	6.40	4.69	73.28
2S	Open	High	0.40	0.30	75.00	1.80	1.38	76.67
2S	Open	Medium	0.20	0.08	40.00	0.50	0.27	54.00
2S	Open	Low	7.10	5.72	80.56	0.00	0.00	0.00
2S	Open	Non	0.00	0.00	0.00	0.00	0.00	0.00
2S	Open	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
		Total	7.70	6.10	79.22	2.30	1.65	71.74
3N	Controlled	High	3.20	2.46	76.88	4.00	2.51	62.75
3N	Controlled	Medium	0.40	0.21	52.50	0.00	0.00	0.00
3N	Controlled	Low	1.40	0.93	66.43	0.60	0.32	53.33
3N	Controlled	Non	0.00	0.00	0.00	0.00	0.00	0.00
3N	Controlled	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
		Total	5.00	3.60	72.00	4.60	2.83	61.52
3S	Controlled	High	2.90	2.31	79.66	4.00	3.31	82.75
3S	Controlled	Medium	0.20	0.16	80.00	0.00	0.00	0.00
3S	Controlled	Low	0.05	0.04	80.00	1.10	0.82	74.55
3S	Controlled	Non	0.00	0.00	0.00	0.00	0.00	0.00
3S	Controlled	Unidentified	0.00	0.00	0.00	0.00	0.00	0.00
		Total	3.15	2.51	79.68	5.10	4.13	80.98
4N	Open	High	3.50	2.38	68.00	1.60	1.43	89.38
4N	Open	Medium	0.00	0.00	0.00	0.00	0.00	0.00
4N	Open	Low	2.70	1.48	54.81	0.90	0.64	71.11
4N	Open	Non	0.05	0.01	20.00	0.00	0.00	0.00

Annex II. Key features of Lo Manthang pasture recorded during the study period according to mapping unit code

1. PASTURE NAME: NGHILE KARCHUNG		
Total area	:	1.52 Km^2
Total vegetation cover	:	45% (Grassland - 30%, Shrubland- 15%, Bareland- 55%)
Main floristic composition	:	*Caragana gerardiana, Penisetum* spp., *Stipa* spp., *Elymus* spp., *Ephedra gerardiana, Aster himalaicus, Tanacetum nubigenum, Artemisia* spp., *Astragalus* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep (winter), horse, lulu cow, goat and sheep (summer)
Corrals	:	Two
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1.5 to 2 hrs.
Accessibility to pasture	:	Manageable
Movement with in the pasture	:	Manageable
Grazing season	:	Summer + Winter
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	-
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Not available

2. PASTURE NAME: TEGATHONG		
Total area	:	3.07 Km^2
Total vegetation cover	:	50% (Grassland - 35%, Shrubland - 15%, Bareland – 50%)
Main floristic composition	:	*Caragana gerardiana, Lonicera* spp., *Stipa* spp., *Elymus* spp., *Penisetum* spp., *Tanacetum nubigenum Aster himalaicus, Artemisia* spp., *Astragalus* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Cattle, goat and sheep
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	2.5 to 3 hrs.
Accessibility to pasture	:	Manageable
Movement with in the pasture	:	Manageable
Grazing season	:	Summer + Winter+ Spring
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Low

Uprooting of bushes and shrubs	:	-
Availability of water	:	Not available

3. PASTURE NAME: SUMRA		
Total area	:	2.19 Km^2
Total vegetation cover	:	40% (Grassland - 10%, Shrubland - 30%, Bareland – 60%)
Main floristic composition	:	*Caragana gerardiana*, *Artemisia* spp., *Artemisia* spp. I, *Penisetum* spp., *Stipa* spp., *Rosa sericea*, *Ephedra gerardiana*, *Tanacetum nubigenum*, *Astragalus* spp., *Sophora moorcroftiana.*
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Yak, goat and sheep
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1.5 to 2 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Winter + Spring
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Grey wolf (*Canis lupus*), Golden jackal *(Canis aureus)* , Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Red fox (*Vulpes vulpes*)
Annual No of kills	:	2 to 3
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Low
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Not available

4. PASTURE NAME: THULUNG		
Total area	:	3.28 Km^2
Total vegetation cover	:	40% (Grassland - 15%, Shrubland - 25%, Bareland – 60%)
Main floristic composition	:	*Caragana gerardiana*, *Artemisia* spp., *Potentilla* spp., *Penisetum* spp., *Stipa* spp., *Lonicera* spp., *Ephedra gerardiana*, *Tanacetum nubigenum*, *Astragalus* spp.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Goat, sheep
Corrals	:	Three
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1 to 1.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Winter + Spring
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Grey wolf (*Canis lupus*), Golden jackal (*Canis aureus*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Grey wolf (*Canis lupus*), Golden jackal (*Canis aureus*)
Annual No of kills	:	10 to 15

		marmot (*Marmota bobak*), Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	Yes
Predators	:	Golden jackal (*Canis aureus*)
Annual No of kills	:	2 to 3
Other Causes of Livestock loss	:	Marshy land (1-2)
Collection of animal dung	:	Medium
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Boundary conflict with Marang & Tsarang

7. PASTURE NAME: KONGMO		
Total area	:	5.01 Km^2
Total vegetation cover	:	90% (Grassland - 75%, Shrubland -15%, Bareland – 10%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Saxifraga* spp., *Androsace* spp., *Phlomis rotata*, *Meconopsis horridula*, *Nardostachys grandiflora*, *Lonicera* spp., *Caragana versicolor*, *Potentilla* spp.
Pasture Condition	:	Good
Grazing Pressure	:	Medium
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	2.5 to 3 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer
Habitat overlap with wildlife	:	High; overlap with Blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Brown bear *(Ursus arctos)*, Grey wolf *(Canis lupus)*, Blue sheep *(Pseudois nayaur)*, Himalayan marmot *(Marmota bobak)*
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*
Annual No of kills	:	6 to 7
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Good habitat of Blue sheep *(Pseudois nayaur)* and Snow leopard *(Uncia uncia)*,conflict in dung collection with Marang, *Nardostachys grandiflora* collection for incense sticks

8. PASTURE NAME: MEME- GHIMJIN		
Total area	:	1.49 Km^2
Total vegetation cover	:	35% (Grassland - 20%, Shrubland -15%, Bareland – 65%)
Main floristic composition	:	*Caragana gerardiana*, *Penisetum* spp., *Stipa* spp., *Elymus* spp., *Ephedra gerardiana*, *Aster himalaicus*, *Tanacetum nubigenum*, *Artemisia* spp., *Astragalus* spp.
Pasture Condition	:	Very bad
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep (winter); lulu cow, horse, goat, sheep (summer)
Corrals	:	One

Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1.5 to 2 hrs.
Accessibility to pasture	:	Very difficult
Movement with in the pasture	:	Very difficult
Grazing season	:	Winter + Spring
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Golden jackal (*Canis aureus)*, Blue sheep *(Pseudois nayaur)*
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Golden jackal (*Canis aureus)*
Annual No of kills	:	1 to 2
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	High
Availability of water	:	Not available

9. PASTURE NAME: GHOWATHANG		
Total area	:	1.55 Km^2
Total vegetation cover	:	40% (Grassland -10%, Shrubland - 30%, Bareland – 60%)
Main floristic composition	:	*Caragana gerardiana*, *Penisetum* spp., *Stipa* spp., *Elymus* spp., *Ephedra gerardiana*, *Aster himalaicus*, *Tanacetum nubigenum*, *Artemisia* spp., *Astragalus* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Yak, goat& sheep (winter); lulu cow, horse, goat and sheep (summer)
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	Half an hour
Accessibility to pasture	:	Manageable
Movement with in the pasture	:	Very difficult
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Grey wolf *(Canis lupus)* and Golden jackal (*Canis aureus)*
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	None
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Not available
Note	:	People of other villages hire the corals and stay for 2-3 months

