

Management of Himalayan medicinal and aromatic plants within a complex socio-ecological system

Abstract

Medicinal and Aromatic Plants (MAPs) are essential resources for the rural people in developing countries. These resources are unfortunately depleting rapidly due to continuous over-harvesting and conversion of natural habitats. In mountainous communities in Nepal, the rural people have been involved in the wild harvesting of Himalayan medicinal and aromatic plants (HMAPs) for their livelihood and medicinal health-care. In recent years, many mountain forests are facing the problem of rapid degradation of HMAPs. Nepal has tremendous diversity in socio-cultural and ecological system. The government's simple framework does not function well in a complex mountainous socio-ecological structure. Therefore, it was essential to analyze the various resource systems in mountainous communities. This article analyzes two different resource systems in the distant western mountain district of Nepal. It is an analysis of management research. In addition it questions under which conditions HMAPs resources can be either well managed or mismanaged. This research will examine why some communities have disastrous outcomes. The findings will show that the forest system with the inactive forest governing local institution is disastrous. In contrast, a vigorous forest governing local institution could make conditions for proper management of HMAPs resources. Ostrom's multitier framework (2007) is useful for detecting the variables of resource destruction and explores the conditions of the local management of HMAPs in the complex socio-ecological system of mountainous communities. The primary intent of the research is to improve the degradation problem of HMAPs in remote high mountainous communities.

Key words: Himalayan medicinal and aromatic plants, Nepal, mountainous communities, a multitier framework for SES, forest governing local institutions, management of local resources

1. INTRODUCTION

Medicinal and Aromatic Plants (MAPs) are essential resources for the rural people in developing countries. They are used for three purposes, the first of which is medicinal. The second purpose is to provide nutritional supplements. The third purpose is to provide locals with work to support their livelihood. MAPs resources are depleting rapidly due to continuous over-harvesting and conversion of natural habitats. According to Walter and Gillett, 34, 000 MAPs species out of 49, 000 MAPs species assessed are found globally threatened with potential extinction (Walter and Gillett, 1998). The fourth World Conference on Medicinal and Aromatic Plants (9-13 Nov 2008, Cape Town, South Africa) acknowledged the increasing global need for utilizing MAPs as renewable resources. Since MAPs play the unique role to ensure human, animal and social welfare both in developing and developed countries, it is essential to prevent the decline of the plants resources (WOCMAP IV, 2008). WOCMAP IV also recognized that it is vital to promote the conservation strategy with regard to halting the

decline of plant resources and associated indigenous innovations and practices that support the livelihood, food security and primary health care of local people.

The Largest majority of MAPs species in trade worldwide are collected in the wild natural environment (LANGE and SHIPPMANN 1997; SRIBASTAVA et. al. 1996; XIAO PEN-GEN 1991, SHIPPMANN et al. 2006, Paul et. al. 2008). SHIPPMANN et al. estimate that less than 1 % of the total numbers of medicinal plants used worldwide are cultivated for commercial production and the rest are harvested in natural environment. Many researchers argue that MAPs will continue to be wild harvested¹ over the long term (SHIPPMANN et al. 2006, Paul et. al. 2008, Ticktin 2004). Therefore it is obvious that forest is the habitat of MAPs, and proper forest management is required to manage MAPs resources. Besides, MAPs management strategy should be included in the forest management program.

In mountainous communities in Nepal, the rural people have been involved in the wild harvesting of Himalayan medicinal and aromatic plants (HMAPs) for their medicinal health-care. They have been doing this practice for hundred years. Also they earn their household income harvesting and trading of these plants resources. In recent years however, many mountainous communities are facing the problem of rapid degradation of HMAPs resources. A great attention is required for proper conservation, sustainability and utilization of these resources (Edwards 1994, Malla et al. 1995, Subedi 2001, Subedi 1997, Khem et al. 2006, Risto 1996, Koyama 2002). In recent years, HMAPs and other forest resource management programmes are conducted in some mountainous communities. However, many of them have been unsuccessful with unsustainable outcomes. One of the reasons for the failure of the management initiatives is inappropriate governance framework. The mountainous communities have different biophysical and socio-cultural environment, therefore they require a separate framework suitable to their distinct socio-ecological system. The scientists and government officials must develop effective management strategies for mountainous region in order to secure the future of these valuable natural resources.

Why single framework does not work in Nepal?

Nepal has tremendous diversity in socio-cultural and ecological system within an area of 147, 181 square kilometres land. The elevation of this small country ranges from 100 metres to the world highest pick 8, 848 metres along the 200 kilometres of north to south transect. The dramatic variation in elevation results the variation in rainfall, humidity and temperature as well. Nepal is divided into three physiographic areas; Mountain region², Hill region³ and Terai

¹ Harvesting in natural environment

² The mountain region spread on the northern part of Nepal. It is also called Himalayan region. It is situated in the Great Himalayan Range. This region is the origin of many important rivers in Nepal and India. The Rivers Cross Hill region, bring fertile soil and deposit to Terai and Northern India. The life of the people is very challenging in this region due to inaccessibility to a sub arctic and arctic climate. The socio-cultural behaviors of some communities in mountain region are similar to Tibetan tradition, and of some communities are similar to the people of Hill

region⁴. These ecological belts spread east to west. The distribution of natural vegetation in these three regions ranges from evergreen tropical rain forests in Terai to dry alpine shrub in the Himalaya. In addition, diverse socio-cultural and economic behaviors exist in different regions. However even with such diversity, most of the important decision making and policies are implemented based on the centralized Hill region. The government's strategies for the development program are created with Hill and Terai in mind. While diverse socio-ecological system exists within an area, a single framework does not function well with these various socio-ecological structures. Moreover it gives harmful impacts on the community. Recently forest resource management activities are approaching to some remote mountainous communities. However the management activities are similar to the approach in Hill and Terai. There is no specific approach for managing HMAPs and other forest resources in mountainous region.

A specific framework is required for the mountainous communities

Mountain regions are often inaccessible. Economic possibilities are very limited. Less than 1 % land is suitable for cultivation. Hence they highly depend on their forest for medicinal health care, nutritional supplement, residential energy and feeding their livestock. Their socio-cultural and economic activities are interconnected with their forest. Since the vegetation in this region is very slow growing, and local people highly depend on them for their living, non-destructive use of these plant resources is very complicated.

