

Status, Use and Management of *Jimbu* (*Allium* spp.):  
A Case Study from Upper Mustang, Nepal



One of the species of *Jimbu* herb, *Allium przewalskianum* Regel.

By  
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the degree of Master of Science in Tropical Ecology and Management of  
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## Declaration

I, Ram Chandra Nepal, hereby declare that this Thesis is the product of my original work and that it has not been submitted to any other University for award of any degree. Information from various sources has been duly acknowledged.

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## **List of Acronyms and Abbreviations**

ACA	: Annapurna Conservation Area
ACAP	: Annapurna Conservation Area Project
CAMC	: Conservation Area Management Committee
ECF	: East Coast Fever
HMG	: His Majesty's Government
IUCN	: The World Conservation Union
KMTNC	: King Mahendra Trust for Nature Conservation
NGO	: Non Governmental Organization
NTFP	: Non-timber Forest Product
PRA	: Participatory Rural Appraisal
SD	: Standard Deviation
VDC	: Village Development Committee

## Abstract

Virtually in all cultures worldwide, people have been using plants as a source of medicines and spices. However, during the last decades, the transition from subsistence to market-based economies has created a serious impact on all aspect of natural resource base including medicinal plants. Furthermore, indigenous medicinal knowledge and tradition is being lost. This study was carried out in Upper Mustang, Nepal, to understand the status, use and management of *Jimbu* (*Allium* spp.), a perennial herb. Specifically, I studied local people's knowledge on the uses, contribution to household cash income from the sale, availability in the wild, and present management systems in the villages. Further I examined how the knowledge on the medicinal uses of *Jimbu* is affected by demographic characteristics of the people, and who are most likely to participate in the collection, and sale. I administered semi-structured questionnaires to household representatives. Forty six percent of the households have been using *Jimbu* as a traditional medicine to cure some kinds of human and livestock illnesses whereas, ninety three percent of the households have been using it as a spice. Fifty two percent of the households were involved in the *Jimbu* collection, and each household collected 6.71 ( $\pm$  8.22 SD) and 6.02 ( $\pm$  7.76 SD) kilograms (air dried weight) in 2003 and 2004, respectively. Twenty three percent of the households were involved in *Jimbu* trade each year. The total amount of *Jimbu* that was collected for trading purposes were 2,493 and 2,532 kilograms in 2003 and 2004, respectively. The average household cash income from the sale of *Jimbu* was Nepalese Rupees 4,516 ( $\pm$  4,623 SD) (US\$ 59) and 4,827 ( $\pm$  44,973 SD) (US\$ 68) in 2003 and 2004, respectively. *Jimbu*'s contribution to the household cash income is estimated to 10.41 % ( $\pm$  6.79 SD). In the perception of local people of Upper Mustang, the availability of *Jimbu* in the wild is decreasing. There is no active management system in the village for the *Jimbu*. People's knowledge on the medicinal uses of *Jimbu* is significantly related to the sex of the users. The participation in *Jimbu* collection is significantly influenced by age, sex and literacy of the people. Male and literate people who are young (20 to 39 years old) participate more in *Jimbu* collection than adults (40 to 59 years) and old (older than 59 years). The cash income from *Jimbu* to the household is significantly and positively influenced by the involvement of one of the household members in seasonal trade. *Jimbu* is widely used as a spice and medicine, and has a significant contribution to the household cash income. Sustainable use of it may be attained if rotational or alternate sites harvesting systems is introduced in the wild and further domestication on the private land is encouraged.

*Key words: medicinal plants; NTFP; ethno-botanical knowledge; seasonal trade; cash income; regression model*

## **Introduction**

The use of plants for food and medicine by people represents a long history of human interaction with the environment (Pei 2001). Virtually in all cultures worldwide, people have been using medicinal plants for their preventive and curative health care (Hoareau and DaSivla 1999). Ancient literatures as well as modern scientific studies indicate that plants supply the main medicine for many people's health care. Perhaps the oldest written document on the use of medicinal plants in Asia is *Vedas* from about 4500 to 600 years B. C. (Pei 2001, Gurib-Fakim 2006).

The World Health Organization (Akerele 1992) reports that about 80% of the world's population relies on traditional herbal medicine for their primary health care needs. Valuable herbal traditions commonly found in developing countries have always been considered an important component of the cultural heritage of the world (Pei 2001). 'Medicinal plants are the local heritage with global importance' (Prajapati et al. 2003).

Increased focus on harmful effects of artificial drugs has resulted in increased use of herbal medicine in many western countries (Shinwari and Gilani 2003). Therefore, the popularity of herbal medicine has also grown in western societies (Hamilton 2004). Many people in the developing countries continue living according to their traditional way of life including the use of traditional medicines to cure their health problems (Prajapati et al. 2003).

For the last few decades, environmental as well as cultural changes, and the transition from subsistence to market-oriented economies have created serious impacts on all aspects of traditional medical systems by affecting traditional medicines' resource base and environment (Pei 2001). As a result of over harvesting of medicinal plants, there is degradation of resource base and hence loss of biodiversity (Etkin 1998). Furthermore, there is loss of indigenous medicinal knowledge and tradition. This has led to the breakdown of traditional medicinal systems (Pei 2001).

Ethnobotanical information on medicinal plants and their uses by indigenous cultures is not only useful for conservation of cultural traditions and biodiversity, but also for community health care and drug development. This information is utilized as a guide for drug development under the assumption that a plant that has been used by indigenous

cultures over a long period of time may have an allopathic application (Farnsworth 1993, Pei 2001).

In many countries, farmers and pastoralists have used for centuries medicinal plants for conservation and maintenance of livestock health. For example, in Mexico cows are treated with herbal extracts to treat intestinal disorders (Hoareau and DaSivla 1999). Similarly, it is reported that in Bulamogi county of Uganda, farmers use herbal medicines to treat nine livestock diseases (Tabuti et al. 2003). East Coast Fever (ECF) is the main livestock disease treated by medicinal plants. Most of the plants used are wild shrubs. Roots and leaves are the plant parts most frequently used as medicine. Thus, medicinal plants have become an integral component of ethnoveterinary medicine. This might be due to the increasing cost of livestock maintenance by the use of new technology, veterinary medicine and vaccines.

In most of the societies traditional ethnoveterinary knowledge is transferred orally from generation to generation. Due to socio-economic, environmental and technological changes, the traditional ethnoveterinary medicine knowledge is gradually disappearing from the societies (Tabuti et al. 2003). Therefore, conservation and documentation of the traditional ethnoveterinary knowledge is in urgent need before it is lost forever from the society.

Plants and their products are also used as spices in many parts of the world. Spices have antiseptic and disinfectant properties (De et al. 1999), and may reduce food born diseases (Hoareau and DaSivla 1999, Grohs and Kunz 2000), by inhibiting the growth of fungi and bacteria (Sato et al. 1993, Thyagaraja and Hosono 1996).

The world is endowed with a rich wealth of medicinal plants. Globally it is estimated that there are approximately 250,000 flowering plants and out of these about 35,000 to 70,000 plants species have been used for medicinal purposes (Farnsworth 1993, Prajapati et al. 2003). The total number of medicinal plant species in the Hindu Kush-Himalayan countries is approximately 7,500 to 10,000 (Pei 2001). However, medicinal value and effectiveness of the species varies with its geographical location and life form.

Medicinal plants play an important role in the lives of rural people, particularly in remote parts of developing countries with few health facilities (Prajapati et al. 2003) and income generating opportunities. Therefore, medicinal plants can contribute to improve

livelihoods through the generation of employment and income. There are many examples, such as in Darchula block of Uttar Pradesh in India, where medicinal herbs constitute 12-13 percent of total income of villages (Farooquee and Saxena 1996).

Controlled harvesting and marketing of medicinal plants is a feasible employment and income generation alternative with greater future potential (Cameron 1996, Pei 2001, Hamilton 2004). Furthermore, sale of medicinal plants contribute to the economic development of the rural communities and support modern industrial development (Pei 2001). However, the availability of medicinal plants in the region determines the potentiality for industrial development.

Traditional management of medicinal plants is built on the basis of indigenous knowledge. Local people have developed reliable knowledge and effective methods to identify, harvest, utilize, maintain and preserve medicinal plants and their habitats for sustainable use (Pei 2001). Therefore, understanding the indigenous knowledge of rural people is important for the development of the region.

The traditional medicinal knowledge including the conservation tradition has been disintegrated in many parts of the world due to rapid interaction with the outside world and influence of the modern culture (Pei 2001). Research and documentation of indigenous knowledge of medicinal plant resources and their management can be a part of the process of coping with such changes without losing valuable local tradition and biodiversity (Pei 2001). In addition to harvesting from the wild, cultivation appears as one of the viable options to the people, whose livelihood is depend on medicinal plants (Farooquee and Saxena 1996). There are about 300 species of medicinal plants under cultivation in China (Pei 2001).

Ethnobotanical information is important for further screening and chemical analysis of plants and herbs (Farnsworth 1993). Many scientists and research institutes use ethnobotanical information for new drug development to fulfil the growing demand of medicine to an increasing human population. For example in China, during the 1980s, at least 20 medicines were developed and established based on traditional ethno-medicine (Pei 2001). Therefore, documentation of ethnobotanical knowledge can be considered an information bank of traditional medicine. Otherwise, it might be lost irreversibly from the society.

