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Full Length Research Paper

Indigenous yak and yak-cattle crossbreed management in high altitude areas of northern Nepal: A case study from Rasuwa district

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This paper summarizes and documents the indigenous yak and chauri managements in high altitude mountainous areas of Nepal through on-the-spot surveys on the farmers from three villages of case study site, Rasuwa district, 35 households were surveyed with open-ended and pre-tested questionnaires, 20 key persons were interviewed with face-to-face conversation and 47 participants were involved in participatory rural assessment (PRA), transhumance characterized by the seasonal movements of livestock between different ecological belts is key grazing pattern in the case sites. Rotational grazing of the pasturelands according to feed availability is the example of deployment of indigenous knowledge adapted by local farmers. Cross breeding of yak with cattle (Tibetan cattle bull or Zebu cattle cow) is popular in traditional herd farming system. The breeding patterns in local yak farming systems reflect the seasonal availability and climatic variation, matching very well to transhumant grazing strategies. Supplementing the herd with a small amount of concentrates in harsh lean period is the traditional feeding management. F1 hybrid calf is carefully reared and F2 hybrid calf is killed by carelessly rearing is an indigenous practice to improve the herd productivity. Careful grazing management and herbal remedies for various diseases, pests and plant poisoning are good examples of indigenous knowledge in animal health care, although the interview and survey results indicate that most farmers believe their indigenous livestock managements are moderately efficient, there are still some problems and limitations for optimizing their yak and chauri management systems. More public supports are expected by local farmers to improve yak and chauri production systems, the potential indigenous industries in remote mountainous areas. It can be recommended and suggested from this case study that making better use of the vast indigenous knowledge that the local farmers possess is necessary when making improved management plans for yak and chauri farming system. Participatory research, policy-making and extension network should be developed to encourage the farmers to work together with professionals for better integrating the indigenous skills with advanced technologies. Indigenous institution development and farmers' capacity building are imperative for better planning and successful implementation of livestock management program.

Key words: Indigenous knowledge, yak and hybrids, management system.

INTRODUCTION

Yak (Bos grunniens) and yak-cattle hybrids (chauri in Nepali) are found throughout northern Nepal and are the prime components of the livestock production system for the sustenance of life by pastoralists in Nepal (Ajirol, 1976; Joshi et al., 1994; Cai and Winener, 1995; Das et al., 1998). Female Yaks (nak in Nepali) and chauri are

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important milk producing animals (Joshi et al., 1994). Yak milk is used for making butter and cheese, which are sold and bartered for grain and other necessities required by herders (Miller, 1994; Thapa, 1996). The long hair that is characterisitcs of yak is used for making ropes, blankets, bags and tents and fine, inner wool of yak is used for making clothing and blankets (Joshi, 1982; Joshi et al., 1994). Yaks' hides are used for leather and their dung can be used as fuel and fertilizer by local farmers. Male yaks and chauri are also beats of burden and sources of meat (Joshi et al., 1994). Moreover, they are closely linked to the cultural and ritual activities of the herding societies (Joshi et al., 1994; Das et al., 1998). Many Nepali mountain people depend on yak and chauri husbandry for their livelihoods. It is doubtful if people could live in much of northern Nepal without yak and yak hybrids (Joshi et al., 1994).

In 2001/2002, Nepali yak and chauri populations are around 95, 447 heads according to the central bureau of statistics and account for about 10% of large grazing livestock population in northern Nepal (CBS, 2004). The economy of northern Nepal is greatly influenced by the income generated through exploitation of yak germplasm resources which in other ways also put their importance on the ecology and socio-cultural, ritual values of local Nepalese (Joshi and Lensch, 1996; Sherchand and Karki, 1996). Although yak and chauri production is not too economically beneficial for local farmers at present, there is no other system that is based upon and takes the advantage of the experience, skill and knowledge of the indigenous people (Sherchand and Karki, 1996). It was reported that Nepali families raising yaks and chauri were increasing by 1.4% each year, although yak and chauri populations were declining at the rate of 1.1% annually (Sherchand and Karki, 1996).

Similar to other high altitude mountainous areas of the Hidu-Kush Himalayas (HKH), the Qinghai-Tibetan Plateau and the plateaus of central Asia, the wide range production practices in yak farming of northern Nepal is a testimony to the diverse animal husbandry skills yak herders have acquired and the unique adaptations they have made for survival in an environment where crop agriculture is generally not possible or limited (Miller, 1996). The facts that prosperous pastoral groups remain to this day bear witness to the extraordinary animal husbandry skills of the farmers. Yak farmers hold specialized knowledge around livestock management and agro-pastoral practices, such as genetic identification of breeds, grazing needs, animal reproduction, animal healthcare, location of water sources and grazing areas, breeding, crop-livestock integrated systems and uses of animal resources. Existing indigenous pastoral systems need to be better understood to ensure that the goals and needs of farmers are incorporated into new development programs (Miller, 1996).