People from the outside cannot acknowledge the real problem. Local people know the details of their problem, their need and the nature of their resources. Local people and local institutions can play an important role on sustainable use of natural resources. Ostrom and some other researchers illustrate that local institutions are vital for the success of the resource management (Ostrom 1990, Ostrom 1992, Berkes et al. 2000). Similarly, Fuerer-Haimendorf (on *The Sherpas of Nepal: Buddhist Highlanders, 1964*) pointed out local institution and local practices can give strong effect on the management of local resources. Research among the local community is required for creating and implementing appropriate management framework for the mountainous communities to manage HMAPs.

This article is an analysis of the local management of HMAPs in two mountainous communities; one is a successful community and another is disastrous community within a

³ The Hill region is situated between Mountain region and Terai region, mostly between 700 to 4000 metres elevation. This region includes Kathmandu, Pokhara and several valleys. There is a diversity of socio-cultural traditions of the people in Hill region. The successful community forestry programs have flourished in hill region of Nepal.

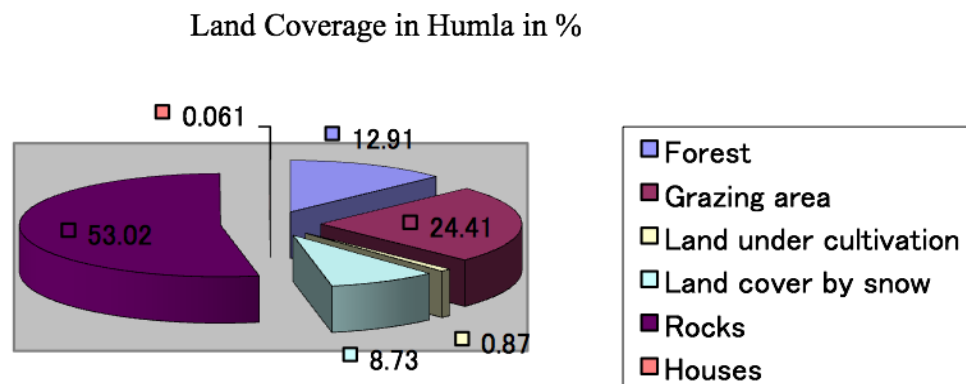
⁴ The Terai region in Nepal is a part of Gangetic plains. It is a geographically flat area of Nepal in the southern lowland of the country adjoining India. The land in Terai is very fertile. This region contains a high valued hard wood forest. These forests however are diminishing rapidly with the lack of suitable governance framework. Diversity exists in language, ethnic group, and culture. The socio-cultural behavior of many of the people is similar to the people of north India.

district in western Nepal. It analyzes the research question- under which conditions HMAPs resources are well managed. It also examines why some communities are disastrously mismanaged. The findings show that the forest system with the inactive forest governing local institution is disastrous. In contrast, a vigorous forest governing local institution could make conditions to properly manage HMAPs resources. Ostrom's multitier framework (2007) is applied to analyze the problems of the destruction of HMAPs and search the potentialities of successful HMAPs management in the complex socio-ecological system of mountainous communities. The intent of the research is to improve the degradation problem of HMAPs in remote high mountainous communities.

Study site

Humla district is located in high mountain physiographic region in the northwestern region of Nepal bordering Tibet. It is a remote Himalayan district with no access to roads. Topography is rocky & steep with snowfall for several months. Agriculture land is limited to only 0.87%.

Fig. 1-1 Land coverage in Humla



Source: District Profile Humla, 2004

Agricultural production is not sufficient for survival. Humli people can only survive 3-9 months from agriculture. The district is often known for its food shortage, environmental degradation, low productivity, gender inequalities, and negligible employment opportunities. Livelihood is very difficult. In the past, people in Humla engaged in trade between Tibet and to the south of Humla in a 6 month cycle using sheep and goats herding to supplement their livelihood (Furer-Haimendorf 1975). In recent years, the trade between Tibet and the south of Humla is declining and the supplement for their livelihood is commercial collection of HMAPs.

Temperate, sub-temperate, tropical climate is found in the district. The maximum temperature ranges from 10 ° to 25 ° Celsius, while minimum temperature ranges from -10 ° to -18 ° Celsius in the district. Generally dry and cold climate exists in the high alpine valley. The topography

of the district creates a region of high floral diversity including many valuable MAPs (Subedi, 2001).

The communities of Humla are highly dependent on their forest for their livelihood. Forests in this Himalayan district are therefore under threat. As a result Community forestry and leasehold forestry program has been initiated in the district. Forest registering started in 1996. Since 1996 to present, 44 leasehold forests and 45 community forests were handed over to local communities in the district. Mixed results can be seen in forest resource management. In some communities forest seems open access resource, though they are under community forestry system. In some communities, forest and forest resources are well managed by the local communities.

The field studies were carried out in two different communities within Humla district. Two different forest systems, Takpafuk Community Forest in Bargaun-Limangtang village (hereafter, Bargaun) and Mauri Community Forest in Raya village (hereafter, Raya) were studied. Both communities are located in a similar ecological zone.

In Raya the forest was handed over to the local community in 1997 during project intervention period. There was a short term project intervention in Raya. The name of the project was “Community Based Ecosystem Management Project through Local Enterprise Development” (Hereafter, Humla Project). The project was implemented in 1994 in Humla district which covered 8 villages in Humla including Raya. The project has been implemented by Asia Network for Small Scale Bioresources (ANSAB)⁵ along with Appropriate Technology International (ATI) and Humla Conservation and Development Association (HCDA)⁶. Humla Oil Pvt. Ltd. (HOPL) was established as an initiative of the project in 1994. It produced oils from HMAPs which were used as flavorings, fragrances and as medicines. In 1996, the company expanded its processing ability by establishing the second distillation unit with a capacity to process up to 60 tons of different kinds of MAPs (Subedi, 1998). However this project ended up in 2001 during Maoist insurgency period⁷.