The Chiang-Mai declaration recognises that medicinal plants are essential in primary health care, in self-medication, and in national health services (Hoareau and DaSivla 1999). The declaration further recognises the loss of medicinal plants diversity world-wide, and focuses attention on the economic value of medicinal plants through drug development. Similarly, the Kari-Oca declaration focuses on the needs of inventory, conservation, and bequeath to future generations the existing traditional knowledge of herbs and medicinal plants (Hoareau and DaSivla 1999).

Topographical and altitudinal variations create conducive environment to grow various medicinal plants in Nepal. There are about 7,000 flowering plants reported from Nepal, out of which over 700 plants and herbs are of medicinal importance (Shrestha and Joshi 1996, Shrestha 2001, IUCN 2004). Currently, there are about 100 species which are traded in Nepal (Edwards 1996). The species which are being traded spans from remote forests and meadows to international markets and consumers (Olsen 2005b), and the main market is India (Olsen 2005a).

High value medicinal plants are collected from alpine pastures. Harvest and sale of these medicinal plants provide an important source of cash income to the rural people (Olsen and Helles 1997b, Olsen 1998, 2005b). People residing in the high mountain areas of Nepal derive as much as 50 % of household cash income from commercial collection of medicinal plants (Edwards 1996, Olsen and Helles 1997a, Olsen 2005b). Moreover, Olsen (1998) has estimated that 50-100 % of the households are involved in commercial medicinal plants harvesting from the high mountain (2700 m to 3400 m a.s.l.) communities of the Gorkha, district, Nepal.

The increasing demand for medicinal plants has threatened future exploitation and increased the risk of species extinction (Shrestha 2001). Many alpine medicinal plants of the Nepalese Himalayas are assumed to be threatened (Singh et al. 1979) due to combination of over-harvesting and habitat destruction (Shrestha and Joshi 1996). Moreover, medicinal plant harvesting is uncontrolled, and plants being harvested are commonly not fully matured, thus hampering regeneration and the quality of the product (HMG 2002). In Upper Mustang, seven medicinal plant species, including *Allium* spp., have been classified as rare (Arjel 2002). Therefore, reliable information about the

availability, use, management, and markets are in urgent need in order to monitor the medicinal plants in Nepal.

In Nepal, three species (e.g. *Dactylorhiza hatagirea*, *Picrorhiza scrophulariflora*, *Juglans regia* (bark)) are banned from collection and another eight (e.g. *Nardostachys grandiflora*, *Rauwolfia serpentine*, *Cinnamimum glaucescens*, *Valeriana jatamansi*, *Lichen* spp., *Abies spectabilis*, *Taxus wallichiana*, and *Cordyceps sinensis*) are banned for export outside the country. Moreover, people have to follow the government's legal procedure to collect, transport, and export the medicinal plants. Even medicinal plants cultivated on private lands are subjected to government permission for trade (Shrestha 2001).

Many previous studies from Nepal have focused on documenting indigenous knowledge on the medicinal uses of plants (Manandhar 1985, Joshi and Edington 1990, Manandhar 1991), trade of non-timber forest products including medicinal plants (Edwards 1996, Olsen 1998, Olsen and Larsen 2003, Olsen 2005a), non-timber forest policy (Larsen et al. 2000) and the documentation of medicinal plants that are used (Manandhar 1980, 1995a, 1995b).

There is no systematic study on *Jimbu* (*Allium* spp.), a herb which is widely used as spice and medicine in rural villages and towns in Nepal. The focus of my study is placed on understanding the social aspect of *Jimbu* use, the management, and availability in the Upper Mustang region. The specific objectives of my study were: 1. What are the local uses of *Jimbu*? 2. How much is the contribution of *Jimbu* to the cash income of the local people? 3. What is the availability of *Jimbu* in the wild? 4. What are the local management strategies for *Jimbu*? 5. What is people's knowledge on the medicinal uses of *Jimbu* and how is that knowledge linked to demographic characteristics? 6. Who are most likely to participate in the collection of *Jimbu*? 7. Which households are most likely to benefit (get cash income) from selling *Jimbu*?

### **Study Area**

Upper Mustang is located at central-north part of Nepal (28° 47' 39'' – 29° 19' 54'' N and 83° 28' 55'' – 84° 15' 16'' E) bordering the Tibetan Autonomous Region of China to the North. The Upper Mustang region is considered the southernmost extension of

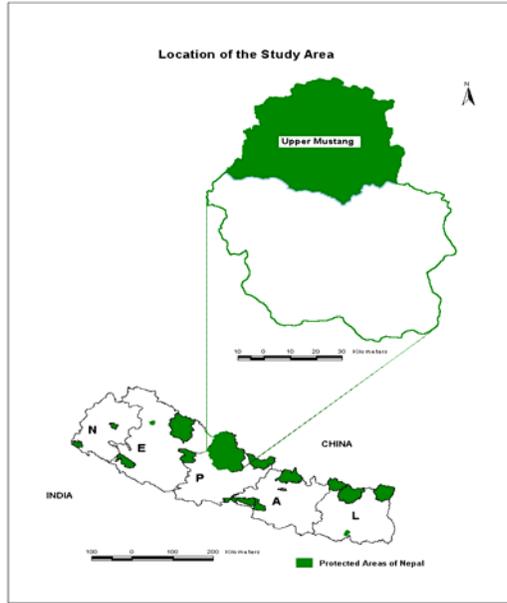


FIG. 1. Location of Upper Mustang in Nepal. It is inside the Annapurna Conservation Area, one of the protected areas of Nepal.



FIG. 2. Location of sample villages and field verification sites (sample plot locations) in Upper Mustang.

Tibetan plateau and has an extension of approximately 2,545 km<sup>2</sup>. Alluvial fans, jutting sandstone ridges, abandoned glacial moraines, and broad sandy terraces are the visible forms of landscape in the region (Sharma et al. 2004).

The entire Upper Mustang region lies on the trans-Himalayan zone, and hence the area receives very little annual rainfall (554 mm between April and October) (Baskota and Sharma 1998). The altitude of Upper Mustang region ranges from 2800 m to above 6000 m a.s.l. Most of the land surface lacks vegetative cover; rain, snow, and wind act on the sandy soils to cause erosion. The entire landscape resembles a high altitude desert. More than 40 percent of the land surface is rangelands and pastures (Blamont 1997).

There are 75 districts in Nepal. The upper Mustang belongs administratively to the Mustang district. Each district is divided into Village Development Committees (VDCs), the smallest local administrative (political) unit in Nepal. There are seven VDCs in Upper Mustang: Chhuksang, Ghami, Tsarang, Lomanthang, Surkhang, Chhoser and Chhonup. A population of 5,395 inhabitants lives in Upper Mustang, distributed in 1,171 households (CBS 2002). Most of the people are Buddhist and they are influenced by Tibetan culture (Baskota and Sharma 1998). The ethnic groups residing in Upper Mustang are *Bista*, *Gurung* and *Kami*. The *Gurung* constitute the predominant ethnic group in terms of population, however *Bista* are the traditional ruling class in the area.

The Upper Mustang region is one of the least populated areas of Nepal, but has one of the highest densities (1,508 per sq. km.) in terms of cultivated land (Blamont 1997). The extreme ecological conditions of high altitude have shaped the life-style and cultures of the people of the region. Most of the people migrate to the lowlands during the winter. Agriculture, livestock herding and seasonal trading are the most important economic activities of the people. During the winter, people are involved in seasonal trade, which takes place in different parts of Nepal and India.

Upper Mustang is located within the Annapurna Conservation Area (ACA) (Fig. 1), a protected area managed under the legal provision of National Parks and Wildlife Conservation Act (1973) of Nepal. ACA is administered by King Mahendra Trust for Nature Conservation (KMTNC), a non-governmental organization of Nepal. Conservation Area Management Regulation (HMG 1996) and directives under this regulation are the basis for the management of ACA (Heinen and Mehta 1999, Mehta and

Heinen 2001). The legislation stipulates that local peoples are the key actors of the natural resources management in ACA who are empowered through the Conservation Area Management Committee (CAMC) formed in each VDC. CAMCs are responsible for the necessary arrangements for the conservation, management and sustainable utilization the natural resources according to their approved operational plan (HMG 1996).

In addition to the formal legal institutions, there is one local informal institution in the villages where the village head (*Mukhiya*) is the chief and has a strong influence in the village to mobilize the local people to carry out various activities including nature conservation, community development or religious activities. The Local Self-governance Act, 2055 (HMG 1999) is another strong legal framework under which authority has been devolved to VDCs to manage natural resources over their territory thereby creating some legal conflicts between CAMCs and VDCs.

### ***Jimbu Species***

Two species of *Allium*, family Amaryllidaceae (*Allium hypsistum* Stearn and *A. przewalskianum* Regel) are known as *Jimbu* in Nepal (IUCN 2004). Both species are perennial herbs growing in clumps. A well drained sandy soil of high arid region is the growing habitat of both species. The above ground parts of these species are used as spices (Shrestha and Joshi 1996) and medicines in rural households in Nepal (IUCN 2004).

*A. hypsistum* grows in the central Nepal north of the main Himalayan range and adjoining the Tibetan plateau. Its reticulately fibrous bulb-coats, 4 to 6 narrow linear leaves, very short pedicels, slightly dentate tepals and simple included filaments together distinguish it from other Himalayan species. It has been recorded at about 4 miles southwest of Saldanggaon (29°18' N, 83°05' E) at about 5500 m a.s.l. altitude in north-central Nepal (Stearn 1960). Flowering occurs from July to August (HMG 1982). This species is endemic to Nepal (IUCN 2004).