Mountainous farmers in northern Nepal actively conserve, manage and improve the yak and hybrids resources in harmony with their specific environmental conditions, food needs, animal pathogenic conditions, socio-economic options and cultural values (Joshi et al., 1994; Thapa, 1997; Bauer, 2002; Shaha, 2002). However, the livestock resources, knowledge and practices of pastoralists and other livestock keepers are often ignored in livestock policies and research programs (Robinson, 1993). The previous narrow, technical approaches to livestock in northern Nepal neglected the social, cultural and ecological particularities of livestock production and specifically yak production (Joshi et al., 1994). The research into indigenous yak management systems is very important to optimize the integration of the traditional livestock management systems developed by local people into modern science and technology and rational policy-based livestock production systems so that the positive impact is maximized and any negative impact minimized. On this basis, this case study was conducted to introduce and broadcast the traditional yak and chauri management systems in high mountainous areas of northern Nepal, to evaluate the effectiveness of indigenous management systems and disseminate the good practices within yak-raising areas and other dominance of the world and to make recommendations of integrating the indigenous knowledge into research and planning in yak management systems.

METHODOLOGY

This case study was performed in Rasuwa district, the high Himalayan and mountainous district of Nepal and "grazing land for sheep" in local Tamang language. It is situated in the north-west part of the central development region (latitude 27°57′30″ to 28°23′30″N, longitude 85°7′00″ to 85°48′15″), about 120 km north from Kathmandu, the capital city of Nepal. It is surrounded the Langtang and Salang Sungo ranges from the northern border with Tibet autonomus region of China, Sindhupalchowk district, Nuwakot and Dhading districts of Nepal in southeast, south and west respectively. The district has total area of 1514.24 km^2, with 119.15 km^2 cultivated land, 378.83 km^2 forest land, and 260.12 km^2 grass and bush land in land use types. Ethnically, the most part of the district is dominated by the Tibetan origin Tamang group. There are altogether 18 village development communities (VDCs), 9 Ilaks (2 VDCs in each Ilak) and one constituency in administrative units and 8689 households with an average household size of 5.05. In 2001, the district had a census population of 43,900, which is less than 0.2% of Nepal's population and 64.7 of population is Tamang people (TRPAP, 2005). Livestock raising is the staple farming system in this district. Yak and chauri herding is a traditional livestock farming system for Tibetan origin Tamang people.

3 communities from three VDCs, Dhunche, Gatlang and Langtang were selected in this district as investigation sites for the field surveys under the consideration of their difference in geographic location, climatic zone and farming systems (Table 1). Open-ended and pre-tested questionnaires, key-person interviews and participatory rural appraisal (PRA) tools were used in farmers' survey and investigation. The farmers were interviewed and surveyed by using face-to-face method as this is the most accurate method for surveying the people who can't read and write (Salant and Dillman, 1994). PRA developed by SNV/Nepal (2004) is a good tool to encourage farmers to give their knowledge, ideas and opinions freely, in such way the information missed in questionnaire surveys and key-person interviews can be supplemented. Totally 35 households were surveyed with questionnaires, 20 key persons (old

Table 1. General informtion about case study sites and interviewees.

Items	Dhunche community	Gatlang community	Langtang community
Information about case study sites Geographic location (elevation)	Low hill (1900 m)	Middle hill (2200 m)	High Mountain (3300 m)
Climatic zone	Tranzition zone between sub-tropical and temperature	Temperature zone	Subalpine zone
Farming systems	Multiple farming of livestock, crop, fodder and vegetable	Crop-livestock mixture farming	Livestock farming (tourism)
Total households	164	223	61
Livestock composition in ech household	1-2 cattle, 2-3 buffalo, 4-5 sheep and goats, 10-15 yak and chauri (only 10% of households keep yak farming)	1-2 cattle, 10-20 sheep and goats, 10-15 yak and chauri (half of hoseholds keep yak farming)	20-30 sheep, 2-3 horses, 10-15 yak and chauri (80% of households keep yak farming)
Information about interviewees			
Numbers	10	14	11
Questionnaire survey	6	6	8
Keyperson interview	21	14	12
PRA			
Average age			
Questionnaire survey	41.5	36.5	33.2
Keyperson interview	54.5	55.4	57.2
PRA	34.7	37.1	38.4
Average education level			
Questionnaire survey	Primary school	Primary school	Primary school
Keyperson interview	Illiteracy	Illiteracy	Illiteracy
PRA	Primary school	Primary school	Primary school
Proportion of female interviewee			
Questionnaire survey	60%	21.4%	27.2%
Keyperson interview	33.3%	16.7%	37.5%
PRA	61.9%	28.6%	33.3%