According to Subedi and the local people, HMAPs harvesting was regulated well in Raya during the project intervention period. However, at present, forest users in Raya are not organized. There is competition on the harvesting of economically valuable HMAPs such as *Nardostachys Gradndiflora*, *Valeriana wallichii DC*, *Neopicrorhiza Srophulariifloa*. There are not any rules and regulations to control the over harvesting of HMAPs and other forest products in recent years.

In Bargaun, the HMAPs and other forest resource management system is initiated by the local people themselves. Formally Takpafuk Community Forest was handed over to community in

⁵ An NGO

⁶ Now its name is change to Himalaya Conservation and Development Association (HCDA)

⁷ Maoist insurgency was started on 13 February 1996 and ended on 21 November 2006 in Nepal

1997. They used this forest for centuries. In the past, forest users used to manage their forest resources. But after the handover of the forest, the forest users are formally organized to Community Forest User Group (hereafter, FUG). FUG in Bargaun crafts their rules and regulations by themselves to proper utilize HMAPs and other forest resources. Unlike Raya, there is no direct intervention from outside agencies on managing their forest resources. However, they got some technical supports (identifying non-users, identifying borders) from District Forest Office (DFO).

2. METHODS

Data Collection

Purposive sampling method is used to select two different forest management systems. The sample households (HHs) were selected randomly. Primary data were collected from field research that was carried out 3 times (exceeding 1 month in each visit) in 2007 (winter), 2008 (summer), and 2009 (autumn) followed by the preliminary visit in 2007. The data on historical trend of HMAPs collection, the perception of users in HMAPs condition during 15 years, attributes of user groups, attributes of residences, governance system, and characteristics of local institution were collected through group discussion with FUGs, field observation, household survey and interview. Household survey was conducted in 30 HHs out of 46 HHs in Bargaun and in 78 HHs out of 133 HHs in Raya. Face to face interviews were implemented because this is the most precise method for surveying people who are unable to read or write. (Salant and Dillman, 1994). The in-depth interview was conducted to analyze the forest governance system regarding resource management.

Data Analysis

Both qualitative and quantitative techniques were used to analyze the data. The perception of users in HMAPs condition during 15 years, historical trend of HMAPs collection attributes of user groups, governance system and characteristics of institutional arrangement were analyzed using systematic qualitative techniques (Patton, 1990, Miles and Huberman, 1994). The attributes of residences are analyzed quantitatively.

Ostrom's multitier framework (2007) is applied as a theoretical framework to analyze the combination of variables of resource destruction and resource management in two different forests systems of mountainous communities. (Ostrom, 2007).

3. FINDINGS

Table 3-1 Comparison of socio-economic situation of two communities

Attribute	Raya	Bargaun
Number of households	133	45
Number of ethnic group	10	1
Walking distance from Simikot	5 hours	4 hours
Average land holding size (in Hectare)	0.306	0.446
Average size of household	6.5	9.2
Annual Per capita income	109.34 \$	130.64 \$
Contribution of different sectors on Livelihood (in %)	Agriculture 45.15 HMAPs collection 26.38 Livestock 10.58 Wage labour 4.41 Service 10.89 Trade 1.58 Others 1.05	Agriculture 52.55 HMAPs collection 7.75 Livestock 25.10 Wage labour 10.06 Service 2.49 Trade 1.05 Others 0

Source: Field Survey, 2008, 2009.

The number of HHs in Raya is larger in comparison to Bargaun.. Many different ethnic groups live in Raya. However Bargaun is inhabited with only one ethnic group called *Lama*. The tradition of *Lama* is similar to Tibetan culture. On the contrary Raya, culture resembles Hill region with its mixture of different cultures. The Land holding size of the HHs in Bargaun is slightly bigger than Raya. With larger land holding size, the size of HH is also bigger in Bargaun.. The Per capita income was measured to examine the economic situation in both villages. Though both villages had very low per capita income, in comparison, Bargaun is more prosperous than Raya. Agriculture is the main source of livelihood in both villages. The entire respondent household was engaged in agriculture, which produced 52.55 % of their total income in Bargaun and 45.15 % in Raya. The contribution of agriculture is greater in Bargaun. HMAPs collection⁸ is the second major source of HHs income in Raya that contributed 26.38 %, while the contribution of HMAPs was 7.75 % in Bargaun. The share of HMAPs collection is greater in Raya. Livestock transhumant⁹ is the second main source of income in Bargaun is 26.15 %. While in Raya, livestock contributes only 10.58 %. Sheep, horse, *Khachhad* (mule), *Jhuma* (mountain cow), *Jhupa* (mountain ox) are the main types of cattle herds. Most of respondent households own livestock in small to large numbers (3 to 215). The number of

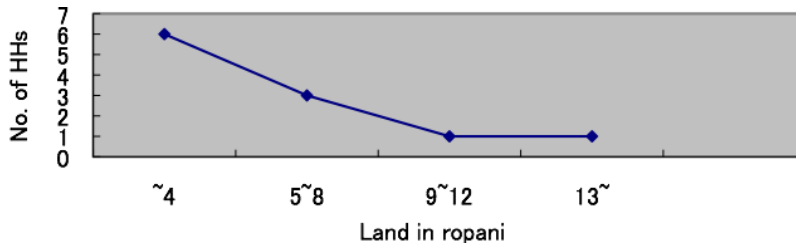
⁸ The contribution of HMAPs on medicinal health care and nutritional supplement was not measured in this research.

⁹ Transfer of livestock from one grazing area to another suitable grazing area with the changing of seasons. This practice is found in the Himalayan region in Nepal for hundreds of years.

livestock varies depending on the numbers of male members of an active age within a household. Those households with a greater commitment to livestock herding are economically prosperous. The livestock is used to carry food stock for food deficiency period of the household. There are no other industries or private sector employment opportunities. In both villages both male, female engaged in agriculture and collection of HMAPs. Wage labor is another source of income. Mostly male members are engaged in the wage labor¹⁰ activities in Bargaun, while in Raya female also engaged in wage labor.