*A. przewalskianum* species can be recognized by its bright-red finely reticulate bulb-coat, narrow leaves and small purplish flowers with protruding stamens, the inner three filaments having a broad oblong base with a tooth on each side at the top, and a

slender upper part, while the three outer filaments are subulate. It has been recorded in Damodar Kunda area (4200 m a.s.l.) in north-central Nepal (Stearn 1960). Flowering occurs from July to August. The species is considered as vulnerable in regard to its conservation status (Shrestha and Joshi 1996).

### **Methodology**

*Household survey.* – A household survey was carried out from July to September 2005. Samples were distributed in seven VDCs. Multi-stage simple random sampling (Som 1996) was used to select households for the questionnaire survey. Each VDC was divided into three different areas (e.g. ward number 1-3, 4-6, and 6-9) based on wards and one of these areas were randomly selected for the questionnaire survey. I assumed that all wards were homogeneous with respect to *Jimbu* collection, use, and management. The sample comprised in total 25 percent of the households in the study area. The interviews were conducted with household representatives alternately with males and females (Lise 2000). A total of 105 households were interviewed.

I administered semi-structured questionnaire to the household representatives (Appendix 1). The questionnaires comprised questions regarding demographic characteristics of the household, availability of *Jimbu* in the wild, income from the sale of *Jimbu*, management and use of *Jimbu*.

*Determination of sample size.* – Sample size for household survey was determined on the basis of formula given by Cochran (1963). The formula is:

$$n = [Z^2 p(1-p)]/e^2$$

where n = number of samples required, Z = abscissa of standard normal curve, p = variability on the responses, e = margin of error.

I assumed maximum variability on the responses and hence I used p = 0.5. I took 10 percent as the margin of error and 5 percent level of significance. As there were 1,171 households in Upper Mustang, I used finite population correction to determine the sample size. I added 15 percent extra sample to avoid shortage of data due to missing responses or non responses. So, finally, 105 households were sampled.

*Estimation of Jimbu collection and sale.* – In general, people in my study site do not keep written records regarding the amount of *Jimbu* collected each year. I therefore asked

interviewees to recall the approximate amount of Jimbu collected and sold during 2003 and 2004. When answering my question, people estimated the amount they collected and sold in previous years in their local unit (*Mana* or *Pathi*). I converted it to kilograms, by taking several samples of *Jimbu* in the villages and weighing them (1 *Pathi* = 8 *Mana* = approximately 400 grams of air dried *Jimbu*).

*Estimation of cash income from selling Jimbu.* – I used an indirect method to estimate the percentage of cash income in a household from selling *Jimbu*. I gave 50 grains of wheat (or maize) to interviewees and asked them to separate (or take out) certain amount of grains which was equivalent to the approximate amount of cash income from selling *Jimbu* if that much (50 grains) was the total cash income of the household in a year from all sources.

*Interview with key informants.* – Key informants were interviewed to obtain general information about the study area. During the interview I also asked questions that were similar to those asked in the questionnaire to gain a broader understanding of the process of collecting and sale of *Jimbu*. Key informants included VDC chairperson, Conservation Area Management Committee chairperson, chairperson of women's group, and member of the youth group in all VDCs. A total of 27 persons were interviewed ( Appendix 2).

*Participatory rural appraisal.* – Participatory rural appraisal (PRA) (Chambers 1994) was conducted with a group of local people (6-8) to obtain information on the *Jimbu* growing sites in the pastures. A three dimensional topographic model of Upper Mustang was used to locate the *Jimbu* growing sites on the map (Appendix 5).

*Field verification.* – Field surveys were carried out in three sites to verify the availability of *Jimbu* in the pasture. On the sites, I laid out transects along the altitudinal gradient and along the contour at the place where I first encountered the *Jimbu* plant. I recorded information about *Jimbu* in a 1 m<sup>2</sup> plot at 50 m distance along the transect (Appendix 3).

*Data analysis.* – All the data were tabulated using Microsoft Excel and MINITAB Release 14 was used for statistical analysis.

*Analysis for the knowledge on Jimbu use.* – Some of the previous studies (Benz et al. 2000, Ladio and Lozada 2004, Case et al. 2005) have separately documented that knowledge on the plant use is influenced by age, sex and literacy of the people.

Therefore, I hypothesized that the knowledge on the medicinal uses of *Jimbu* is influenced by the demographic characteristics of a person (e.g. age, sex, and literacy). I used logistic regression model (Neupane et al. 2002, Agrawal and Gupta 2005) to analyse the influence of the explanatory variables on the probability of knowledge of the people on the medicinal uses. The model is as follows:

$$\text{Logit } (\pi) = \alpha + \beta_1 \text{ age} + \beta_2 \text{ sex} + \beta_3 \text{ literacy}$$

where  $\pi$  = probability of knowledge on the medicinal uses of *Jimbu*,  $\alpha$  = regression constant,  $\beta_i$  = regression coefficients ( $i = 1, 2, 3$ ).

The ‘logit  $\pi$ ’ measures the log odds of the knowledge on the medicinal uses of *Jimbu*. The knowledge on the medicinal uses of *Jimbu* was coded as 1 and 0 for those who have and who do not have knowledge, respectively. Similarly, the explanatory variable, age was coded as young (1), adult (2) and old (3) for those who have age between 20 to 39, 40 to 59 and older than 59, respectively. Sex was coded 1 and 0 to represent male and female, education was coded as 1 and 0 to represent literate and illiterate, respectively. I distinguished people as literate for those who could read and write (either Nepali or Tibetan language), otherwise illiterate. I used maximum likelihood estimation method to estimate the value of constant,  $\alpha$ , and regression coefficients,  $\beta_i$ .

*Analysis for the participation in Jimbu collection.* – People have to travel to remote and difficult areas to collect *Jimbu* either for subsistence or business purposes. These difficulties and remoteness as well as demographic characteristics of the people might have influenced the people’s approach to *Jimbu* collection. Therefore, I hypothesized that the probability of participation in *Jimbu* collection is influenced by demographic characteristics like age, sex, and literacy, and external factors like nearest distance of collection sites. I used logistic regression model to analyse the data. The following is the empirical model.

$$\text{Logit } (\pi) = \alpha + \beta_1 \text{ age} + \beta_2 \text{ sex} + \beta_3 \text{ literacy} + \beta_4 \text{ ndofcs}$$

where  $\pi$  = probability of participation in *Jimbu* collection,  $\alpha$  = regression constant,  $\beta_i$  = regression coefficients ( $i = 1, 2, 3, 4$ ).

The 'logit  $\pi$ ' measures the log odds of participation in *Jimbu* collection. The participation was coded as 1 and 0 for those who have and who do not have participated in *Jimbu* collection, respectively. Similarly, the explanatory variable age was coded as young (1), adult (2) and old (3) for those who have age between 20 to 39, 40 to 59 and older than 59, respectively. Sex was coded 1 and 0 to represent male and female, literacy was coded as 1 and 0 to represent literate and illiterate, respectively. Nearest distance from the collection site was measured in hours to reach the *Jimbu* collection sites from respective household. I used maximum likelihood estimation method to estimate the value of constant,  $\alpha$ , and regression coefficients,  $\beta_i$ .

*Analysis for the cash income from Jimbu.* – The average forest derived household income in a village closer to forest and with better market access have been found more than that of the other villages (Wickramasinghe et al. 1996). Wickramasinghe (1996) has also reported that family size, as a proxy of labour availability, is a main discriminating factor between those households who do and those who do not gather forest products for commercial purposes. This might be the case also for the households in Upper Mustang. Therefore, I hypothesized that the probability of cash income from the sale of *Jimbu* is influenced by family size of the household, nearest distance of collection sites from the household, and participation in seasonal trade. I used following empirical model to analyse the data using the logistic regression method.

$$\text{Logit } (\pi) = \alpha + \beta_1 \text{ fsize} + \beta_2 \text{ ndofcs} + \beta_3 \text{ strade}$$

where  $\pi$  = probability of cash income from *Jimbu*,  $\alpha$  = regression constant,  $\beta_i$  = regression coefficients ( $i = 1, 2, 3$ ), fsize = family size of the household, ndofcs = nearest distance of *Jimbu* collection sites, strade = participation in seasonal trade.

The 'logit  $\pi$ ' measures the log odds of cash income from the sale of *Jimbu*. The cash income was coded as 1 and 0 for those who have and who do not have cash income from *Jimbu*, respectively. Similarly, the explanatory variable family size was measured in number which was between 1 and 12. Nearest distance of the *Jimbu* collection sites from

the respective households was measured in hours. Participation in seasonal trade was coded as 1 and 0 for those who did and who did not participated in the seasonal trade. I used maximum likelihood estimation method to estimate the value of constant,  $\alpha$ , and regression coefficients,  $\beta_i$ .

*Processing of green Jimbu.* - People only collected the above ground vegetative part of the *Jimbu* herb from the wild. After collection, they used simple processing to keep the flavour of *Jimbu* over time. The green *Jimbu* plant was lightly beaten to squeeze out some water from it (Appendix 5). Then it was dried in a shed for several days until it was completely air dried. Direct sunlight was avoided since local people believed that sun dried *Jimbu* have lower quality.

## Results

### *Uses of Jimbu*

*Uses of Jimbu as a traditional medicine.* – Forty six percent (n = 105) of the households of Upper Mustang have been using *Jimbu* as a traditional medicine to cure some kind of human and livestock illnesses. However, 54 % of the households did not report to acknowledge the uses of *Jimbu* as medicine. Two thirds of the respondents that did not report the use of *Jimbu* as medicine were females (Table 1). The knowledge about the use of *Jimbu* as medicine was independent of the age of the respondents ( $\chi^2 = 1.45$ , df = 2, P = 0.49). For humans *Jimbu* was mainly used against cough and cold (flu) followed by high altitude sickness and stomach pain (Fig. 3). Diarrhoea or loose dung, cough and cold, and lung and liver diseases were the major livestock illnesses treated with *Jimbu* (Fig. 4).