10. PASTURE NAME: DHEMMA		
Total area	:	3.06 Km^2
Total vegetation cover	:	80% (Grassland - 80%, Shrubland - 5%, Bareland – 20%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Potentilla* spp., *Androsace* spp., *Phlomis rotata*, *Caragana versicolor*, *Anaphalis triplinervis*, *Leontopodium jacotianum*, *Saxifraga* spp., *Artemisia* spp., *Bistorta* spp., *Arenaria bryophylla*, *Nardostachys grandiflora*, *Rhododendron*

		lepidotum, Rhododendron anthopogon, Cordyceps sinensis, Berberis erythroclada, Cortia depressa, Lonicera spp., *Ponerorchis chusua, Potentilla fruticosa*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep
Corrals	:	Absent
Herding camps	:	One
Time taken to reach from Lo manthang	:	4 to 5 hrs.
Accessibility to pasture	:	Manageable
Movement with in the pasture	:	Very difficult
Grazing season	:	Summer
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia),* Brown bear *(Ursus arctos)* Blue sheep *(Pseudois nayaur)*, Himalayan woooly hare (*Lepus oiostolus*), Himalayan marmot (*Marmota bobak*)
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*
Annual No of kills	:	6 to 7
Other Causes of Livestock loss	:	Slipping off the cliff
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available
Note	:	Mat cutting for gomba restoration work

11. PASTURE NAME: THIBETANG		
Total area	:	0.84 Km^2
Total vegetation cover	:	40% (Grassland - 20%, Shrubland - 20%, Bareland – 60%)
Main floristic composition	:	*Caragana gerardiana, Astragalus* spp., *Astragalus* spp.I, *Carex* spp., *Penisetum* spp., *Kobressia* spp., *Euphorbia stracheyi, Artemisia* spp., *Anaphalis triplinervis*
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Goat, sheep, lulu cow, donkey
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1.5 to 2 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	-
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Low
Uprooting of bushes and shrubs	:	Low
Availability of water	:	Not available
Note	:	Traders route for transporting livestock from Tibet

12. PASTURE NAME: LEK-THAMMA		
Total area	:	2.11 Km^2
Total vegetation cover	:	70% (Grassland - 60%, Shrubland - 10%, Bareland – 30%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Phlomis rotata*, *Gentiana* spp., *Sinolimprichtia alpina*, *Androsace* spp., *Saxifraga* spp., *Meconopsis horridula*, *Rhododendron lepidotum*, *Saussurea simpsoniana*, *Rheum moorcroftianum*, *Spiraea arcuata*, *Picrorhiza scrophulariiflora*, *Potentilla fruticosa*.
Pasture Condition	:	Medium
Grazing Pressure	:	Medium
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	4.5 to 5 hrs.
Accessibility to pasture	:	Manageable
Movement with in the pasture	:	Very difficult
Grazing season	:	Summer
Habitat overlap with wildlife	:	High; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Blue sheep Snow leopard (*Uncia uncia)*
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*
Annual No of kills	:	6 to 7 yaks
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Medium
Uprooting of bushes and shrubs	:	Low
Availability of water	:	Available
Note	:	Good habitat of Blue sheep *(Pseudois nayaur)* and Snow leopard *(Uncia uncia)*

13. PASTURE NAME: KEKYAP		
Total area	:	21.02 Km^2
Total vegetation cover	:	50% (Grassland - 50%, Shrubland - 0%, Bareland – 50%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Astragalus* spp., *Astragalus* spp.l, *Allium oreoprasum*, *Arenaria bryophylla*, *Arenaria granduligera*, *Artemisia* spp., *Aster himalaicus*, *Bistorta* spp., *Cortiolla hookeri*, *Corydalis govaniana*, *Delphinium* spp., *Cremanthodium* spp., *Ephedra gerardiana*, *Gentiana algida*, *Penisetum* spp., *Stipa* spp., *Poa* spp., *Lancea tibetica*, *Leontopodium jacotianum*, *Meconopsis horridula*, *Oreosolen wattii*, *Oxytropis* spp., *Pedicularis longiflora*, *Pedicularis* spp., *Phlomis rotata*, *Potentilla* spp., *Potentilla fruticosa*, *Primula macrophylla*, *Rhodiola himalicus*, *Rhododendron nivale*, *Saussurea gossypiphora*, *Saussurea nepalensis*, *Saussurea simpsoniana*, *Saxifraga aristulata*, *Saxifraga brunonis*, *Silene* spp., *Soroseris hookerana*, *Soroseris pumila*, *Thylacospermum caespitosum*, *Urtica hyperborean*, *Waldheimia nivea*.
Pasture Condition	:	Medium
Grazing Pressure	:	Low
Livestock	:	Yak, horse
Corrals	:	Two
Herding camps	:	Absent

Time taken to reach from Lo manthang	:	16 to 18 hrs.
Accessibility to pasture	:	Very difficult
Movement with in the pasture	:	Very difficult
Grazing season	:	Winter
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Grey wolf *(Canis lupus)*, Red fox *(Vulpes vulpes)*, Kiang *(Equus kiang)*, Blue sheep *(Pseudois nayaur)*, Himalayan wooly hare (*Lepus oiostolus*), Himalayan marmot *(Marmota bobak)*, Brown bear *(Ursus arctos)*
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*, Grey wolf *(Canis lupus)*
Annual No of kills	:	8 to 10
Other Causes of Livestock loss	:	Fall from terrain and cliffs
Collection of animal dung	:	Only by herders for their use
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Belongs to Mustangi Raja, only Raja has the outhority to use this pasture, illegally yaks from Dolpa use the grazing areas during the summer. The area is one of the most important refuge habitats of Kiang *(Equus kiang)*; the animal uses the area as corridor for migrating to Kekyap from Tibet during summer season.

14. PASTURE NAME: KARA LIKCHUNG		
Total area	:	0.45 Km^2
Total vegetation cover	:	35% (Grassland – 30%, Shrubland – 5%, Bareland – 65%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Sinolimprichtia alpina*, *Nardostachys grandiflora*, *Picrorhiza scrophulariiflora*, *Phlomis rotata*, *Potentilla* spp., *Spiraea arcuata*, *Astragalus* spp.
Pasture Condition	:	Medium
Grazing Pressure	:	Medium
Livestock	:	Yak
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	5.5 to 6 hrs.
Accessibility to pasture	:	Manageable
Movement with in the pasture	:	Manageable
Grazing season	:	Summer
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Grey wolf *(Canis lupus)*, Blue sheep (*Pseudois nayaur)*, Himalayan marmot *(Marmota bobak)*
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*, Grey wolf *(Canis lupus)*
Annual No of kills	:	1 to 2
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Good habitat of Snow leopard (*Uncia uncia*)

15. PASTURE NAME: DHIPLE		
Total area	:	3.09 Km^2
Total vegetation cover	:	85% (Grassland – 80%, Shrubland – 5%, Shrubland – 15%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Potentilla* spp., *Androsace* spp., *Phlomis rotata, Caragana versicolor, Anaphalis triplinervis, Leontopodium jacotianum, Saxifraga* spp., *Artemisia* spp., *Bistorta* spp., *Arenaria bryophylla, Nardostachys grandiflora, Rhododendron lepidotum, Rhododendron anthopogon, Cordyceps sinensis, Berberis erythroclada, Cortia depressa, Lonicera* spp., *Potentilla fruticosa, Picrorhiza scrophulariiflora*
Pasture Condition	:	Good
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Three
Herding camps	:	Three
Time taken to reach from Lo manthang	:	3.5 to 4 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very difficult
Grazing season	:	Summer
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia),* Blue sheep *(Pseudois nayaur),* Himalayan marmot *(Marmota bobak)*
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*
Annual No of kills	:	1 to 2
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available

16. PASTURE NAME: SHETTY PANGA		
Total area	:	3.48 Km^2
Total vegetation cover	:	70% (Grassland – 50%, Shrubland – 20%, Shrubland – 30%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Phlomis rotata, Potentilla* spp., *Potentilla fruticosa, Caragana versicolor, Lonicera* spp., *Spiraea arcuata, Artemisia* spp., *Artemisia* spp.l, *Rhododendron lepidotum, Anaphalis triplinervis, Androsace* spp., *Saxifraga* spp., *Cortia depressa, Berberis erythroclada, Gentiana ornate, Geranium donianum, Leontopodium jacotianum, Ephedra gerardiana, Caragana gerardiana, Thymus linearis*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, lulu cow cow, horse, donkey
Corrals	:	One
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	3 to 3.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Blue sheep *(Pseudois nayaur)*; Himalayan marmot *(Marmota bobak),* Himalyan wooly hare (*Lepus oiostolus*)

Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available
Note	:	Harvesting of ***lighatur*** (*Geranium* spp.) by the Amchis

17. PASTURE NAME: CHUMJA LHOMA		
Total area	:	1.58 Km^2
Total vegetation cover	:	75% (Grassland – 70%, Shrubland – 5%, Shrubland – 25%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Saxifraga* spp., *Androsace* spp., *Potentilla* spp., *Phlomis rotata*, *Oreosolen wattii*, *Rhododendron lepidotum*, *Cordyceps sinensis*, *Meconopsis horridula*, *Corydalis govaniana*, *Anaphalis triplinervis*, *Thalictrum alpinum*, *Nardostachys grandiflora*, *Lagotis kunawurensis*
Pasture Condition	:	Good
Grazing Pressure	:	Medium
Livestock	:	Yak, horse
Corrals	:	One
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	4.5 to 5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very difficult
Grazing season	:	Summer
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Blue sheep *(Pseudois nayaur)*, Himalayan marmot *(Marmota bobak)*, Brown bear *(Ursus arctos)*
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia)*
Annual No of kills	:	1 to 2
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Medium
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available

18. PASTURE NAME: CHUMJA JHANGMA		
Total area	:	0.64 Km^2
Total vegetation cover	:	65% (Grassland – 60%, Shrubland – 5%, Bareland – 35%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Saxifraga* spp., *Androsace* spp., *Potentilla* spp., *Phlomis rotata*, *Oreosolen wattii*, *Rhododendron lepidotum*, *Cordyceps sinensis*, *Meconopsis horridula*, *Corydalis govaniana*, *Anaphalis triplinervis*, *Thalictrum alpinum*
Pasture Condition	:	Good
Grazing Pressure	:	Medium
Livestock	:	Yak, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	4.5 to 5 hrs.
Accessibility to pasture	:	Very easy

Movement with in the pasture	:	Very difficult
Grazing season	:	Summer
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Grey wolf (*Canis lupus*), Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Medium
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Harvesting of *Nardostachys grandiflora* is a problem

19. PASTURE NAME: CHIMMIK THU		
Total area	:	1.14 Km^2
Total vegetation cover	:	40% (Grassland – 40%, Shrubland – 0%, Bareland – 60%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Phlomis rotata*, *Oreosolen wattii*, *Meconopsis horridula*, *Gentiana* spp., *Androsace* spp., *Saxifraga* spp., *Arenaria bryophylla*, *Potentilla* spp.,*Thalictrum alpinum*, *Corydalis govaniana*, *Bistorta* spp., *Anaphalis triplinervis*, *Astragalus* spp., *Soroseris hookerana*, *Lagotis kunawurensis*, *Ephedra gerardiana*
Pasture Condition	:	Medium
Grazing Pressure	:	Medium
Livestock	:	Yak, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	5.5 to 6 hrs.
Accessibility to pasture	:	Very easy
Movement with In the pasture	:	Difficult
Grazing season	:	Summer
Habitat overlap with wildlife	:	Low; overlap with Blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Grey wolf (*Canis lupus*), Blue sheep *(Pseudois nayaur)*
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Medium
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available

20. PASTURE NAME: SAMDULING		
Total area	:	0.71 Km^2
Total vegetation cover	:	55% (Grassland – 5%, Shrubland – 50%, Bareland – 45%)
Main floristic composition	:	*Caragana versicolor*, *Rosa sericea*, *Rosa* spp., *Berberis erythroclada*, *Lonicera* spp., *Lonicera spinosa*, *Astragalus* spp., *Juniperus indica*, *Ephedra gerardiana*, *Populus ciliata*, *Cotoneaster* spp., *Thymus linearis*, *Anaphalis triplinervis*.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, lulu cow, horse, donkey

Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1.5 to 2 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Continuous
Habitat overlap with wildlife	:	Low; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Grey wolf (Canis lupus), Lynx *(Lynx lynx isabellinus)*, Golden jackal *(Canis aureus)*, Himalayan marmot *(Marmota bobak)*, Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	Low
Availability of water	:	Available
Note	:	Ruins of Gomba still exist and the pasture is named after the Gomba i.e. Samduling Gomba

21. PASTURE NAME: TERA THANG		
Total area	:	1.73 Km^2
Total vegetation cover	:	75% (Grassland – 75%, Shrubland – 0%, Bareland – 25%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Phlomis rotata*, *Cremanthodium* spp., *Geranium donianum*, *Primula buryana*, *Bistorta* spp., *Soroseris hookerana*, *Tanacetum nubigenum*, *Saxifraga* spp., *Androsace* spp.
Pasture Condition	:	Good
Grazing Pressure	:	Medium
Livestock	:	Yak
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	6.5 to 7 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer
Habitat overlap with wildlife	:	Low; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Brown bear *(Ursus arctos)*, Grey wolf *(Canis lupus)*, Blue sheep *(Pseudois nayaur)*, Himalayan wooly hare(*Lepus oiostolus*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Yak and blue sheep *(Pseudois nayaur)* graze together and locals reported sometimes yaks chase away the Grey wolf *(Canis lupus)* to save the blue sheep

22. PASTURE NAME: GHYAKHA		
Total area	:	1.92 Km^2
Total vegetation cover	:	65% (Grassland – 60%, Shrubland – 5%, Bareland – 35%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Phlomis rotata*, *Oreosolen wattii*, *Bistorta* spp., *Arenaria bryophylla*, *Arenaria densísima*, *Meconopsis horridula*, *Nardostachys grandiflora*, *Androsace* spp., *Saxifraga* spp., *Rhododendron lepidotum*, *Rhododendron anthopogon*, *Corydalis govaniana*, *Corydalis alburyi*, *Cordyceps sinensis*, *Spiraea arcuata*, *Potentilla fruticosa*, *Delphinium* spp., *Viola biflora*, *Lilium nanum*, *Lamium tuberosum*, *Lamium rhomboideum*, *Primula buryana*, *Rhodiola himalicus*, Fern
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	5 to 5.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer
Habitat overlap with wildlife	:	Low; overlap with blue sheep *(Pseudois nayaur)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)*, Brown bear *(Ursus arctos)*, Grey wolf *(Canis lupus)*, Blue sheep *(Pseudois nayaur)*, Himalayan marmot *(Marmota bobak)*, Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	Yes
Predators	:	Snow leopard *(Uncia uncia)*, Grey wolf *(Canis lupus)*
Annual No of kills	:	5 to 6
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available

23. PASTURE NAME: LOWATHANG		
Total area	:	2.16 Km^2
Total vegetation cover	:	70% (Grassland – 60%, Shrubland -10%, Bareland – 30%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Bistorta* spp., *Phlomis rotata*, *Cremanthodium* spp., *Arenaria bryophylla*, *Primula buryana*, *Nardostachys grandiflora*, *Gentiana* spp., *Androsace* spp., *Saxifraga* spp., *Rhododendron anthopogon*, *Corydalis govaniana*, *Spiraea arcuata*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	3.5 to 4 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Autumn
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Grey wolf *(Canis lupus)*, Red fox *(Vulpes vulpes)*, Himalayan marmot *(Marmota bobak)*

Livestock depredation	:	Yes
Predators	:	Grey wolf *(Canis lupus)*
Annual No of kills	:	2 to 3
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Boundary conflict with Chonnup in dung collection and grazing