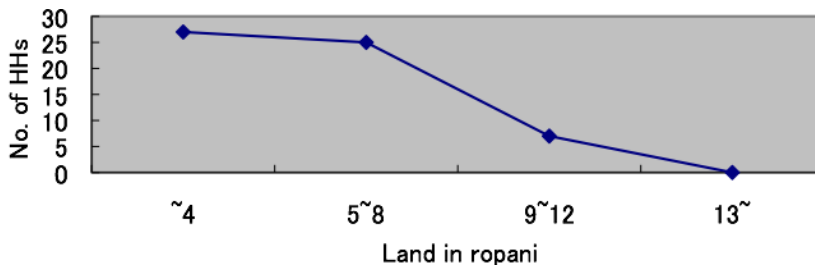
Because agriculture is the main source of income of the both villages, the relation between land holding size and commercial collection¹¹ of HMAPs was measured.

Fig. 3-1 The relation between commercial collection of HMAPs and land holding in Bargaun



Source: Field Survey, 2009.

Fig. 3-2 The relation between commercial collection of HMAPs and land holding in Raya



Source: Field Survey, 2009.

¹⁰ Unskilled labor work within village and in Simikot

¹¹ The collection of HMAPs to generate household income

The fig 3.1 and fig. 3.2 show the relationships between commercial collection of HMAPs and land holding size in both villages. Households with small land holding had greater engagement in commercial collection of HMAPs. It indicates that the HHs with limited economic opportunities tend to engaged in commercial collection of HMAPs activities.

Condition of the Forest and HMAPs

In both study sites HMAPs such as *Ghodamarcha (Thymus linearis)*, *Siude laharo (Ipomoea nil)*, *Dalechuk (Hippophae tibetana)*, *Dhupjadi (Jurinea dolomiaea)*, *Bhutkesh (Selinum wallichianum)*, *Padamchal (Rheum austral)*, *Panchaule (Dactylorhiza hatagirea)* were collected for local consumption for their medicinal healthcare needs and nutritional supplements. All of the respondent households collected these HMAPs for local consumption. While some of the species such as *Katuki (Neo-picrorhiza Scrophulariifloa)*, *Sugandhawal (Valeriana wallichii)*, *Jatamansee (Nardostachya gradndiflora)*, *Atees (D himalayai)*, *Guchhi chyau (Morchella conica)*, and *Nirbisee (Delphinium denudatum)* were collected for commercial purpose as well as local consumption. *Jatamansee*, *Katuki*, *Ghuchichyau*, and *Atees* were major commercially collected HMAPs in the study sites.

According to users' evaluation there was severe destruction of HMAPs in Raya. In Raya, 94.9 % respondents recognized commercially collected MAPs are declined in their forest. On the contrary there was no depletion of HMAPs in Bargaun (Table 3.3). Although only the users' evaluation of the condition of HMAPs was not sufficient to draw a firm conclusion, it helped the researcher to compare the conditions of two forests in general.

Table 3-2 Perception of users about the condition of HMAPs on their forest during last 15 years

Users' perceptions about the condition of HMAPs	Decreased	About the same	Increased	Don't know
Raya	94.9 %	0 %	0 %	5.1 %
Bargaun	0 %	53.4 %	43.3 %	3.30 %

Source: Field Survey, 2009

Both forests are located in similar ecological zone (climate, topography and elevation), but obviously different in terms of its management and utilization. The size of Raya forest is larger, however in terms of average forest size per users; it is slightly smaller than in Bargaun. All of the people collect HMAPs for medicine. However the commercial collection (to generate household income) was greater in Raya. The collection of HMAPs and other forest resources is regulated by FUG in Bargaun. However there are no regulations in Raya. They started collecting plants before the proper time of harvesting. As mentioned prior, intervention from outside agency was found in Raya in the past. But at present time, they have no support for regulating HAMPs and forest. In both villages, the communities hold the ownership of forest.

3-3 Comparison of two forest systems

Attribute	Raya	Bargaun
Size of forest (in Hectare)	982.89	396.21
Year of handover	1997	1997
Average forest size per users (in Hectare)	7.39	8.80
Climate	Temperate	Temperate
Location	High mountain	High mountain
HMAPs collection for medicine	100 %	100 %
Commercial collectors ¹² of HMAPs	75.64 %	36.65
Size of forest user group	133	45
Nature of forest user group	Disorganized	Organized
Nature of collector	Competitive	Regulated by FUG
External Support for HMAPs management	Yes (only in past)	No
Owner of forest	Community	Community
Forest management plan	Yes (but not in use)	Yes
Who design and implement community forest	HCDA	Local people (technical support from HCDA)
Forest monitoring and patrolling	No	Yes
Some Regulations of HMAPs harvesting	None	(i) Harvesting of HMAPs in 3 years interval (ii) Harvesting of HMAPs after maturation (iii) Open forest for collection only for certain period ¹³ (iv) Do not harvest all parts of root.

Source: Field Survey, 2008 and Field Survey, 2009

Both forests had a forest management plans; but it is implemented only in Bargaun. HMAPs harvesting was regulated by operational rules in Bargaun. However no regulation mechanism was found in Raya.

The numbers of days engaged by household members on FUG activities (such as participation in group meetings, repair of fencing.) during last 12 months was calculated. In Bargaun, 6.7 % respondents spent 2 days, 13.3 % spent 6 days, 3.3 % spent 8 days and 13.3 % spent more than 10 days. Only 6.7 % respondents household did not engaged on FUG activities. This indicates that majority of the people engaged in forest resource management activities are in Bargaun. However, this is not the case in Raya, where no FUG activities were conducted during last 12 months.

The researcher acknowledged the reasons why the users engaged in FUG activities in Bargaun. .

¹² Collection of HMAPs from natural environment to earn household income

¹³ Only for 2 weeks during collection season. And only 2 persons per household were allowed to enter forest

Table 3-4 Reasons for engaging FUG activities in Bargaun

SN	Reasons	% of respondent
1	To increase access to forest product	10.7%
2	To manage forest and get more benefit in future	60.7%
3	Access to other benefits, e.g. government support or development program	0.0%
4	Respondent's duty to protect forest for the community	7.1%
5	Being respected and rewarded as a responsible person in village	0.0%
6	Social aspects (working together, have interaction with people, fear of exclusion)	85.7%
7	Forced by government or neighbour	0.0%
8	Higher price for forest products	0.0%
10	Better quality of forest products	0.0%
9	other	3.6%
	other: to protect forest for their children (answer form respondent)	

Source: Field Survey 2009.