TABLE 1. Gender knowledge (%) to the traditional medicinal uses of *Jimbu*.

User	Traditional medicinal uses of <i>Jimbu</i>	Male	Female	Total
People	Unknown	18	36	54
	Flu	21	15	36
	High altitude sickness	1	0	1
	Stomach pain	1	0	1
Livestock	Diarrhoea or loose dung	5	2	7
	Cough and cold	6	0	6
	Lung and liver disease	4	0	4

*Notes:* The responses were not exclusive to a single use.

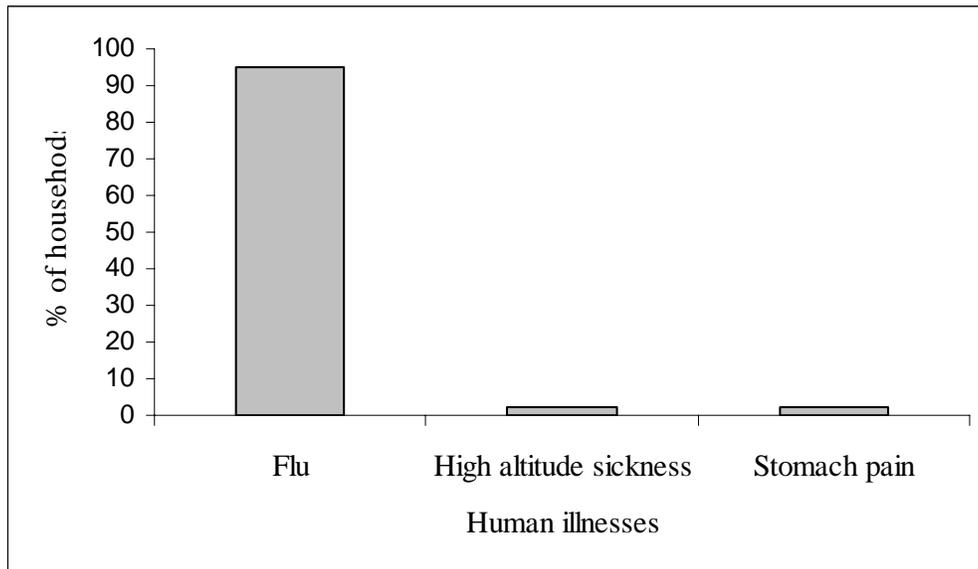


FIG 3. Use of *Jimbu* for different human illnesses. Note that 38 percent of the people of Upper Mustang use *Jimbu* as a traditional medicine to treat these kinds of human illnesses.

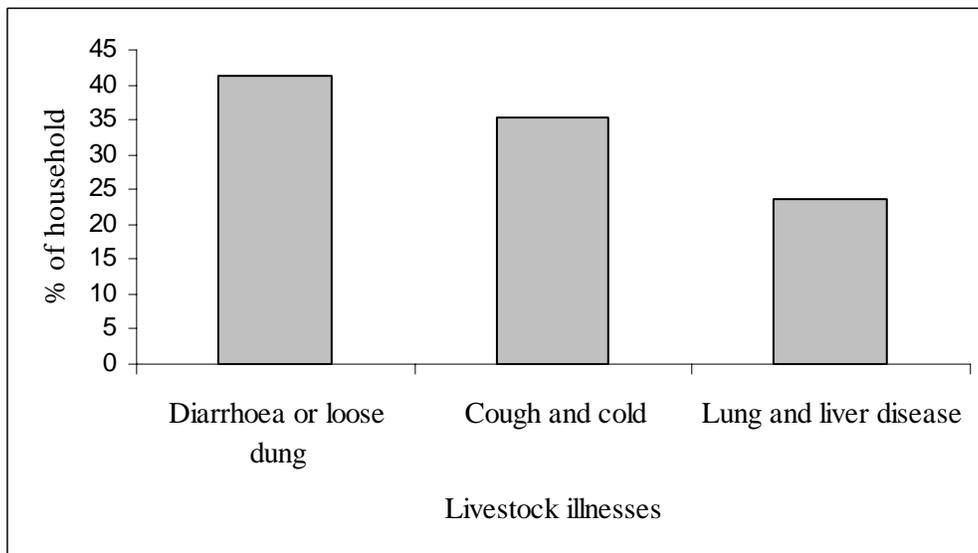


FIG 4. Percentage of households that use *Jimbu* for different livestock illnesses. Note that 16 % people of Upper Mustang use *Jimbu* as a traditional medicine to treat these kinds of livestock illnesses.

The probability of knowledge of the people on the medicinal uses of *Jimbu* is significantly related to the sex of the users (Table 2). But, the age and literacy are not

significant ( $P > 0.05$ ). The odds of having knowledge on medicinal uses of *Jimbu* is 3 times higher for males than for females for given age category and literacy.

TABLE 2. Relation of age, sex, and literacy with the knowledge of people on medicinal uses of *Jimbu* (logistic regression).

Predictor	Coefficient	SE	Z	P	Odds Ratio
Constant	-1.32	0.44	-3.03	0.00	
agecat					
2	0.71	0.48	1.47	0.14	2.03
3	0.002	0.69	<0.001	0.998	1.00
sex	1.10	0.45	2.44	0.02	3.00
literacy	1.01	0.52	1.94	0.052	2.75

Notes: agecat, category of age which is categorized as 1 (20 to 39 years), 2 (40 to 59 years), and 3 (older than 59).

Coefficient, logistic regression coefficient; SE, standard error; Z, wald statistic (which has a  $\chi^2$  distribution); P = level of significance

n = 105; Pearson  $\chi^2 = 2.68$ , df = 6, P = 0.85; Deviance = 3.06, df = 6, P = 0.80

*Uses of Jimbu as a spice.* – *Jimbu* is commonly used as a spice in Upper Mustang. Ninety three percent of the households have been using it in vegetable curries, 87 % in lentil soups, 30 % in pickles, 29 % in meat items, and 1 % in other items (like *momo*, a local dish). There are also some people (5 % of the households) in Upper Mustang, who have never used *Jimbu* as a spice (Fig. 5).

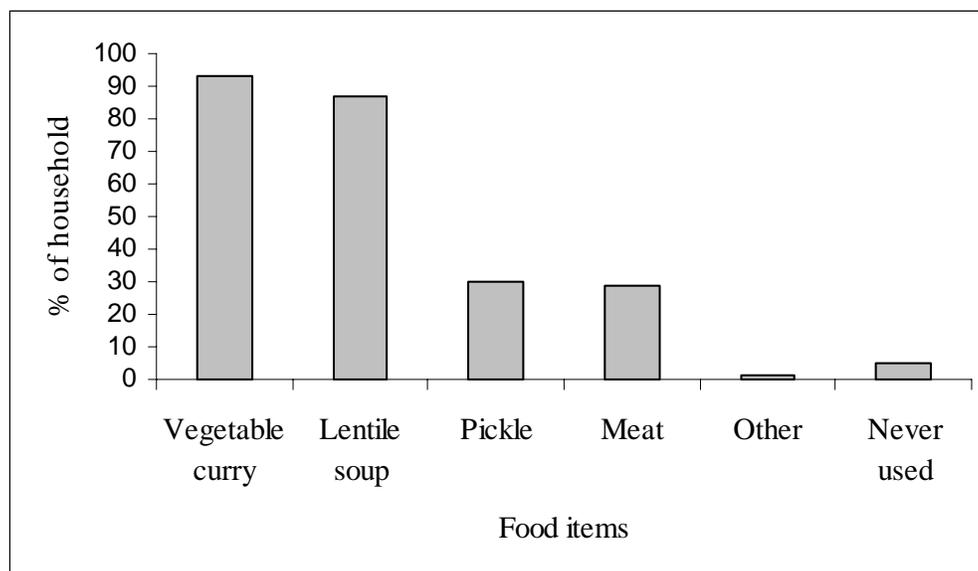


FIG 5. Percentage of households that use *Jimbu* as spice in different food items.

### *Income from the sale of Jimbu*

Fifty two percent (n = 105) of the households reported that they have been involved in *Jimbu* collection from the wild (pasture). However, the involvement fluctuates each year, 37 % and 47 % of the households were involved in the collection of *Jimbu* during 2003 and 2004, respectively. The purpose of the collection also varies, 18 % of the households collected only for domestic use, whereas 34 % of the households collected both for domestic use and for commercial sale purposes. Similarly, 31 % of the households collected *Jimbu* in both years. Twenty-three percent of the households were regularly involved in *Jimbu* collection both for domestic use as well as commercial sale purposes. Of those collecting with the purpose of selling, 29 % and 31 % of the households sold *Jimbu* in 2003 and 2004, respectively.

In most cases, males (62 %) were involved in *Jimbu* collection. Out of those involved in *Jimbu* collection, *Gurung* (93 %) was the main ethnic group followed by *Kami* (5 %) and *Bista* (2 %). Middle sized families were most frequently involved in the collection of *Jimbu* (Fig. 6).