24. PASTURE NAME: YAJA		
Total area	:	0.97 Km^2
Total vegetation cover	:	60% (Grassland – 40%, Shrubland – 20, Bareland – 40%)
Main floristic composition	:	*Caragana versicolor, Spiraea arcuata, Rhododendron lepidotum, Kobressia* spp., *Carex* spp., *Penisetum* spp., *Bistorta* spp., *Arenaria bryophylla, Tanacetum nubigenum*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Three
Herding camps	:	Four
Time taken to reach from Lo manthang	:	2 to 2.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer + Autumn
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Grey wolf *(Canis lupus)*, Himalayan marmot *(Marmota bobak)*, Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	Yes
Predators	:	Grey wolf *(Canis lupus)*
Annual No of kills	:	2 to 3
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available

25. PASTURE NAME: MHELUNGMA		
Total area	:	1.21 Km^2
Total vegetation cover	:	60% (Grassland – 35%, Shrubland – 25%, Bareland – 40%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Phlomis rotata, Androsace* spp., *Saxifraga* spp., *Bistorta* spp., *Thalictrum alpinum, Artemisia* spp., *Lonicera spinosa, Astragalus* spp., *Caragana versicolor, Spiraea arcuata*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	One
Herding camps	:	One
Time taken to reach from Lo manthang	:	2 to 2.5 hrs
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer + Autumn

Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Grey wolf *(Canis lupus)*, Golden jackal *(Canis aureus)*, Himalayan wooly hare (*Lepus oiostolus*), Himalayan marmot (*Marmota bobak*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available

26. PASTURE NAME: GHOGLE		
Total area	:	1.30 Km^2
Total vegetation cover	:	80% (Grassland – 40%, Shrubland – 40%, Bareland – 20%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Bistorta* spp., *Caragana versicolor*, *Lonicera* spp., *Lonicera spinosa*, *Berberis erythroclada*, *Spiraea arcuata*, *Astragalus* spp., *Artemisia* spp. *I*, *Rhododendron lepidotum.*
Pasture Condition	:	Good
Grazing Pressure	:	High
Livestock	:	Goat and sheep, in summer yak and horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	2 to 2.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Manageable
Grazing season	:	Summer + Autumn
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Grey wolf (*Canis lupus*), Himalayan marmot (*Marmota bobak*), Himalyan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available

27. PASTURE NAME: TUKUTHANG		
Total area	:	1.52 Km^2
Total vegetation cover	:	50% (Grassland – 40%, Shrubland – 10%, Bareland – 50%)
Main floristic composition	:	*Artemisia* spp., *Penisetum* spp., *Stipa* spp., *Astragalus* spp., *Caragana gerardiana*, *Ephedra gerardiana.*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse, lulu cow, donkey
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1 to 1.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy

Grazing season	:	Summer + Autumn + Spring
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Golden jackal *(Canis aureus)*, Grey wolf (*Canis lupus*), Himalayan wooly hare (*Lepus oiostolus*), Himalayan marmot (*Marmota bobak*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Way to other pastures and traders' route

28. PASTURE NAME: LLIK KANGANG		
Total area	:	4.29 Km^2
Total vegetation cover	:	40% (Grassland – 30%, Shrubland – 10%, Bareland – 60%)
Main floristic composition	:	*Penisetum* spp., *Artemisia* spp., *Kobressia* spp., *Caragana gerardiana*, *Arnebia* spp., *Astragalus* spp., *Artemisia* spp.l, *Ephedra gerardiana*, *Aster himalaicus.*
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1 to 1.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Manageable
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Grey wolf (*Canis lupus*), Golden jackal *(Canis aureus)*, Himalayan wooly hare (*Lepus oiostolus*), Himalayan marmot (*Marmota bobak*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Boundary conflict with Chhonup VDC

29. PASTURE NAME: BHINAMA		
Total area	:	1.80 Km^2
Total vegetation cover	:	40% (Grassland – 30%, Shrubland – 10%, Bareland – 60%)
Main floristic composition	:	*Penisetum* spp., *Stipa* spp., *Kobressia* spp., *Potentilla* spp., *Tanacetum nubigenum*, *Caragana gerardiana*, *Astragalus* spp., *Artemisia* spp.l, *Ephedra gerardiana*, *Aster himalaicus*, *Lonicera* spp., *Artemisia* spp.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse, lulu cow, donkey
Corrals	:	Absent

Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1 to 1.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Golden jackal *(Canis aureus)*, Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available

30. PASTURE NAME: JHURUBHOKTA		
Total area	:	1.74 Km^2
Total vegetation cover	:	30% (Grassland – 25%, Shrubland – 5%, Bareland – 70%)
Main floristic composition	:	*Penisetum* spp., *Stipa* spp., *Kobressia* spp., *Potentilla* spp., *Tanacetum nubigenum, Caragana gerardiana, Astragalus* spp., *Artemisia* spp.I, *Ephedra gerardiana, Aster himalaicus, Lonicera* spp., *Artemisia* spp.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse, lulu cow, donkey
Corrals	:	Five
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1 to 1.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Golden jackal *(Canis aureus)*, Himalayan Marmot (*Marmota bobak*), Himalayan Wooly hare (*Lepus oiostolus*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	High
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available
Note	:	Goat and sheep corral in summer of Lo Manthangand other livestock graze throughout the year, traders' route and way to other pastures

31. PASTURE NAME: DHADHI		
Total area	:	1.17 Km^2
Total vegetation cover	:	15% (Grassland – 10%, Shrubland – 5%, Bareland – 85%)
Main floristic composition	:	*Penisetum* spp., *Stipa* spp., *Kobressia* spp., *Potentilla* spp., *Tanacetum nubigenum, Caragana gerardiana, Astragalus* spp.,

		Artemisia spp.l, *Ephedra gerardiana*, *Aster himalaicus*, *Lonicera* spp., *Artemisia* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse, cattle, donkey
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	0.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Golden jackal *(Canis aureus)*, Himalayan Wooly hare(*Lepus oiostolus*), Himalayan marmot (*Marmota bobak*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Not available
Note	:	Main route to other pastures

32. PASTURE NAME: GHYAKDHOPPA		
Total area	:	1.30 Km^2
Total vegetation cover	:	35 % (Grassland - 25%, Shrubland - 10%, Bareland – 65%)
Main floristic composition	:	*Caragana gerardiana*, *Astragalus* spp., *Artemisia* spp.l, *Penisetum* spp., *Artemisia* spp., *Aster himalaicus*.
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, lulu cow, donkey
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	0.5 to1 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Manageable
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Golden jackal *(Canis aureus)*
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	High
Availability of water	:	Not available
Note	:	Livestock are especially taken to this pasture for salt licking

33. PASTURE NAME: DHANG DHANG		
Total area	:	3.37 Km^2
Total vegetation cover	:	45% (Grassland – 25%, Shrubland – 20%, Bareland – 55%)

Main floristic composition	:	*Caragana gerardiana, Astragalus* spp., *Artemisia* spp.l, *Penisetum* spp.,*Artemisia* spp., *Aster himalaicus*
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep (taken to this pasture especially for salt licking)
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1 to 1.5 hrs.
Accessibility to pasture	:	
Movement with in the pasture	:	Manageable
Grazing season	:	Winter
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Lynx *(Lynx lynx isabellinus)*, Golden jackal *(Canis aureus)*, Red fox (*Vulves vulpes*), Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Golden jackal *(Canis aureus)*
Annual No of kills	:	5-10
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	High
Availability of water	:	Available
Note	:	The pasture has Salt lick area used by livestock of Chonnup, Lo Manthangand nomads

34. PASTURE NAME: LHANGDE		
Total area	:	3.89 Km^2
Total vegetation cover	:	35% (Grassland – 30%, Shrubland – 5%, Bareland – 65%)
Main floristic composition	:	*Caragana gerardiana, Penisetum* spp., *Stipa* spp., *Artemisia* spp., *Artemisia* spp. *l, Aster himalaicus, Astragalus* spp.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Goat, sheep
Corrals	:	One
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	2 to 2.5 hrs.
Accessibility to pasture	:	Very difficult
Movement with in the pasture	:	Very difficult
Grazing season	:	Winter + Spring
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Blue sheep (*Pseudois nayaur*), Lynx *(Lynx lynx isabellinus)*, Golden jackal *(Canis aureus)*, Red fox (*Vulves vulpes*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Golden jackal *(Canis aureus)*
Annual No of kills	:	4 to 5
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Mud is collected from this pasture for painting house which is a traditional practice