Note 2: respondents were allowed to give up to 3 multiple answers.

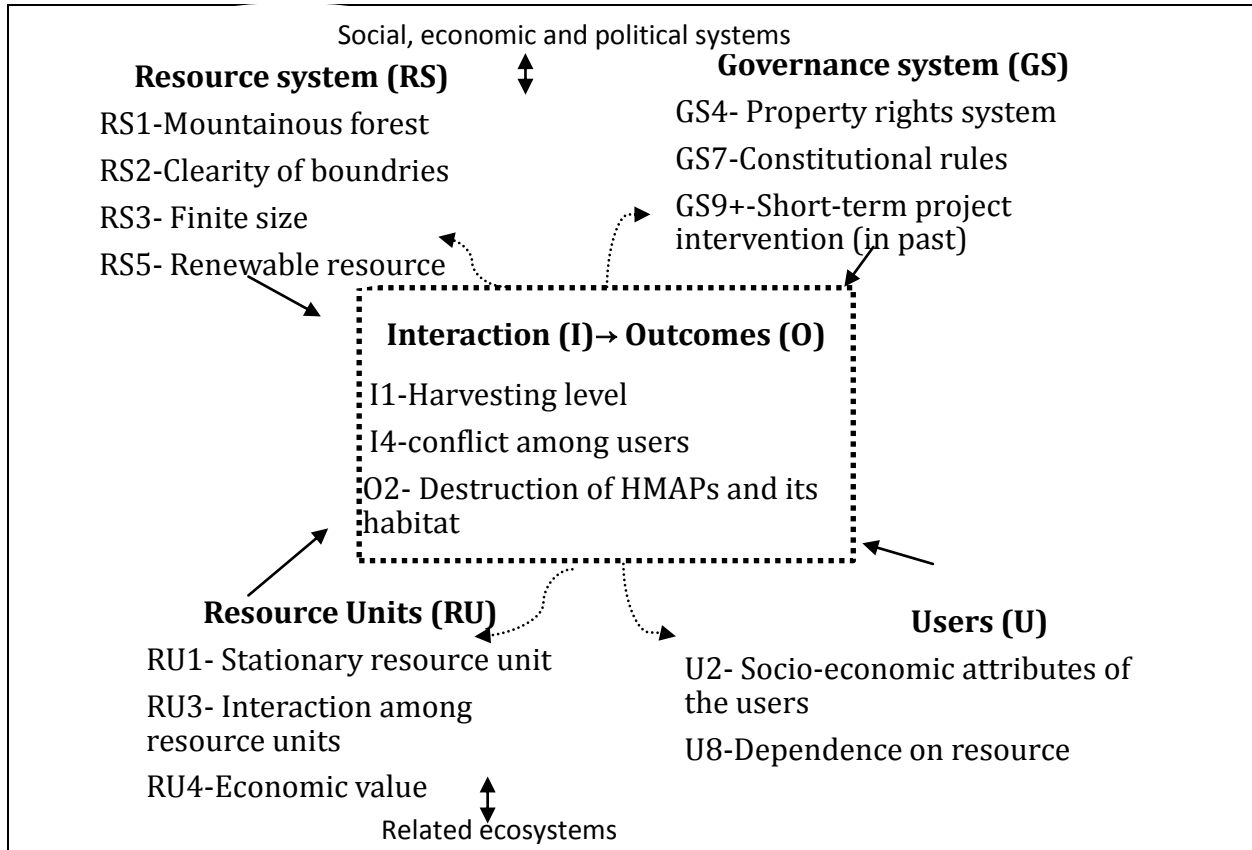
Note 1: 2 respondents' HHs had not engaged FUGs activities in last 12 months, because they did not have time to participate in such activities.

In Bargaun, the majority of users were responsible for the sustainable use of their forest. In addition, most of the respondents engaged in FUG activities because of social aspect. They engaged to have interaction with people, working together and fear of exclusion. This proves that both formal rules and social norms are respected by the local people in Bargaun.