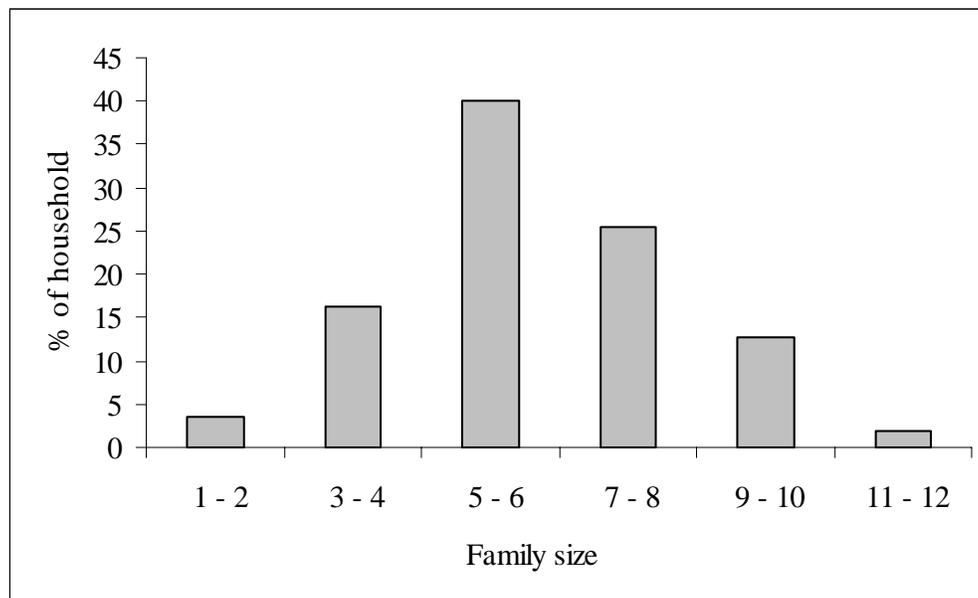


FIG 6. Percentage of the households who participated in *Jimbu* collection by family size.

Out of the households that were involved in *Jimbu* collection, each household collected 6.71 ( $\pm$  8.22 SD) and 6.02 ( $\pm$  7.76 SD) kilograms (air dried weight) in 2003 and

2004, respectively. The mean amount of *Jimbu* collected in these two years was not significantly different ( $t = 0.41$ ,  $df = 86$ ,  $P = 0.69$ ). The estimated total amount of *Jimbu* collected from Upper Mustang in 2003 and 2004 was 2,919 and 3,288 kilograms, respectively.

The total amount of *Jimbu* that was collected from Upper Mustang for selling purposes are 2,493 and 2,532 kilograms in 2003 and 2004, respectively. However, if we included the amount of *Jimbu* purchased from the capital Kathmandu and collected from Tibet and sold by the people of Upper Mustang it totals 4,952 and 4,567 kilograms, respectively. Therefore, out of the households that were involved in the *Jimbu* trade, the amount of *Jimbu* sold by each household was found to be 14.12 ( $\pm 12.41$  SD) and 13.45 ( $\pm 13.31$  SD) kilograms (air dry weight) in 2003 and 2004, respectively. As people also bought *Jimbu* from Kathmandu, the amount sold is greater than the amount collected. There was no significant difference ( $t = 0.20$ ,  $df = 59$ ,  $P = 0.84$ ) in the amount of sale of *Jimbu* from each household in those two years.

The average cash income from the sale of *Jimbu* per household was Nepalese Rupees 4,516 ( $\pm 4,623$  SD) (approximately US\$ 59) and 4,827 ( $\pm 4,973$  SD) (approximately US\$ 68) in 2003 and 2004, respectively ( $t = 0.26$ ,  $df = 59$ ,  $P = 0.80$ ). For those who were involved in the *Jimbu* trade, *Jimbu*'s contribution to the household cash income is estimated as 10.41 % ( $\pm 6.79$  SD).

Households reporting not to be involved (48%) in *Jimbu* harvesting in 2004 and 2003 were mainly *Gurung* (92 %) followed by *Kami* (6 %) and *Bista* (2 %). The main reasons the informants gave for not collecting *Jimbu* were difficulties in collection (44 %), lack of manpower or time (26 %), lack of information on the availability (18 %), changes in profession (10 %), and lack of knowledge about *Jimbu* (2 %).

The probability of participation in *Jimbu* collection is significantly influenced by age, sex and literacy of the people (Table 3). Young (20 to 39 years old) people participate more in *Jimbu* collection than adults (40 to 59 years) and old (older than 59 years). The odds of participation in *Jimbu* collection is 3.74 times higher for males than females for given age category, literacy and nearest distance of *Jimbu* collection sites. Similarly, the odds of participation in *Jimbu* collection is 3.3 times higher for literate than illiterate for given age category, sex and nearest distance of *Jimbu* collection sites. The

distances to the *Jimbu* collection sites have no effect on the level of participation of the people on *Jimbu* collection ( $P > 0.1$ ).

TABLE 3. Effects of age category, sex, literacy, and nearest distance of *Jimbu* collection sites on likelihood of participation in *Jimbu* collection (logistic regression).

Predictor	Coefficient	SE	Z	P	Odds Ratio
Constant	-0.31	0.54	-0.56	0.57	
agecat					
2	-1.11	0.50	-2.23	0.03	0.33
3	-1.73	0.74	-2.35	0.02	0.18
sex	1.32	0.49	2.66	0.01	3.74
literacy	1.19	0.57	2.10	0.04	3.30
ndofcs	0.07	0.09	0.76	0.45	1.07

Notes: agecat, category of age which is categorized as 1 (20 to 39 years), 2 (40 to 59 years), and 3 (older than 59); ndofcs, nearest distance of *Jimbu* collection sites.

Coefficient, logistic regression coefficient; SE, standard error; Z, wald statistic (which has a  $\chi^2$  distribution); P = level of significance

n = 105; Pearson  $\chi^2 = 44.05$ , df = 53, P = 0.80; Deviance = 52.49, df = 53, P = 0.49

TABLE 4. Effects of family size, nearest distance of *Jimbu* collection sites, and participation in seasonal trading on likelihood of cash income from *Jimbu* selling (logistic regression).

Predictor	Coefficient	SE	Z	P	Odds Ratio
Constant	-2.19	0.81	-2.70	0.01	
fsize	-0.04	0.10	-0.36	0.72	0.96
ndofcs	0.05	0.10	0.50	0.62	1.05
Strade	2.87	0.56	5.14	<0.001	17.62

Notes: fsize, family size of the respondent; ndofcs, nearest distance of *Jimbu* collection sites; strade, participation in seasonal trade.

Coefficient, logistic regression coefficient; SE, standard error; Z, wald statistic (which has a  $\chi^2$  distribution); P = level of significance

n = 105; Pearson  $\chi^2 = 78.39$ , df = 72, P = 0.28; Deviance = 81.59, df = 72, P = 0.21

The probability of cash income from *Jimbu* to the household is significantly and positively influenced by the involvement of one of the household members in seasonal trade (Table 4). Family size of the household and the distance of the *Jimbu* collection sites have no influence on the income ( $P > 0.1$ ). The odds of cash income from the sale of

*Jimbu* is 17.62 times higher for those who were participated in seasonal trade than for those who did not participate for given family size and nearest distance of *Jimbu* collection sites.

*Mode of Jimbu trade.* – Most of the people who were involved in the *Jimbu* trade sold *Jimbu* visiting people door to door (82 %). This was a seasonal trade. People went to different parts of the country to sell *Jimbu* during winter. Others (18 %) sold to middlemen or vendors either from their own village or at the nearby town, Jomsom.

#### *Availability of Jimbu*

Most of the people traveled 4.4 ( $\pm$  3.1 SD) hours from their villages to collect *Jimbu*. In general, according to the perception of the informants the availability of *Jimbu* in the wild is either decreasing (48 %) or constant (19 %). This perception was not different between those who were involved in collecting *Jimbu* and those who were not ( $\chi^2 = 0.03$ ,  $df = 1$ ,  $P = 0.87$ ). The perception was also shared among men and woman ( $\chi^2 = 0.10$ ,  $df = 1$ ,  $P = 0.75$ ). Young (20 to 39 years old), adult (40 to 59 years old) and elderly (older than 59 years) people also have the same impression ( $\chi^2 = 2.93$ ,  $df = 2$ ,  $P = 0.23$ ). The main reasons for the decrease in *Jimbu* availability in the wild is related to a decline in the amount of rainfall or to changes in the rainfall pattern during the past years. The amount of rainfall on the early summer was the main determining factor (72 %) whether there would be abundant *Jimbu* growing in the pasture or not. However, 31 % of the informants (male 18 % and female 82 %) reported not knowing the status in the wild. Similarly, 28% of informants did not know the relation between rainfall and availability of *Jimbu*.

*Field verification.* – I recorded *Jimbu* up to 4637 m a.s.l. (29° 12' 2'' N, 84° 4' 37'' E). Average density of *Jimbu* in *Jhimjhyang* area (29° 11' 44'' N, 84° 4' 20'' E) was high ( $6.88 \pm 10.64$  SD clumps per  $m^2$ ) as compared to *Karan* (28° 58' 19'' N, 84° 0' 50'' E) ( $4.67 \pm 2.52$  SD clumps per  $m^2$ ) and *Taprang lek* (28° 59' 20'' N, 83° 58' 58'' E) ( $0.25 \pm 0.46$  SD clump per  $m^2$ ) (Appendix 4).

### *Management of Jimbu*

All of the households involved in collecting *Jimbu* (52 %) collected on community land. Commonly the above ground part of the *Jimbu* herb was manually harvested. However, sometimes people uprooted the whole plant to transplant it in their kitchen garden. I did not find any rotational, alternate or other systems of *Jimbu* collection in the villages. People went to the same place each year for collecting *Jimbu*.