35. PASTURE NAME: MURI		
Total area	:	7.55 Km^2
Total vegetation cover	:	50% (Grassland – 30%, Shrubland – 20%, Bareland – 50%)
Main floristic composition	:	*Caragana gerardiana*, *Stipa* spp., *Penisetum* spp., *Aster himalaicus*, *Astragalus* spp., *Artemisia* spp., *Artemisia* spp.I, *Arnebia* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	High
Livestock	:	Goat, sheep (winter); horse (summer)
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	3 to 3.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very difficult
Grazing season	:	Summer + Winter
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Lynx *(Lynx lynx isabellinus)*, Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Grey wolf (*Canis lupus*)
Annual No of kills	:	10 to 15
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Not available
Note	:	Good habitat of snow leopard *(Uncia uncia)* and blue sheep (*Pseudois nayaur*)

36. PASTURE NAME: MARCHUNG (Sakau)		
Total area	:	2.32 Km^2
Total vegetation cover	:	15% (Grassland – 5%, Shrubland -10%, Bareland – 85%)
Main floristic composition	:	*Rosa sericea*, *Artemisia* spp., *Ephedra gerardiana*, *Hippophae tibetana*, *Penisetum* spp., *Stipa* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	Low
Livestock	:	Goat, sheep, horse, lulu cow
Corrals	:	Five
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	1. 5 to 2 hrs.
Accessibility to pasture	:	Very difficult
Movement with in the pasture	:	Very difficult
Grazing season	:	Winter
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Lynx *(Lynx lynx isabellinus)*, Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*)
Annual No of kills	:	7 to 8
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-

Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Four corrals were made predator proof by the project in 2004, high depredation area

37. PASTURE NAME: DHARCHONGOMBA		
Total area	:	3.90 Km^2
Total vegetation cover	:	45% (Grassland – 30%, Shrubland – 15%, Bareland – 55%)
Main floristic composition	:	*Stipa* spp., *Penisetum* spp., *Caragana versicolor*, *Caragana gerardiana*, *Artemisia* spp., *Ephedra gerardiana*, *Aster himalaicus*, *Tanacetum nubigenum*, *Arnebia* spp.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Goat, sheep
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	2.5 to 3 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very difficult
Grazing season	:	Winter
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Lynx *(Lynx lynx isabellinus)*, Blue sheep (*Pseudois nayaur*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*)
Annual No of kills	:	5 to 6
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Traders route, good habitat of snow leopard (*Uncia uncial*), blue sheep (*Pseudois nayaur*) and lynx *(Lynx lynx isabellinus)*

38. PASTURE NAME: DHANGJE		
Total area	:	6.13 Km^2
Total vegetation cover	:	50% (Grassland – 25%, Shrubland – 25%, Bareland – 50%)
Main floristic composition	:	*Caragana gerardiana*, *Caragana versicolor*, *Lonicera spinosa*, *Artemisia* spp., *Artemisia* spp.*l*, *Ephedra gerardiana*, *Stipa* spp., *Penisetum* spp., *Astragalus* spp., *Tanacetum nubigenum*, *Arnebia* spp.
Pasture Condition	:	Bad
Grazing Pressure	:	Medium
Livestock	:	Goat and sheep (winter); dzopa, goat, sheep of Surkhang VDC (summer)
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	5.5 to 6 hrs.
Accessibility to pasture	:	Very difficult
Movement with in the pasture	:	Very difficult
Grazing season	:	Summer + Winter
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Snow leopard (Uncia uncia), Blue sheep (*Pseudois nayaur*), Lynx

Time taken to reach from Lo manthang	:	0.5 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Continuous
Habitat overlap with wildlife	:	-
Wildlife using the same habitats	:	Golden jackal *(Canis aureus)*
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Not available

41. PASTURE NAME: CHUJUNG (Yaja)		
Total area	:	51.99Km^2
Total vegetation cover	:	75% (Grassland – 60%, Shrubland – 15%, Bareland – 25%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Anaphalis triplinervis, Arenaria bryophylla, Primula* spp., *Delphinium* spp., *Thalictrum alpinum, Tanacetum nubigenum, Thylacospermum caespitosum, Lagotis kunawurensis, Lancea tibetica, Lichen* spp., *Oreosolen wattii, Oxygraphis polypetala.*
Pasture Condition	:	Good
Grazing Pressure	:	Medium
Livestock	:	Yak, goat, sheep
Corrals	:	Two
Herding camps	:	Two
Time taken to reach from Lo manthang	:	7 to 8 hrs. (one day)
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer
Habitat overlap with wildlife	:	High; overlap with blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Brown bear *(Ursus arctos)*, Grey wolf (*Canis lupus*), Blue sheep (*Pseudois nayaur*), Himalayan marmot (*Marmota bobak*), Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*), Grey wolf (*Canis lupus*), Brown bear *(Ursus arctos)*
Annual No of kills	:	6 to 7
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Low
Uprooting of bushes and shrubs	:	None
Availability of water	:	Available
Note	:	Political boundary of Chhoser VDC but Lo Manthangnomads are using, good habitat of brown bear *(Ursus arctos)*, bushes dominate the river banks, Amchis harvest medicinal plants

42. PASTURE NAME: MUKCHUNG		
Total area	:	33.99 Km^2
Total vegetation cover	:	55% (Grassland – 55%, Shrubland – 0%, Bareland – 45%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Androsace* spp., *Saxifraga* spp.,

		Phlomis rotata, Arenaria bryophylla, Potentilla spp., *Anaphalis triplinervis, Aster himalaicus, Ephedra gerardiana, Stipa* spp., *Tanacetum nubigenum, Pedicularis longiflora, Artemisia* spp.
Pasture Condition	:	Good
Grazing Pressure	:	Low
Livestock	:	Yak
Corrals	:	Absent
Herding camps	:	Absent
Time taken to reach from Lo manthang	:	7 to 8 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Manageable
Grazing season	:	Summer
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Snow leopard (Uncia uncia), Brown bear *(Ursus arctos)*, Lynx *(Lynx lynx isabellinus)*, Blue sheep (*Pseudois nayaur*), Himalayan marmot (*Marmota bobak*), Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	-
Predators	:	-
Annual No of kills	:	-
Other Causes of Livestock loss	:	-
Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Political boundary of Chhoser VDC but Lo Manthangnomads are using, very good habitat of blue sheep (*Pseudois nayaur*)

43. PASTUR NAME: MARCHA		
Total area	:	1.74Km^2
Total vegetation cover	:	55% (Grassland – 40%, Shrubland – 15%, Bareland – 45%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp., *Penisetum* spp., *Potentilla* spp., *Phlomis rotata, Thalictrum alpinum, Artemisia* spp., *Tanacetum nubigenum,Androsace* spp., *Caragana gerardiana, Caragana versicolor, Spiraea arcuata, Juniperus indica, Juniperus squamata, Ephedra gerardiana, Astragalus* spp., *Lonicera spinosa, Oreosolen wattii*
Pasture Condition	:	Medium
Grazing Pressure	:	Medium
Livestock	:	Yak, goat, sheep
Corrals	:	Two
Herding camps	:	Two
Time taken to reach from Lo manthang	:	7 to 8 hrs.
Accessibility to pasture	:	Very difficult
Movement with in the pasture	:	Very difficult
Grazing season	:	Spring
Habitat overlap with wildlife	:	Moderate; overlap with blue sheep (*Pseudois nayaur*)
Wildlife using the same habitats	:	Snow leopard (*Uncia uncia*), Lynx *(Lynx lynx isabellinus)*, Blue sheep (*Pseudois nayaur*), Himalayan marmot (*Marmota bobak*), Himalayan wooly hare (*Lepus oiostolus*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (*Uncia uncia*)
Annual No of kills	:	6 to 7
Other Causes of Livestock loss	:	-