Application of Ostrom's (2007) multitier framework

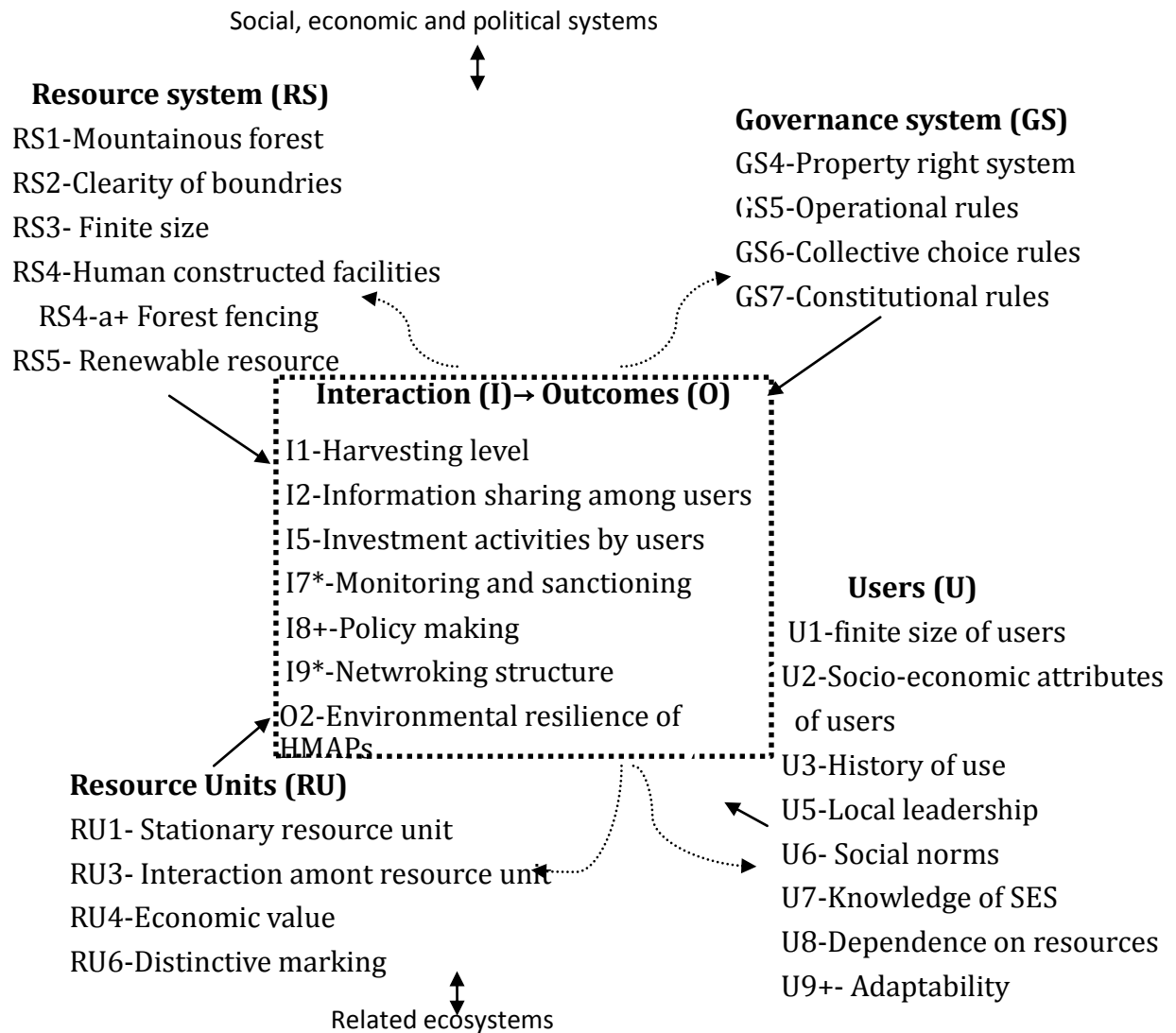
With the given background, this section outlines the institutional setting of these two sites using Ostrom's multitier framework as a theoretical framework.

3.1 A multitier framework for SES in Raya (Original Source: Ostrom 2007)



+new variable (this variable was not included in original framework)

3-1 A multitier framework for SES in Bargaun (Original Source: Ostrom 2007)



*these variables were under the tier of governance system in original framework.

+new variable (this variable was not included in original framework)

4. DISCUSSION

The socio-ecological settings and institutional arrangements of the two forest system are described below.

4 - 1 Resource System (RS)

RS1-Mountainous forest

The resource system was mountainous forest and meadow in both sites where plant growth is very slow and local communities were highly dependent on forest resources for their survival. Based on the given analysis, this research concluded that proper management of HMAPs is possible even in high mountainous forest only if FUG is very responsible to manage their forest.

RS2-Clarity of boundary

Both of the forest systems in Bargaun and Raya have defined boundaries. In Bargaun, all of the forest users were aware of the boundary of their forest but in Raya all the users were aware of the boundary of their forest. Within the forest management plan there was clear definition of users assuring their legal right to resources in both sites. Also there was clear listing of user households. FUG was organized in Bargaun. However in Raya, FUG was only on management plan, and in practice the users were disorganized.

The clear boundary was affirmed after the official handover of community forest in 1997 in both forest systems. In Bargaun, though local people had managed their forest resources for centuries, they faced increasing pressure and difficulties to control the users from outside villages. After the handover of their legal rights, and of the clear boundary of their forests, they could protect their forest from outside users. Thus, this research concluded that clarity of boundary is very important to manage HMAPs and forest. However, only introduction of clear boundary does not work if local users do not take the responsibility of regulating their forest.

RS3-Finite size

The sizes of forest system were fixed in both sites.

RS4- Human constructed facilities

RS4-a Forest fencing

Human constructed facilities were not found in Raya. But in Bargaun, FUG constructed fencing surrounding their forest by themselves. It helped them to protect HMAPs and their forest from livestock. Head of the management committee of Bargaun said “We fence our community forest from our users’ with a group fund that was generated mostly from selling of our HMAPs”. Forest fencing was locally initiated. It indicates that forest fencing is very essential to protect HMAPs.

RS5- Renewable resource

HMAPs are renewable resources. In Bargaun, HMAPs were managed as a renewable resource. However prior mentioned socio-economic attributes of the users in Raya made adverse affect on long term productivity of HMAPs.

4 - 2 Resource Units (RU)

RU1- Stationary resource units

RU2-Economic value

HMAPs are stationary resource units (RU1) and are the common resources of the users in both sites. When HMAPs become mature (RU6) in autumn, (in most of commercially collected HMAPs in study sites) users collect HMAPs and sold them for cash (RU2). HMAPs have economic value in both study sites.

RU3-Interaction among resource units

In addition to the economic benefit, HMAPs nurture the life of local community providing medicine, food and nutrition. All of the respondents depended on HMAPs for medicinal health care in both sites. It indicates users in both sites have somewhat interaction among the resource units. However the culture in Bargaun closely connected with these plants. Every year they collect various kinds of HMAPs to prepare yeast, which is used in local alcohol making. Homemade yeast, homemade alcohol and some HMAPs are most necessary goods on their every cultural and social event. This kind of cultural value of the HMAPs indicates the interaction of the local community to these resources. But this kind of culture was not found in Raya. People in Bargaun, were aware about the nature of their HMAPs (time of maturation, period and system of regeneration, medicinal value). Based on this knowledge they produced their operational rules. It indicates there was interaction of local people to resource units in Bargaun. Thus it is also an important variable on HMAPs management.

RU6-Distinctive marking

In Bargaun, HMAPs collection started after the maturation of plants. However because of competition on collection, HMAPs were collected before maturation of plants that hindered the regeneration of the plants. Distinctive marking (RU6) did not exist in Raya. Thus, this research concluded that this is an important variable for managing HMAPs.