Perceived availability of *Jimbu* (76 %) was the main factor determining the decision of where to collect *Jimbu*, followed by the distance from the villages to *Jimbu* collection sites (24 %). Most of the people (55 %) were non selective in harvesting the *Jimbu*, they collected both flower bearing and non-bearing clumps of the herb. But some preferred to harvest before flowering (25 %). Similarly, some people (20 %) preferred to harvest flowering clumps of the *Jimbu* herb.

People harvested *Jimbu* mainly during July-September each year. Sixty four percent of the households (n = 105) said that there was no need of permission to collect *Jimbu* from the pasture, but 6 % said that they needed permission. However, 30 % of the households did not know about the permit system.

Among the households involved in *Jimbu* collection, 95 % of the households did not pay for the permit. Fifty percent of the households said that anybody from outside their villages was allowed to collect *Jimbu* in their pasture. There were certain areas in the Upper Mustang where people (8 %) from outside the villages were not allowed to collect *Jimbu* without permission from the village head (*Mukhiya*). In the villages where permission to collect *Jimbu* was needed, 33 % of the households said that the village head was responsible for punishing those who violated the norms for collecting *Jimbu*. However, 67 % of the households did not know who was responsible for legal punishment in cases where the norms were violated.

Eighty percent of the household representatives were knowledgeable about the methods of regeneration of *Jimbu*. Out of those who knew the methods for regeneration, 98 % said that it was from rhizome and 2 % said from seeds. Rainwater was the major factor affecting the growth (77 %) and survival (37 %) of *Jimbu* in the wild. Grazing by goats and sheep (66 %) was the second major factor affecting the growth of *Jimbu*, according to the perception of the people.

The majority (52 %) of the households were satisfied with the present management system. However, 47 % of the households were unaware about the existence of any management system. One percent of the households emphasized the need for rules and regulations for better management of *Jimbu* in the wild.

### **Discussion**

*Uses of Jimbu as a traditional medicine.* – The high percentage in the use of *Jimbu* reported in my interviews could result from several factors. The use of *Jimbu* is linked to traditional ways of living in Upper Mustang. *Jimbu* is freely available in the alpine pastures but since it is a seasonal herb, people store it dried in the house for later uses. Through the close interaction of people with their environment and resources, people develop knowledge not only about the properties or uses of different plants, but also about how to manipulate the plant so that it can be kept closer to the house. This is the case with *Jimbu*. However, the widespread use of *Jimbu* could also be explained by the insufficient basic health care facilities in the Upper Mustang. Most of the villages are scattered in remote areas, which has further limited their access to medical services. Currently, villagers must travel to Jomsom (the district headquarters, which is at least four hours walk from a nearest village), if they wanted to receive veterinary services from the government clinic (Blamont 1997). A similar traditional culture has been found in India, where people (92 to 93 %) from Bhotiya community in Nanda Devi Biosphere Reserve, are dependent on herbal treatment for their health problems (Maikhuri et al. 1998b). Similarly, the locals of Almora and Nainital districts of the Indian central Himalaya have evolved indigenous health care practices to maintain their livestock (Samal et al. 2002).

The medicinal uses of *Jimbu* were less known for females, this can be explained by the relatively less involvement of females in the collection and trade of *Jimbu*. This again illustrates the fact that knowledge develops through interactions between people and their environments, but also through the activities that people get involved in. Men are only the local herbal doctors (*Amchis*) in Upper Mustang region. In cases of livestock health problems, generally men are involved in the treatment. These facts might be the reasons why women have less knowledge on the medicinal uses of *Jimbu*.

There seems to be no relationship between the knowledge on the medicinal uses of *Jimbu* and the age of the people. Due to the frequent and extensive uses of *Jimbu* in each household, young people learn the different uses. This is also an indicator of less acculturation on the knowledge of medicinal uses of *Jimbu*. However, this seems contradictory to general findings that due to the effect of modernization and urbanization, young generation tend to have less plant knowledge and their uses (Case et al. 2005). For example, in Manus Island of Papua New Guinea, Case et al. (2005) found significant differences in ethnobotanical knowledge by age of the informant. Similarly, in Mapuche community from north-west Patagonia, Ladio and Lozada (2004) found diminishing plant knowledge with age.

The knowledge on the medicinal uses of *Jimbu* seems independent of literacy of the people. This might be an indicator that knowledge is being transferred from generation to generation from their elders, and it is not taught through the formal education in schools. Furthermore, most of the people are most likely to interact with people outside their culture during seasonal trade or winter migration, because they have less likely to have language barrier as most of the people from Upper Mustang speak Nepali (national language) and their own dialect (Tibetan language). Therefore, the more the interactions with the different people the more the chances of having more knowledge. However, the chance of having knowledge on male is higher than that of female. This can be linked with literacy because, male are more literate than female in Upper Mustang (CBS 2002).

*Uses of Jimbu as a spice.* – *Jimbu* is commonly used as spice in Upper Mustang. Ninety three percent of the households of Upper Mustang are traditionally using it in vegetables, lentil soup, pickles, meat items, as well as in other food items on a regular basis. Generally, people said that *Jimbu* has been used to make the food testy. Many studies (You et al. 1989, Gao et al. 1999, Hsing et al. 2002) have found that the *Allium* species also have various cancer curing properties.

*Income from Jimbu.* – A high percentage of the households in my study site have been involved in *Jimbu* collection at one time or another. Olsen (1998) estimated that between 50 – 100 % of the households were engaged in commercial medicinal plant harvesting in Gorkha district, Nepal.

*Jimbu* collection is a very difficult job. People have to walk far away from the village (in an average 4.4 hours from the village) in dry, sloppy and difficult areas where water is scarce. Sometimes people needed over night camping on the sites. Further, people complained about headache when they were engaged in collecting *Jimbu* for several hours. These might be reasons why about 48 % of the households were not involved in *Jimbu* collection.

The participation in *Jimbu* collection was significantly influenced by age, sex and literacy of the people. My study shows that young, literate men participate more in *Jimbu* collection. As *Jimbu* is found in remote and difficult areas, only young and energetic people are likely to be involved in the *Jimbu* collection. Involvement in household chores and the remoteness of the *Jimbu* collection sites might be the reasons why women participate less in *Jimbu* collection than men (Upadhyay 2005). The literate people are participating more in *Jimbu* collection probably due to easy communicate with people outside the Upper Mustang area during their involvement in seasonal trade.

Income from *Jimbu* was positively related to the involvement of household members in the seasonal trade. *Jimbu* sale being a very old tradition of the Mustangi people, *Jimbu* is one of the seasonal trade sales items. This might explain why the chance of having cash income from the sale of *Jimbu* is 17.62 times higher for those who were participating in the seasonal trade than for those who were not.

The mean amount of *Jimbu* collection in 2003 and 2004 was not significantly different, indicating that *Jimbu* collection was stable over the year and that the resource availability was also relatively constant. However, 48 % households said that the availability of *Jimbu* was decreasing while 19 % said it was constant.

My estimation of the value in terms of cash income from the sale of *Jimbu* per household is similar to what Olsen and Larsen (1993) estimated as the national average income from medicinal plants in Nepal US\$ 66 ± 99, my estimates are between US\$ 59 and 68. During the national survey of Nepal, Olsen and Larsen (2003) estimated that 3 to 44 % (average of 12 %) of the annual household income was from medicinal plants. My estimation for the *Jimbu*'s average contribution to the household cash income is 10.41 % (± 6.79 SD) each year. These two estimates are approximately similar but the difference is that the former was the income from 9 species of medicinal plants and one exude

(*Silajit*) while the later was from a single species, *Jimbu*. This shows that *Jimbu*'s contribution to the household economy is very significant. A study from the tropical forest zone of south-west Cameroon also shows that non-timber forest products play an important part in household incomes and may make up to 15 % of household income (Ambrose-Oji 2003).

*Mode of Jimbu trade.* – Most of the people who were involved in the *Jimbu* trade sold *Jimbu* visiting people door to door (82 %). This is the traditional way of *Jimbu* trade. Few years back, people used to barter *Jimbu* with grains (food items) in the villages. However, recently that system has been slowly replaced by cash system. A similar system of bartering has also been reported from the buffer zone of Nanda Devi Biosphere Reserve, India (Maikhuri et al. 1998a). Generally in Nepal, there is well developed marketing chain for medicinal plants (Edwards 1996, Olsen and Helles 1997b).