Collection of animal dung	:	-
Uprooting of bushes and shrubs	:	-
Availability of water	:	Available
Note	:	Political boundary of ChhoserVDC, Juniper cutting is a problem,only nomads use this pasture

44. PASTURE NAME: DHALUNG		
Total area	:	33.99 Km^2
Total vegetation cover	:	45% (Grassland – 40%, Shrubland – 5%, Bareland – 55%)
Main floristic composition	:	*Kobressia* spp., *Carex* spp.,*Stipa* spp., *Penisetum* spp., *Delphinium* spp., *Aconitum naviculare*, *Astragalus* spp., *Astragalus* spp.I, *Allium* spp., *Androsace* spp., *Anaphalis triplinervis*, *Arenaria bryophylla*, *Arenaria granduligera*, *Artemisia* spp., *Artemisia* spp.I, *Aster himalaicus*, *Bistorta* spp., *Corydalis govaniana*, *Corydalis alburyi*, *Caragana versicolor*, *Cortia depressa*, *Cyananthus incanus*, *Dracocephalum heterophyllum*, *Elsholtzia eriostachya*, *Ephedra gerardiana*, *Euphorbia stracheyi*, *Gentiana robusta*, *Gentiana sp.* *Incarvillea younghusbandii*, *Lamium tuberosum*, *Lancea tibetica*, *Lagotis kunawurensis*, *Lonicera spinosa*, *Oreosolen wattii*, *Oxytropis* spp., *Pedicularis longiflora*, *Pedicularis* spp., *Pedicularis* spp., *Potentilla fruticosa*, *Potentilla anserina*, *Potentilla* spp.I, *Phlomis rotata*, *Rheum moorcroftianum*, *Rhodiola himalicus*, *Saussurea nepalensis*, *Saxifraga* spp., *Sedum* spp., *Silene* spp., *Stellaria decumbens*, *Thalictrum alpinum*, *Tanacetum nubigenum*, *Urtica hyperborean*, *Spiraea arcuata*.
Pasture Condition	:	Medium
Grazing Pressure	:	High
Livestock	:	Yak, goat, sheep, horse
Corrals	:	One
Herding camps	:	Three
Time taken to reach from Lo manthang	:	7 to 8 hrs.
Accessibility to pasture	:	Very easy
Movement with in the pasture	:	Very easy
Grazing season	:	Summer
Habitat overlap with wildlife	:	High; overlap with kiang (*Equus hemionus)* and Tibetan gazelle *(Procapra picticaudata)*
Wildlife using the same habitats	:	Snow leopard *(Uncia uncia)* ,Brown bear *(Ursus arctos)*, Grey wolf *(Canis lupus)*, Kiang *(Equus hemionus* Kiang),Tibetan gazelle *(Procapra picticaudata)*, Blue sheep *(Pseudois nayaur)*, Himalayan marmot (*Marmota bobak*), Himalayan wooly hare(*Lepus oiostolus*)
Livestock depredation	:	Yes
Predators	:	Snow leopard (Uncia uncia), Grey wolf *(Canis lupus)*, Brown bear *(Ursus arctos)*
Annual No of kills	:	5 to 8
Other Causes of Livestock loss	:	-
Collection of animal dung	:	Medium
Uprooting of bushes and shrubs	:	Medium
Availability of water	:	Available
Note	:	Political boundary of ChhoserVDC, used by Chhoser horses as well, traders' route, conflict between Samjung(Chhoser)and Nomads of Lo Manthangand also Chinese nomads , rich in medicinal plants, good habitat of kiang *(Equus kiang)* and Tibetan gazelle *(Procapra picticaudata)*

Annex III. Main floristic composition of the study area

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
1	*Allium fasciculatum*	Amaryllidaceae	H	Rhijiphuwa	Jul-Aug	Use in herbal medicine, edible as vegetables and flavor
2	*Allium hyposistum*	Amaryllidaceae	H	Rhijiphuwa	Jun-Aug	Use in herbal medicine, edible as vegetables and flavor
3	*Allium oreoprasum*	Amaryllidaceae	H	Kekyap	Jul-Aug	Use in herbal medicine, edible as vegetables and flavor
4	*Allium* spp.	Amaryllidaceae	H	Rhijiphuwa, Dhalung	Jul-Aug	Use in herbal medicine, edible as vegetables and flavor
5	*Berberis erythroclada*	Berberidaceae	S	Kara, Gombajuk, Dhema, Dhiple, Sheety, Samduling, Ghogli	Apr-Jul/Aug	Use in herbal medicine, dye
6	*Incarvellia younghusbandii*	Bignoniaceae	H	Dhalung	Jul-Aug	Use in herbal medicine
7	*Arnebia* spp.	Boraginaceae	H	Ilikangkang, Muri, Dharchok ngogba, Dangje	May-Jun	Use in herbal medicine, religious value, dye
8	*Cyananthus incanus*	Campanulaceae	H	Dhalung	Jul-Sep	-
9	*Lonicera* spp.	Caprifoliaceae	S	Teka Dhong, Thulung, Kongma, Dhema, Kara Likchung, Dhiple, Shetty, Samduling, Ghogli, Bhinama, Jhurubhokta, Dhadi	Jun-Jul	-
10	*Lonicera spinosa*	Caprifoliaceae	S	Samduling, Melungma, Ghogli, Dhangje, Marcha (Chumje), Dhalung	May-Jul	Use as fuelwood
11	*Arenaria bryophylla*	Caryophyllaceae	H	Dhema, Kekyap, Dhiple, Chhimkthu, Dhyaka, Lowathang, Yaja, Chhujung (Yaja), Mukchung, Dhalung	Jul-Aug	-
12	*Arenaria granduligera*	Caryophyllaceae	H	Kekyap, Dhalung	Jul-Aug	-
13	*Silene* spp.	Caryophyllaceae	H	Kekyap, Dhalung	Jul-Aug	-
14	*Stellaria decumbens*	Caryophyllaceae	H	Dhalung	Jun-Aug	-

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
24	*Saussurea nepalensis*	Compositae	H	Kekyap, Dhalung, Dhiple, Dhema, Samduling	Jul-Sep	-
25	*Saussurea simpsoniana*	Compositae	H	Lhetmu, Kekyap	Jul-Sep	-
26	*Soroseris hookerana*	Compositae	H	Kekyap, Chhimkthu, Terthang	Jul-Aug	-
27	*Soroseris pumila*	Compositae	H	Kekyap	Jul-Aug	-
28	*Tanasetum nubigenum*	Compositae	H	Nhile Kurchung, Teka Dhong, Sumda, Thulung, Meme Ghyumji, Dhowathang, Terthang, Yaja, Bhinama, Jhurubhokta, Dhadi, Dharchok ngogba, Chhujung (Yaja), Mukchung, Marcha (Chumje), Dhalung	Jul-Sep	Use in herbal medicine, aromatic, incense
29	*Taraxacum* spp.	Compositae	H	Nhile Kurchung, Dhema, Dhiple, Chhujung (Yaja), Rhijiphuwa, Dhalung	Apr-Aug	Use in herbal medicine
30	*Waldheimia nivea*	Compositae	H	Kekyap	Jun-Aug	-
31	*Rhodiola himalensis*	Crassulaceae	H	Kekyap, Dhyaka, Dhalung	Jul-Aug	Use in herbal medicine, ornamental
32	*Sedum* spp.	Crassulaceae	H	Dhalung	Jul-Aug	-
33	*Juniperus indica*	Cupressaceae	T	Samduling, Rhijiphuwa, Marcha (Chumje)	Apr-May	Use in herbal medicine, incense, flavor
34	*Juniperus squamata*	Cupressaceae	S	Rhijiphuwa, Marcha (Chumje)	Apr-May	Use in herbal medicine, incense, flavor
35	*Carex* spp.	Cyperaceae	G	Kongmo, Dhema, Tibethang, Lhetmu, Kekyap, Kara Likchung, Dhiple, Shetty, Chhumejhyangma, Chhimkthu, Terthang, Dhyaka, Lowathang, Yaja, Melungma, Ghogli, Rhijiphuwa, Chhujung (Yaja), Mukchung, Marcha (Chumje), Dhalung		-