4 - 3 Governance system (GS)

At the present time, the forest governance system was totally different in these two forest systems though both sites hold similar property right system (community). HMAPs harvesting was regulated well in Raya during 1997 to 2001(the project intervention period). However, at present, forest users in Raya are not organized in practice, though officially FUG was existed. There is competition on the harvesting of economically valuable HMAPs. The operational rules are not in practice. There was no forest patrolling and monitoring by local users. From government sides they only set the collection limit. However the limit of collection was not respected by the users in Raya.

In Bargaun, the local resource management system was initiated by the local people themselves. The forest users are formally organized into FUG. FUG is responsible institution to manage the forest resources. The rules and regulations were crafted and formulated by FUG. Forest patrolling and monitoring was conducted by users .

GS4- Property right system

In both forest systems community hold ownership of their forest.

GS5- Operational rules

In Bargaun, the operational rules were established by FUG. In the beginning, they received some technical supports from HCDA. Although in recent years, operational rules were crafted only by FUG and those rules were respected by all users.

In contrast operational rules were not found in practice in Raya making destruction of HMAPs and its habitat. The operational rules are vital on management of HMAPs.

GS6-Collective choice rules

In Bargaun, operational rules crafted by FUGs could be changed through consensus among the members of FUGs during *Thulobaithak*¹⁴. There were no any external influences (from government and development agencies) on the formation and modification of operational rules. However they had to get the approval from DFO before new rules come into operation.

While in Raya where destructive harvesting was found, they did not modify any operational rules, once it was made by the support of HCDA. Their rules were only on paper.

Thus, this variable is one of the vital conditions of the local management of HMAPs.

GS7- Constitutional rules

In Bargaun, no dispute was found modifying and implementing constitutional rules. But in Raya, the constitutional rules existed only in paper, but not in practice.

GS9-Short-term project intervention

In Raya, there was short-term project intervention in the past for proper use and development of HMAPs. Because the local people have the lack of leadership capabilities and lack of adaptability to a new system, the short-term project produced a negative impact on proper harvesting.

4 - 4 Users (U)

U1-Finite users

In both forest system users were fixed.

U2- Socio-economic attributes of users

In Raya, HMAPs was the second main source of livelihood. The people in Raya were poorer in comparison to Bargaun. They tried to maximize their income by harvesting of HMAPs. The local institution (FUG), that was supposed to control over harvesting is inactive and did not conducted any activities to manage HMAPs.

U3-History of use

Bargaun had long tradition of the management of HMAPs. The plant-people relation has existed in harmony with nature for the hundreds of years in Bargaun. For example, *Atees* is a

¹⁴ General assembly of FUG which was held 4 times a year in Bargaun

small, slow-growing plant collected for its root. It is found in the Himalaya region and collected for commercial propose and local consumption such as yeast preparation, diarrhea and cough remedies. Jhyappa Lama, a respondent, reported that, “About 60 years before, in our village, we used to collect ‘*Atees*’ in 3 years frequency; we said it is ‘*Tiyalobarsa*’¹⁵. We did not collect ‘*Atees*’ every year and we did not collect whole root of ‘*Atees*’. In that time people from Sawa used to bring us cloths, axes and curved knives in our village and my grandfather used to exchange ‘*Atees*’ for those things. I still have a cloth piece that was exchanged with *Atees*”. Even in that time they left some part of root for its regeneration. These kinds of valuable knowledge about resource harvesting are still continuing in Bargaun. During 1990s they collected HMAPs in 5 years rotation. In recent years, the rotation time is 3 years. In the group discussion, the reason for the change of the rotation year was recorded. “In recent years the population of HMAPs was increasing and they changed the rotation period of harvesting”. The history of use could give positive impact on HMAPs management.

U5-Local leadership

In Bargaun, the leaders of FUG lead the management activities of FUG. The leaders supervise the harvesting activities of users and other forest management activities conducted by FUG. In Raya this variable did not exist.

U6-Social norms

Basically social norms are the informal laws (rules) that govern the behaviors of the people. In Bargaun, some of the social norms were included on forest management plan, and had become formal rules¹⁶. The people who broke the formal rules had sanctions imposed. The informal rules are verbal rules and followed by people in their everyday life. Those who broke the informal rules could be outcaste from the community. In the group discussion it was recorded that “The only wealth of their village was their forest”. These kinds of norms were the instruments to control over harvesting of HMAPs. Based on the analyzed data, the researcher concluded that Bargaun is rich in social norms and those social norms played a vital role on proper managing HMAPs.

U7-Knowledge of socio-ecological system (SES)

The knowledge of SES learned by local people with close interaction to their forest for centuries is very essential for sustainable use of HMAPs. Most of commercially collected HMAPs in study sites are collected for roots and rhizomes. Because of dry and cold climatic condition in Himalaya their regeneration and growth is slow. Local people know this phenomenon and follow certain kinds of harvesting and management techniques. They do partial harvest of roots/rhizomes of *Atees*, *Katuki* and *Jatamansee*. They do not harvest the entire root. Another aspect was season of harvesting. FUG opened their forest for 2 weeks only after maturation of the *Atees*, *Jatamansee* and *Katuki*.

¹⁵ In local term it means in every three years.

¹⁶ In this research, formal rules mean those rules that were written in forest management plan and implemented by local people.

In Bargaun, FUGs established the regulations of HMAPs harvesting by themselves. The amount of HMAPs harvesting decided by FUG was always smaller than the government permit in Bargaun. In contrast, illegal harvesting was acknowledged in Raya exceeding the government permit. The analyzed data indicates people in Bargaun had ecological knowledge about their plants resources and they also know the sustainable level of harvesting which were being helpful on HMAPs management.

U8-Dependence on HMAPs

The dependence on HMAPs for livelihood is higher in Raya than in Bargaun. Raya dependency on HMAPs instigated over harvesting of them.

U9+-Adaptability

In both sites, people had their customary forest even before handover of community forests. Users' group mechanism was a new system for both villages. In the case of Bargaun, the new mechanism could be adapted and mixed with the customary system of resource management. After the handover of the forest, they could control forest users from other villages. According to the users, the population of HMAPs was increased after the exclusion of non-members.