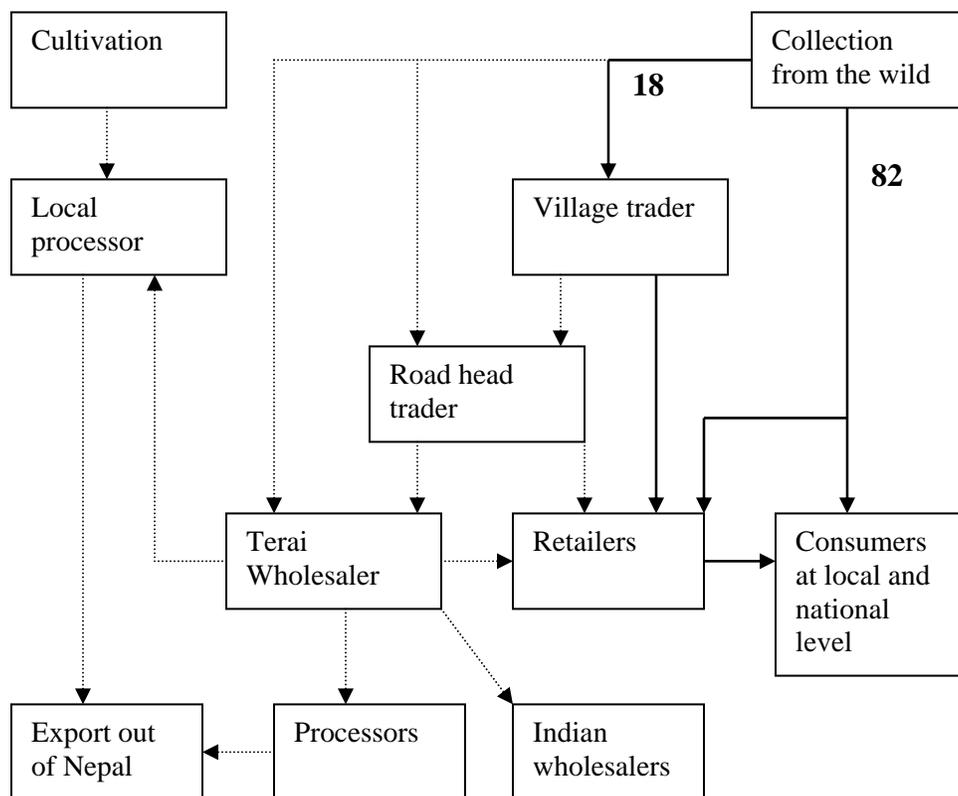


FIG. 7. Schematic diagram showing marketing chain for medicinal plants (modified from Olsen and Helles (1997b)) in Nepal. The solid lines show the marketing chain for *Jimbu* from Upper Mustang. The numbers are the estimates of percentage of the households involved in *Jimbu* trade.

As opposed to conventional marketing system of medicinal plants (Edwards 1996, Olsen and Helles 1997b) in Nepal, most of the households (82 %) from Upper Mustang involve themselves in the *Jimbu* business acting both as collectors and traders (Fig. 7). This system of business provides maximum opportunities for getting profit from the sale of *Jimbu*. If traders had been involved between collectors and retailers, the main profit would have been distributed between traders and retailers. As we have seen from most of the studies (Olsen and Helles 1997b, Ojha 2001), collectors have not been able to reap fair benefit in the marketing chain. In general, this is not the case in Upper Mustang.

*Availability of Jimbu.* – Most of the people travelled approximately 4.4 hours from their villages to collect *Jimbu*. This means that either *Jimbu* was unavailable nearby the villages or it is being rare due to over harvesting. According to the perception of the informants the availability of *Jimbu* in the wild is decreasing (48 %). This might be due to either environmental changes (such as less rainfall or shifting in the rainfall pattern) or over harvesting of *Jimbu* in the area. Perception of some of the informants (19 %) was that availability of *Jimbu* is constant in the wild. If rainfall was the major factor for growth and survival of the *Jimbu*, it might be that *Jimbu* is decreasing at present but that it might recover if rainwater is available on time. This claim might need further investigations. Other factor affecting the availability of *Jimbu* is livestock grazing. Grazing is open in Upper Mustang and most of the domestic animals graze *Jimbu*.

*Management of Jimbu.* – *Jimbu* is mainly found in the community land of Upper Mustang. Therefore, all the households involved in collecting *Jimbu* collected from community land. I did not find any management prescriptions for *Jimbu* in the operational plans of CAMCs. Therefore, despite the legal frameworks, there are no formal management plans for the conservation and development of *Jimbu* in Upper Mustang yet. However, in some of the villages (e.g. *Tangya*, *Tetang*) village heads have control over *Jimbu*, and hence they have regularized the harvesting of *Jimbu* in the villages in an informal way.

People mainly collected the above ground vegetative part of *Jimbu* herb. Out of those who were involved in *Jimbu* collection, 55 % were interested to collect both flowering and non-flowering clumps of *Jimbu* indiscriminately. Furthermore, 25 % were interested to collect *Jimbu* before flowering. This kind of harvesting method might have

negative impact on the regeneration of *Jimbu*. However, *Jimbu* being a perennial herb, regenerates from rhizomes every year.

In most of the places in Upper Mustang, there is no restriction in *Jimbu* collection. Most of the local people do not have to pay for the permit to CAMC, VDC or village head. This might be the reason that a high proportion of households were satisfied with the present system of management.

It seems that distance to the *Jimbu* sites does restrict many people to go for *Jimbu* collection. This might be the indicator that *Jimbu* is a very essential resource for the people of Upper Mustang. Eighty percent of the household representatives were knowledgeable about the methods of regeneration of *Jimbu*. About 10 % of the households have cultivated *Jimbu* in their kitchen garden or in a small pot at the roof top of their house for subsistence use. Most of the people (98 %) regenerated it from rhizome collected from the nearby pasture. This species can also be micro-propagated if needed to do large scale plantation (Wawrosch et al. 1999, Wawrosch et al. 2001).

In conclusion, *Jimbu* is widely used in Upper Mustang as a spice and as a traditional medicine. Many households get significant income from the *Jimbu* trade which can be comparable with the average income from medicinal plants at the national level. However, due to absence of active management, uncontrolled harvesting, and diminishing rainfall, its availability has been reduced in the wild. Some of the households have domesticated *Jimbu* for their subsistence use. There is no problem for market of *Jimbu*. *Jimbu* being a perennial herb, sustainable use may be attained if rotational or alternate sites harvesting systems is introduced in the wild and further domestication on the private land is encouraged.

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## Appendix 1

### Questionnaire for the household survey

Date: \_\_\_\_\_ Name of the surveyor: \_\_\_\_\_

1. Name of the respondent: \_\_\_\_\_ Age: \_\_\_\_\_ Sex: \_\_\_\_\_  
 VDC: \_\_\_\_\_ Ward: \_\_\_\_\_ Village: \_\_\_\_\_  
 Education: \_\_\_\_\_ Family size: \_\_\_\_\_ Occupation: \_\_\_\_\_ Caste: \_\_\_\_\_

Questions related to resource availability

2. Is there *Jimbu* available in the pasture? Yes No

3. How many different kinds of *Jimbu* do you find in the pasture? Please name most important to least one.

a. \_\_\_\_\_ b. \_\_\_\_\_ c. \_\_\_\_\_ d. \_\_\_\_\_

4. Which kind of *Jimbu* is mostly available in the pasture?

a. \_\_\_\_\_ b. \_\_\_\_\_ c. \_\_\_\_\_ d. \_\_\_\_\_

5. Do you collect *Jimbu*? Yes No

If no, why? .....

If yes: Which species do you mostly collect?

6. Which parts of the plant do you collect? root above ground part whole plant

7. Why do you collect *Jimbu*?

For commercial purpose For domestic use Both use

8. On an average, how much do you collect in a year? (Kilogram or *pathi*)

Parts used	This year	Last year	Previous year	Remarks (If increasing and decreasing why?)
Above ground part				man power, availability, demand, climatic conditions, others (specify)

9. Where do you collect it, please name the places of collection?

10. How far are the places from your village?

Name of the place distance from the village

-----  
 -----  
 -----

11. What type of land-use do you collect from?

private land community land other land (specify)----- do not know

12. Describe the major physiographic properties of the collection sites.

Name of the sites                      physiographic properties  
 (ridge, plain, river side, wet area, dry area, grass/shrub  
 land, others specify)

-----  
 -----

13. Do you collect *Jimbu* in the same place each year or in different places in different years?

14. What factors are important to decide where you will collect?

Distance from village              Quality (types) of the *Jimbu*              other factors

15. When do you collect it? Month =

Before flowering      After flowering              After seed shedding              Do not know

16. Where do you sell it?      a. middle man              b. vender              c. house to house

17. In general, what is the availability of *Jimbu* in the wild?

Getting easier to find              Getting more difficult to find              Not changing

18. How much *Jimbu* was there to collect? (answers: a lot, few, none, etc)

10 years ago              5 years ago              last year              this year

-----  
 -----  
 -----  
 -----

Why?

19. How much *Jimbu* do you think will there be to collect? (answers: a lot, few, none, etc)

Next year              in two years              in 5 years              in 10 years

-----  
 -----  
 -----  
 -----

Why?

Questions related to contribution to cash income

20. How much did you sell in a year? (Kilogram or *pathi*)

Parts used	This year	Last year	Previous year	Remarks (If increasing and decreasing why?)
Above ground part				man power, availability, demand, others (specify)

21. What was the selling price per kilogram or per *pathi*?

Parts used	This year	Last year	Previous year	Remarks (If increasing and decreasing why?)
Above ground part				man power, availability, demand, others (specify)

22. How much time (hours) does it take to go, collect and come back from the collection sites?

Sites	Time to go	Time for collection	Time to come back	Collected amount

23. How much is the labour cost per day (village rate)?

24. What are the sources of your cash income (other than selling of *Jimbu*) in a year?

Sell of livestock:	Sell of agriculture products:
Sell of other NTFPs:	Services (government/NGO):
Daily labour:	Seasonal trading (outside the village):
Hotel/tea shop:	Others (.....):
Total cash income per year:	

25. How much do *Jimbu* contribute to the cash income in your family?

None (0 %)	Negligible (1-5 %)	significant (6-25 %)	a lot (26-50 %)	very much (51-100 %)
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Questions related to management strategies

26. When do you collect *Jimbu*? Is there any specific time for collection in a year?

27. Do you need permission to collect *Jimbu*?      Yes                  No  
If yes, who provides the permission?

28. Do you pay for the permit?                          Yes                  No  
If yes, how much?

29. Do you collect *Jimbu* in the same place each year?      Yes                  No  
If no, how do you select the sites?