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
36	*Kobressia* spp.	Cyperaceae	G	Kara, Gombajuk, Kongma, Dhema, Tibethang, Lhetmu, Kekyap, Kara Likchung, Dhiple, Sheety, Chhumjeloma, Chhumjejhyangma, Chhimkthu, Terthang, Dhyaka, Lowathang, Yaja, Melungma, Ghogli, Llikangkang, Bhinama, Jhurubhokta, Dhadi, Rhijiphuwa, Chhujung (Yaja), Mukchung, Marcha (Chumje), Dhalung		
37	*Pterocephalus hookeri*	Dipsacaceae	H	Nhile Kurchung, Dhema, Dhiple, Chhujung (Yaja), Rhijiphuwa, Dhalung	Jun-Aug	-
38	*Hippophae tibetana*	Elaeagnaceae	S	Marchung	Apr-May	Use in herbal medicine, multipurpose herbs
39	*Ephedra gerardiana*	Ephedraceae	H	Nhile Kurchung, Sumda, Thulung, Meme Ghyumji, Dhowathang, Kekyap, Shetty, Chhimkthu, Samduling, Tukuthang, Llikangkang, Bhinama, Jhurubhokta, Dhadi, Marchung, Dharchok ngogba, Dhangje, Rhijiphuwa, Mukchung, Marcha (Chumje), Dhalung	May-Jun	Use in herbal medicine
40	*Rhododendron anthopogon*	Ericaceae	S	Dhema, Dhiple, Dhyaka, Lowathang	Mar-Jun	Use in herbal medicine, incense, flower use as tea
41	*Rhododendron lepidotum*	Ericaceae	S	Dhema, Lhetmu, Kara Likchung, Dhiple, Shetty, Chhumjeloma, Chhumjejhyangma, Dhyaka, Yaja, Ghogli	Jun-Aug	-
42	*Rhododendron nivale*	Ericaceae	S	Kekyap	May-Jun	-
43	*Euphorbia stracheyi*	Euphorbiaceae	H	Tibethang, Dhalung	May-Jul	-

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
44	*Gentiana algida*	Gentianaceae	H	Kekyap	Jul-Aug/Oct	Use in herbal medicine
45	*Gentiana depressa*	Gentianaceae	H	Dhema, Dhiple, Samduling, Dhalung, Chhujung (Yaja)	Sep-Oct/Nov	-
46	*Gentiana ornata*	Gentianaceae	H	Shetty	Jun-Aug	-
47	*Gentiana robusta*	Gentianaceae	H	Dhalung	Aug-Sep	Use in herbal medicine
48	*Gentiana* spp.	Gentianaceae	H	Lhetmu, Chhimkthu, Lowathang, Dhalung	Jul-Aug	-
49	*Swertia* spp.	Gentianaceae	H	Dhema, Dhiple, Dhalung, Chhujung (Yaja)	Jul-Aug	Use in herbal medicine
50	*Geranium donianum*	Geraniaceae	H	Shetty, Terthang	Jul-Aug	Use in herbal medicine
51	*Elymus* spp.	Gramineae	G	Nhile Kurchung, Teka Dhong, Meme Ghyumji, Dhowathang		-
52	*Penisetum* spp.	Gramineae	G	Nhile Kurchung, Teka Dhong, Sumda, Thulung, Kara, Gombajuk, Meme Ghyumji, Dhowathang, Tibethang, Kekyap, Yaja, Tukuthang, Llikangkang, Bhinama, Jhurubhokta, Dhadi, Ghyakdhokpa, Dhangdang Thanga, Langde, Muri, Marchung, Dharchok ngogba, Dhangje, Tilikheju, Marcha (Chumje), Dhalung		-
53	*Poa mustangensis*	Gramineae	G	Kekyap		-
54	*Stipa* spp.	Gramineae	G	Nhile Kurchung, Teka Dhong, Sumda, Thulung, Kara, Gombajuk, Meme Ghyumji, Dhowathang, Tekyap, Tukuthang, Bhinama, Jhurubhokta, Dhadi, Langde, Muri, Marchung, Dharchok ngogba, Dhangje, Rhijiphuwa, Tilikheju, Mukchung, Dhalung		-

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
55	*Cordyceps sinensis*	Hypocreaceae	F	Dhema, Dhiple, Chhumjeloma, Chhumjejhyangma, Dhyaka		Use in herbal medicine
56	*Dracocephalum heterophyllum*	Labiateae	H	Dhalung	Jun-Aug	Use in herbal medicine, aromatic plant
57	*Elsholtzia eriostachya*	Labiateae	H	Dhalung	Jul-Aug	Aromatic plant
58	*Lamium rhomboideum*	Labiateae	H	Dhyaka	Jul-Aug	Aromatic plant
59	*Lamium tuberosum*	Labiateae	H	Dhyaka, Dhalung	Jul-Aug	Aromatic plant
60	*Phlomis rotata*	Labiateae	H	Kongmo, Dhema, Lhetmu, Kekyap, Kara Likchung, Dhiple, Shetty, Chhumjeloma, Chhumejhyangma, Chhimkthu, Terthang, Dhyaka, Lowathang, Melungma, Mukchung, Marcha (Chumje), Dhalung	Jun-Jul	Use in herbal medicine, aromatic plant
61	*Thymus linearis*	Labiateae	H	Shetty, Samduling	Apr-Sep	Use in herbal medicine, edible as tea, flavor, spicies, aromatic plant
62	*Astragalus* spp.	Leguminosae	H	Nhile Kurchung, Teka Dhong, Sumda, Thulung, Kara, Gombajuk, Meme Ghyumji, Dhowathang, Tibethang, Chhimkthu, Samduling, Tukuthang, Llikangkang, Bhinama, Jhurubhokta, Dhadi, Ghyakdhokpa, Dhangdang Thanga, Langde, Muri, Dhangje, Marcha (Chumje), Dhalung	May-Jun/Jul	-
63	*Astragalus* spp. *(Spiny)*	Leguminosae	S	Kara, Gombajuk, Tibethang, Kekyap, Dhalung	Jul-Aug	-

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
64	*Caragana gerardiana*	Leguminosae	S	Nhile Kurchung, Teka Dhong, Sumda, Thulung, Kara, Gombajuk, Meme Ghyumji, Dhowathang, Tibethang, Shetty, Tukuthang, Llikangkang, Bhinama, Jhurubhokta, Dhadi, Ghyakdhokpa, Dhangdang Thanga, Langde, Muri, Dharchok ngogba, Dhangje, Rhijiphuwa, Tilikheju, Marcha (Chumje)	May-Jul	Use as fuel wood
65	*Caragana versicolor*	Leguminosae	S	Kara, Gombajuk, Kongma, Dhema, Dhiple, Shetty, Samduling, Yaja, Melungma, Ghogli, Dharchok ngogba, Dhangje, Rhijiphuwa, Marcha (Chumje), Dhalung	Apr-Jun	Use as fuel wood
66	*Oxytropis williamsii*	Leguminosae	H	Kekyap, Dhalung	May-Aug	-
67	*Sophora moorcroftiana*	Leguminosae	S	Sumda	May-Jun	Use in herbal
68	*Lilium nanum*	Liliaceae	H	Dhyaka	Jun-Jul	-
69	*Polygonatum* spp.	Liliaceae	H	Dhema, Dhiple, Kekyap, Dhalung, Chhujung (Yaja)	May-Jun	-
70	*Ponerorchis chusua*	Orchidaceae	H	Dhema	Jul-Aug	-
71	*Corydalis albrury*	Papaveraceae	H	Dhyaka, Dhalung	Jul-Aug	Use in herbal medicine
72	*Corydalis govaniana*	Papaveraceae	H	Kekyap, Chhumjeloma, Chhumjejhyangma, Chhimkthu, Dhyaka, Lowathang, Dhalung	Jul-Aug	Use in herbal medicine
73	*Bistorta* spp.	Polygonaceae	H	Dhema, Kekyap, Dhiple, Chhimkthu, Terthang, Dhyaka, Lowathang, Yaja, Melungma, Ghogli, Dhalung	Jul-Aug	-