They took new information and knowledge positively, they discussed it in FUG meetings and decided and followed it only if it is good for them. In the case of Raya, local people could not adapt the new system making more destruction of HMAPs.

4 - 5 Interaction (I)

I1-Harvesting level

The amount of HMAPs harvesting level was decided by FUG in Bargaun. The harvesting level set by FUG was always smaller than the government permit in Bargaun. In contrast, in Raya harvesting level of HMAPs was decided by DFO. The harvesting level of HMAPs exceeded the government permits. Also illegal harvesting was acknowledged in Raya.

I2-Information sharing among users

In Bargain, priorly mentioned two kinds of meetings were supportive for information sharing among users. Most of the users were conscious about the rules and regulations regarding HMAPs and forest management. Table 3.4 shows that most of the respondents engaged in activities of FUG because of social aspects (working together, have interaction with people and fear of exclusion). It indicated that users share the information about HMAPs and forest management among each other in Bargaun. In contrast, since there is competition on harvesting in Raya, the users did not share the information regarding HMAPs making destruction of HMAPs.

People in Bargaun share the information about their management technique to the users of neighboring forests. Bargaun has become and an example of well managed forest in Humla. According to local people, DFO took people from other villages to have them learned about the forest management practice in Bargaun. They said, "It was the first time they saw government official in their village".

I4-Conflict among users

In Raya, there was competition among the users on the harvesting of HMAPs; it created conflict among the users. In contrast, no disputes were found in Bargaun.

I5-Investment activities by users

In Raya, there were not any investment activities by users. However in Bargaun, FUG invested the income from HMAPs on forest management activities; such as forest fencing and paying salary of a forest guard.

I7-Monitoring, patrolling and sanctioning

Forest monitoring, patrolling and sanctioning were locally initiated and implemented by FUG in Bargaun. FUG appointed a woman to the position of forest patroller. They changed their forest patroller in every 2 years. In the group discussion with FUG, the reason for choosing woman forest guard was documented. The reason was “women would have no connection with forest bandits and they are more trustworthy for that job”. This unique idea of forest patrolling was initiated by the local community itself. In addition, local monitoring was very helpful on controlling over-used of HMAPs and forest. The eyes of all member of FUG were on their forest, and could identify if somebody came from outside village. The members of FUG were aware of the right users and schedule of entering forest. Those who break the rules were imposed to a sanction. The forest user group has a clear provision for sanctions in its constitution. There was no excuse for those who violate the rules and regulation. Those who broke the rules got both economic as well as social penalty. The forest fire is regarded as the biggest offense. Those who made forest fire should pay Rs. 3000, and there is also social penalty. The social penalty is also very influential. However in Raya, sanctioning, forest patrolling and monitoring by users did not exist.

From the government side, they only imposed the limit of HMAPs harvesting and banned on collecting some HMAPs. But because of this system, illegal harvesting was recognized in Raya. The researcher concluded that the monitoring, patrolling and sanctioning by local people are vital components for success. Besides, HMAPs monitoring strategy of Nepalese government was having opposite negative effects in mountainous communities.

I8- Policy making

In Bargaun, the policy making process was made by FUG. There were two kinds of group meetings; one is of management council of FUG that is held every month, and another is with all members of FUGs is held 4 times a year. In the group meetings, FUG decides the schedule of harvesting, amount of harvesting¹⁷ also review the rules and regulations. While in Raya at present time, a policy making process was not found. Thus the researcher concluded that a policy making process by local users is essential condition on regulating HMAPs.

¹⁷ The amount of harvesting decided by FUG is always smaller than the government permit in Bargaun. In contract, illegal harvesting was acknowledged in Raya exceeding the government permit

4 - 6 Outcomes (O)

O2-Environmental resilience of HMAPs (in Bargaun)

Environmental resilience of HMAPs was achieved in Bargaun. The combination of clarity of boundary, forest fencing, distinct marking, collective choice rules, locally crafted rules and regulations, local leadership, social norms, knowledge of socio ecological system, adaptability of the users to new system, monitoring and patrolling by local users, sanctioning, local policy making process were the vital conditions of the local management of HMAPs.

O2-Destruction of HMAPs (in Raya)

The combination of variables of not having practice of collective choice rules, operational rules, no monitoring, patrolling, sanctioning and fencing activities by local users, short-term project intervention with the lack of adaptability, inactive local institutions, higher dependency on HMAPs for livelihood, conflict among the users were the detected variables for the destruction of HMAPs in Raya.

5. CONCLUSION

The researcher has come to the following conclusions:

- (1) In Nepal, mountainous regions are inaccessible. Government officials, policy makers and development agencies stopover in remote mountain region only occasionally. The culture and language in mountain region is different from Hill and Terai. It is not simple for outside agencies to recognize the socio-cultural and ecological setting of mountain resource systems. The local people and local institutions could recognize the diversity of their resource system. They know much about the techniques to strengthen the environmental resilience of HMAPs. Hence only they could design the perfect arrangement of utilizing their resource system. We have to learn more from local communities. Therefore, more research with mountainous communities is required to generalize the framework appropriate to other mountainous communities.
- (2) HMAPs are vital resource for the life of mountainous community. They have depended on HMAPs for their primary health care need for hundreds of years. Therefore, there are strong social norms about HMAPs in some of the mountainous communities. These social norms could be one of the instruments to control over harvesting of HMAPs in those communities.
- (3) The livelihood in the mountainous communities in Nepal is very difficult. Agriculture is the main source of livelihood. But agricultural production is very limited in mountain region. The analyzed data shows that economically poorer HHs were more engaged in HMAPs collection. Therefore new economic opportunities (such as tourism, fruit growing) should be introduced in the mountain region.
- (4) The outside agencies should not force the local people and local institutions to follow new system if they have lack of adaptability.
- (5) The long-term project intervention is required to the communities having vulnerable resource condition, lack of leadership and lack of adaptability.

- (6) Locally crafted rules and regulations are vital on managing HMAPs resources.
- (7) Forest patrolling and monitoring should be conducted by users
- (8) Forest fencing is very helpful to protect the HMAPs from livestock

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