30. Is anybody from outside the village allowed to collect *Jimbu*? Who controls this?

31. If anybody violates the norms of collecting *Jimbu*, who is responsible to punish the person?

32. Do you know the methods of regeneration/propagation of *Jimbu*? Yes                  No  
If yes, what is the most successful method?

33. What are the factors affecting *Jimbu* growth and survival? (for example: irrigation, rain, soil, aspect, grazing pressure, time of the collection, altitude, others specify)

Growth	Survival
a.	a.
b.	b.

34. How can we ensure better growth and survival?

Growth	Survival
a.	a.
b.	b.

35. Are you happy with the present management system?    Yes                      No  
 If no, what are your suggestions?

Questions related to local uses

36. What are the uses of *Jimbu* you and your family make?

As a medicine:

Ailments	Which parts of the plant?

As a spice –                      (which part of the plant?)

Others uses – what?    (which part of the plant?)

37. Do you know how other people are using it? Who uses in that way?

## Appendix 2

### Questionnaire for the interview with key persons

Date:

Name of the interviewer:

1. Name of the key person:

Position:

Age:

Sex:

VDC:

Ward:

Village:

Education:

Occupation:

Caste:

#### Questions related to resource availability

2. What are the 3 most important plants collected by villagers from the wild for consumption as food and medicine?

For food:

For medicine:

3. Do you collect *Jimbu* from the pasture?    Yes                      No

4. How many different kinds of *Jimbu* do you find in the pasture? Please name most important to least one.

a.    b.    c.    d.

5. Which kind of *Jimbu* is mostly available in the pasture?

a.    b.    c.    d.

6. Could you please tell me the history of *Jimbu* collection in your village?

-When did the villagers start collecting *Jimbu*?

-Time of major events such as- lowest harvest and highest harvest

7. Where do people go to collect *Jimbu*? Please give all possible locations. (point out on the map if possible)

8. How far are the places from your village?

Name of the place                      distance from the village

-----                                      -----

-----                                      -----

9. In general, what is the availability of *Jimbu* in the wild?

Getting easier to find

Getting more difficult to find

Not changing

10. How much *Jimbu* was there to collect? (answers: a lot, few, none, etc)

10 years ago

5 years ago

last year

this year

-----

-----

-----

-----

Why?

11. How much *Jimbu* do you think will there be to collect? (answers: a lot, few, none, etc)

Next year	in two years	in 5 years	in 10 years
-----	-----	-----	-----

Why?

Questions related to contribution to cash income

12. Who collects the *Jimbu*? All households of the village or certain number of households.

13. If certain number of households, why? Please specify the reasons.  
Because they are poor, lower caste, higher caste, other reasons

14. In an average, how much *Jimbu* do a household or a person collect in a year?

-Root:

-Above ground part:

15. Is there any limitation on the amount of collection per household or per person in your village?

16. Where do people sell it? a. middle man b. vender c. house to house

17. How is the demand of *Jimbu*? Increasing decreasing constant

18. How much was the demand of *Jimbu*? (answers: a lot, few, none, etc)

10 years ago	5 years ago	last year	this year
-----	-----	-----	-----

Why?

19. How much will be the demand of *Jimbu*? (answers: a lot, few, none, etc)

Next year	in two years	in 5 years	in 10 years
-----	-----	-----	-----

Why?

20. How much was the selling price (in the village) per kilogram or per *pathi*?

10 years ago	5 years ago	last year	this year
-----	-----	-----	-----

21. Is there different selling prices for the *Jimbu*? Why ? (due to quality of the product, increasing demand, shortage of the resource or anything else)?

22. How much the *Jimbu* contribute to the cash income of the villagers?  
 None                      Negligible                      significant                      a lot                      very much  
 (0 %)                      (1-5 %)                      (6-25 %)                      (26-50 %)                      (51-100 %)

Questions related to management strategies

23. When do people collect *Jimbu*? Is there any specific time for collection in a year?

24. Who decides the time to collect *Jimbu*? Individual household or an institution?  
 If an institution, what is the name of the institution?

25. Is there any system of revenue collection? Yes No  
 If yes, how much is the revenue?

26. Do people collect *Jimbu* in the same place each year? Yes No  
 If no, how do people select the sites?

27. Is anybody from outside the village allowed to collect *Jimbu*? Who controls this?

28. How do you ensure the protection of *Jimbu*?

29. If anybody violates the norms of collecting *Jimbu*, who is responsible to punish the person?

30. How is the punishment carried out?

31. What are measures that you think would be useful to ensure the sustainable utilization of *Jimbu*?

32. Do you know the methods of regeneration/propagation of *Jimbu*? Yes No  
 If yes, what is the most successful method?

33. Has anybody ever tried to cultivate *Jimbu*? Yes No  
 If yes, who are the cultivators?

34. What are the factors affecting *Jimbu* growth and survival?

Growth	Survival
a.	a.
b.	b.
c.	c.

35. How can we ensure better growth and survival?

Growth	Survival
a.	a.
b.	b.
c.	c.

36. Are you happy with the present management system? Yes No  
If no, what are the best ways?

Questions related to local uses

37. Is there any local processing *Jimbu* before taking it to the market? Yes No  
If yes, how is it processed (e.g. grinding, drying, etc)?

Processing of roots:

Processing of above ground parts:

38. What are the uses of *Jimbu* you and your family make?

As a medicine:

Ailment	Parts of the <i>Jimbu</i> used

As a spice – (which part of the plant?)

Others – specify? (which part of the plant?)

39. Do you know how other people are using it? Who uses in that way?



## Appendix 4

### Summary information on the field verification survey.

Sites	Transect no	Starting location		Aspect	Average slope (°)	Altitude range (m)	No of 1m <sup>2</sup> plots	No of clumps	Flowering shoots	Green weight (g)	Air dry weight (g)	% of green weight
		Latitude	Longitude									
Jhimjhyang	1	29.19756	84.08194	East	29	4282 to 4637	8	9	2	26	4.67	17.96
Jhimjhyang	2	29.19557	84.07214	Flat	2	4619 to 4621	3	82	1	90	17.33	19.26
Jhimjhyang	3	29.19425	84.06848	South-east	2	4610 to 4618	6	26	5	88	16.67	18.94
Karan	4	28.97201	84.01397	North	26	4174 to 4266	3	14	0	40	data lost	
Taprang lek	5	28.9889	83.98284	West	24	4171 to 4186	9	2	0	12	data lost	

*Note* : m, metre; no, number; g, gram

Descriptive statistics on Jimbu clumps per metre square	Sites		
	Jhimjhyang	Karan	Taprang lek
Mean	6.88	4.67	0.25
Standard Error	2.58	1.45	0.16
Median	1	5	0
Standard Deviation	10.64	2.52	0.46
Range	34	5	1
Minimum	0	2	0
Maximum	34	7	1
Sum	117	14	2
Count	17	3	8

## Appendix 5

### Various photographs taken during the field visit to Upper Mustang, Nepal



Upper Mustang, a scene of the northern part. The closest settlement seen in the picture is the Lomanthang village.



Upper Mustang, a scene of the southern part. The settlement seen in the picture is the Tsarang village.



A closer look of a village in Upper Mustang, Dhi.



During the questionnaire survey at Dhuk village, Chhoser VDC.



PRA with local people. A ACAP staff is helping to fix marks for *Jimbu* sites.



An interviewee estimating household cash income from sale of *Jimbu*.



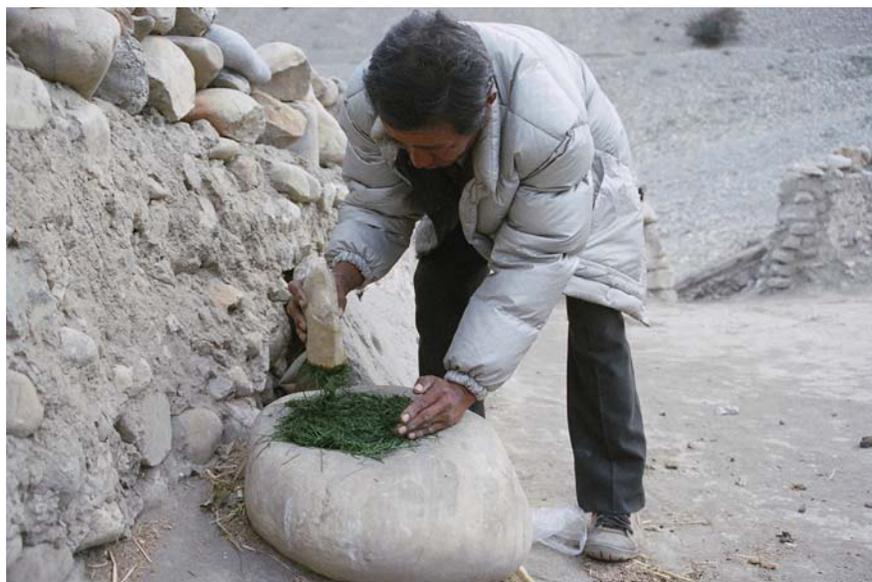
*Jimbu* grown in its natural habitat, Jhimjhyang area (4580 m a.s.l.), Upper Mustang.



Local people are collecting *Jimbu* in Jhimjhyang area (4630 m a.s.l.).



*Jimbu* grown on a kitchen garden at Marang village.



A farmer is demonstrating the *Jimbu* crushing for drying.



A bunch of air dried *Jimbu*.



Researcher with a local guide in *Jimbu* growing site, Karan (4266 m a.s.l.), Surkhang VDC, Upper Mustang.