and experienced people who have settled for quite long time) were interviewed and 47 participants were involved in PRA in 3 villages (Table 1). The information about indigenous grazing practices, feeding strategies, calf rearing, breeding management, health care in yak and chauri farming systems was gathered through general reconnaissance, informal survey of households and interview of key persons. Supplemental information on the problems, constraints, challenges, opportunities and changes in indigenous yak and chari management system were collected and recorded through farmer's group discussion and communication (PRA). Secondary information were obtained from central and districit offices, professional researchers and officials to cross-check the primary data (Sedhain, 1993). Moreover, the literatures, reports and documents related to this study are reviewed as the references to testify the information we obtained and collected.

RESUTLS

Grazing practices

Transhumance, characterized by the seasonal movements of livestock between different but complementary ecological belts is key grazing pattern in 3 VDCs and it is also a recurrent feature of indigenous grazing management systems in northern Nepal. According to the physical features climatic conditions, demand for forage and availability of pasture land, the farmers have established different migratory routes and pastures for grazing animals. The necessity of feed supply for maintenance, movement, growth, production and reproduction required by the grazing animals is one of the essential movement of the herds during the course of the year. The animals are moved towards high alpine pastures in the monsoon season and to lower pastures or forestry during the winter (Figure 1). In Dhunche, the farmers settle in the lowland and herd their livestock in ascending transhumance from the oak forestry (about 1900 m in altitude) surrounding their settlements in winter to Wedang pasture (about 4200 m in altitude) in summer. In Gatlang, the farmers settle close to their community oak forestry (about 2000 m) for winter grazing and herd their livestock in ascending transhumance to Sanjen pasture (about 4400 m in altitude) for summer grazing. In Langtang, the farmers settle in the middle way of transhu-

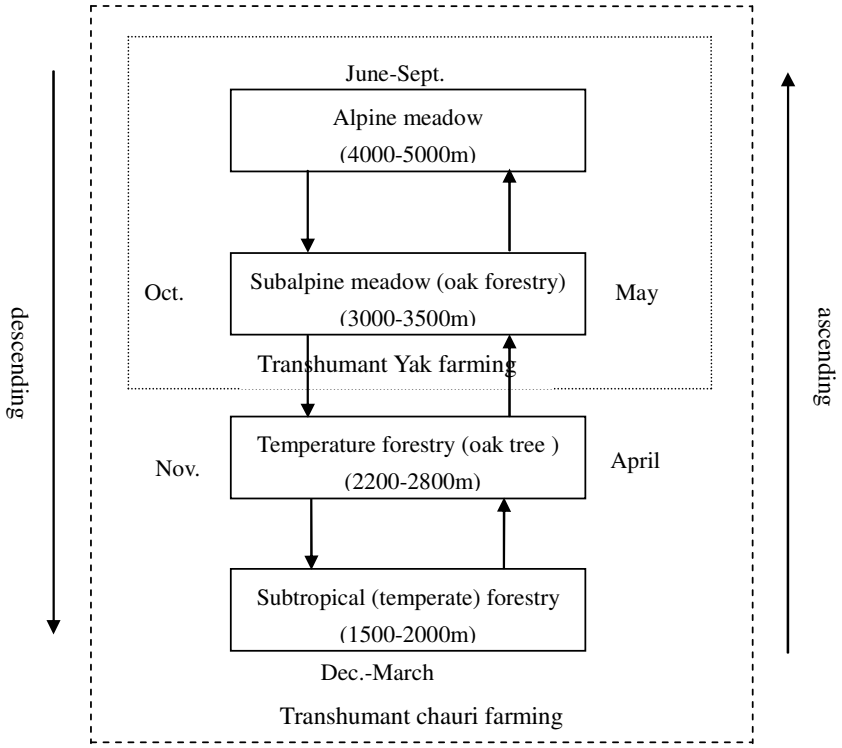

Figure 1. Indigenous transhumant yak (···) and chauri (–) farming systems in Rasuwa District, Northern Nepal.

mance routine, so they move up in ascending transhumance to Yala pasture (4400 m) for summer grazing and go down in descending transhumance to Ghoda forestry (2100 m) for winter grazing.