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
74	*Androsace* spp.	Primulaceae	H	Kara, Gombajuk, Kongma, Dhema, Lhetmu, Dhiple, Shetty, Chhumjeloma, Chhumjejhyangma, Chhimkthu, Terthang, Dhyaka, Lowathang, Melungma, Mukchung, Marcha (Chumje), Dhalung	Jun-Aug	-
75	*Primula buryana*	Primulaceae	H	Terthang, Dhyaka, Lowathang	Jun-Jul	
76	*Primula macrophylla*	Primulaceae	H	Kekyap	Jul-Aug	Use in herbal medicine
77	*Primula* spp.	Primulaceae	H	Chhujung (Yaja)	Jul-Aug	-
78	*Aconitum* spp.	Ranunculaceae	H	Dhalung	Jul-Aug	Use in herbal medicine
79	*Anemone rupicola*	Ranunculaceae	H	Dhiple, Samduling, Dhema, Chhujung (Yaja), Dhalung	Jun-Aug	-
80	*Delphinium* spp.	Ranunculaceae	H	Kekyap, Dhyaka, Chhujung (Yaja), Dhalung	Jul-Aug	-
81	*Oxygraphis polypetala*	Ranunculaceae	H	Chhujung (Yaja)	Jun-Jul	-
82	*Ranunculus* spp.	Ranunculaceae	H	Dhiple, Samduling, Dhema, Chhujung (Yaja), Dhalung	May-Jun	-
83	*Thalictrum alpinum*	Ranunculaceae	H	Chhumjeloma, Chhumjejhyangma, Chhimkthu, Melungma, Chhujung (Yaja), Marcha (Chumje), Dhalung	JunAug	-
84	*Cotoneaster* spp.	Rosaceae	S	Samduling	May-Jun	-
85	*Potentilla anserina*	Rosaceae	H	Dhalung	Jun-Jul	Use in herbal medicine, root edible as vegetable
86	*Potentilla fruticosa*	Rosaceae	H	Dhema, Lhetmu, Kekyap, Dhiple, Shetty, Dhyaka, Dhalung	Jun-Aug	Use in incense
87	*Potentilla plurijuga*	Rosaceae	H	Dhema, Dhiple, Samduling, Dhalung, Chhujung (Yaja),Rhijiphuwa	Jun-Aug	Use in herbal medicine

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
88	*Potentilla* spp.	Rosaceae	H	Thulung, Kongmo, Dhema, Kekyap, Kara Likchung, Dhiple, Shetty, Chhumjeloma, Chhumjejhyangma, Chhimkthu, Bhinama, Jhurubhokta, Dhadi, Mukchung, Marcha (Chumje)	May-Jul	-
89	*Rosa* spp.	Rosaceae	S	Samduling	Jul-Jul	-
90	*Rosa sericea*	Rosaceae	S	Sumda, Samduling, Marchung	May-Aug	Use in herbal medicine, fruits are used as tea
91	*Spiraea arcuata*	Rosaceae	S	Lhetmu, Kara Likchung, Shetty, Dhyaka, Lowathang, Yaja, Melungma, Ghogli, Marcha (Chumje), Dhalung	Jun-Jul	Ornamental
92	*Populus ciliata*	Salicaceae	T	Samduling, all settlements	Mar-Apr	Use for timber
93	*Salix babylonica*	Salicaceae	T	All settlements	Jul-Jul	Use for timber
94	*Saxifraga aristulata*	Saxifragaceae	H	Kekyap	Jul-Aug	-
95	*Saxifraga brunonis*	Saxifragaceae	H	Kekyap	Jun-Aug	-
96	*Saxifraga* spp.	Saxifragaceae	H	Kara, Gombajuk, Kongmo, Dhema, Lhetmu, Dhiple, Shetty, Chhumjeloma, Chhumjejhyangma, Chhimkthu, Terthang, Dhyaka, Lowathang, Melungma, Mukchung, Dhalung	Jun-Aug	-
97	*Lagotis kunawurensis*	Scrophulariaceae	H	Chhumjeloma, Chhumjejhyangma, Chhimkthu,Chhujung (Yaja), Dhalung	Jun-Aug	-
98	*Lancea tibetica*	Scrophulariaceae	H	Kekyap, Chhujujng (Yaja), Dhalung, Dhiple	Jul-Aug	Use in herbal medicine
99	*Oreosolen wattii*	Scrophulariaceae	H	Kekyap, Chhumjeloma, Chhumjejhyangma, Chhimkthu, Dhyaka, Chhujung (Yaja), Marcha (Chumje), Dhalung	Jun-Aug	Use in herbal medicine
100	*Pedicularis longiflora*	Scrophulariaceae	H	Kekyap, Mukchung, Dhalung	Jul-Aug	Use in herbal medicine, semi

SN	Botanical Name	Family	HSTG	Name of the pasture	Flowering Season	Remarks
						parasitic plant
101	*Pedicularis* spp.	Scrophulariaceae	H	Kekyap, Dhalung	Jul-Aug	Semi parasitic plant
102	*Picrorhiza scrophulariiflora*	Scrophulariaceae	H	Lhetmu, Kara Likchung, Dhiple	Jun-Aug	Use in herbal medicine
103	*Cortia depressa*	Umbelliferae	H	Dhema, Dhiple, Shetty, Dhalung	Jun-Aug	Use in herbal medicine
104	*Cortiella hookeri*	Umbelliferae	H	Kekyap	Jul-Sep	Aromatic plant
105	*Urtica hyperborea*	Urticaceae	H	Kekyap, Dhalung	Jul-Aug	Use in herbal medicine, edible as vegetable
106	*Nardostachys grandiflora*	Valerianaceae	H	Kongmo, Dhema, Kara Likchung, Dhiple, Chhumjeloma, Chhumjejhyangma, Dhyaka, Lowathang	Jun-Aug	Use in herbal medicine, incense, purfume
107	*Viola biflora*	Violaceae	H	Dhyaka	May-Jun/Aug	-

Note: H=Herb, S=Shrub, T=tree, G=grass (Source: Field survey; Chetri *et al.* 2005)

Annex IV. Photographs

Photo 1. Controlled plot, July

Photo 2. Open plot, July

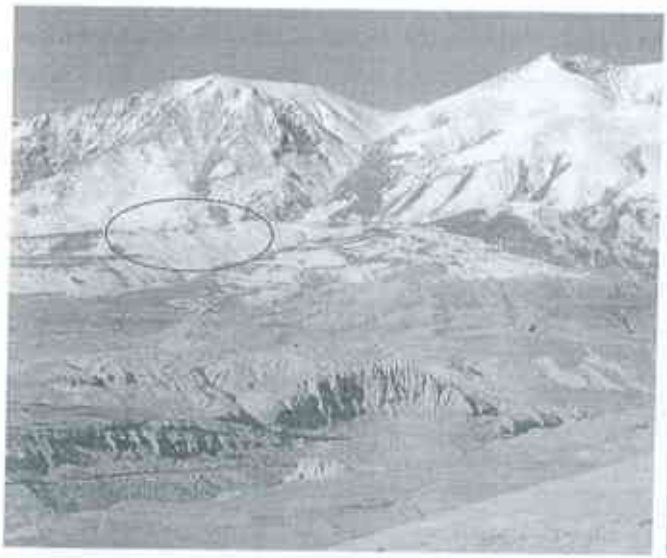

Photo 3. Encircled section showed the experimental plots' site during November

Photo 4. Controlled plots, November

Photo 5. Ground truth data collection for vegetation mapping

Photo 6. Boundary delination and field verification of the pasture

Photo 7. Interaction with key informant

Photo 8. Interaction with herders

Photo 9. Nomads Family at Dhema pasture, note at the back ground *Caragana* spp. dominated shrubland, November 2005

Photo 10. Goat and sheep grazing, Samduling pasture, November 2005

Photo 11. Yak at salt lick, Marchung, July 2005

Photo 12. An important herbal plant – *Dracocephalum tanguticum*, July 2005