In this indigenous transhumance grazing system, different herds are grazed in different sites by the farmers according to their adaptability. Normally, chauri are moved gradually from alpine pastures at peak mountain as high as 4000 - 5000 m in summer to forestry areas in the downstream valley as low as 1500-2000 m in winter. The yaks never go down below 3,000 m and spend the winter in subalipne pastures or forestry (shrubs). The cattle, mostly zebu (*Bos indicus*) are herded together with yak for mating and producing hybrid in summer and graze on village scrubland or the stubble-field of cultivated zone in winter. According to the regulations or decisions made by community committee or user groups (e.g., yak and chauri committee), local farmers move their livestock following a fixed grazing step (transhumance routine) and time table in every year. Generally, the summer pastures are grazed from middle June to late September, winter pastures are grazed from late November to middle March and transitional grazing lands (temperate forestry, sub-alpine pastures or shrub lands) are utilized in the rest time of the year.

Rotational grazing of the pasturelands according to feed availability is another example of the deployment of indigenous knowledge adapted by local farmers for centuries. The pasturelands (summer, winter or transitional pastures) are rotationally grazed by farmers on a regular basis. The rotational movement from one plots to another plots every 10 - 15 days according to the grass cover, the indigenous indicators that herder usually use. The same sites can be repeatedly grazed in same grazing season after the cover and height of re-grew grasses are over the limitation. Some farmers protect their campsite by covering the ground with stone or reseeding with native grass when they move to another campsite. Local farmers declared that such rotational grazing can protect pastures from being overgrazed and help increase forage production. Moreover, local farmers stressed that the external and internal parasite problems can be reduced when the rotational grazing practices are followed. The carrying capacity is also calculated by using a well defined method among the herder groups to ascertain the stability of each pasture for a fixed number of animals. As part of their indigenous pastureland management practices, most farmers in the case study sites maintain only the animals that their food requirements can be met by the supplies of winter feeds (forages and fodder).

Breeding strategies

Although yaks are pure breed in Nepal, cross breeding of

Table 2. Characteristics of yak and hybrids in Rasuwa district.

Items	Yak	cattle	Dimjo	Urang
Altitude range (m)	**>3000**	**<3000**	**2300 - 4900**	**2000 - 4300**
Body weight (kg)				
male	300	300	365	360
female	225	210	235	230
Total life span (years)	15	15	20	20
Age of first heat (years)	3 - 4	2 - 2.5 yr	2.5 - 3	3 - 4
Month of first calving	44 - 56	34-40	39 - 45	44 - 56
Gestation period (days)	260	300	270	270
Lactation length (months)	6	6 - 8	7 - 8	7 - 8
Annual milk yield (kg)	720	410 - 980	1700	1300
Birth weight (kg)	12 - 15	18 - 20	12 - 17	15 - 19
Calving interval (months)	15 - 18	12 - 14	12 - 15	12 - 15
Weight 12 month(kg)	60 - 65	65 - 70	60 - 65	60 - 65

Source: Annual Report of Rasuwa District Livestock Service Office (2005)

yak with cattle is popular in traditional herd farming system. The cross breeding can benefit from the higher performance of hybrid vigor (more milk and meat production) and the crosses are better adapted than the parents to various range of altitudes/ecological zones (Table 2). 3 species of the Bos genus can be parent stock of the cross breeds; Tibetan cattle (*Bos taurus*), small humpless cattle replenished from Tibet in the past, occur largely at higher altitudes; Zebu cattle (*Bos indicus*) are large hump cattle adapted to low to middle altitudes; Yak *(Bos grunniens*), the domesticated livestock at the higher altitudes since long time ago. In langtang VDC, the farmers usually cross pure yak bulls with femal Zebu cattle to produce hybrid called *Urang* and corss pure yak cows (nak) with male Tibetan cattle to produce cross-breed called *Dimjo*. In Dhunche and Gatlang VDCs, the farmers only cross pure yak bulls with female Zebu cattle to produce Urang. The male offspring of these cross-breeds are stile, while females can reproduce.

Although the issue of back crossing in yak farming system is still not entirely clear for both the farmers and the professionals, local farmers usually cross yaks for the first 3 to 4 generations with cattle. The characteristics of the F1 hybrid resemble more those of the mother than the father, so the farmers choose the F1 which is most suited to the altitude range of their specific transhumant system. The males of F1 hybrids are used for draft and pack purpose and the females of F1 have their greatest values as milk producers. The females of the F2 hybrid is relatively unproductive, but in a few cases local farmers keep them to breed further up to F6 crosses in order to obtain stock which is close in characteristics to the pure yak or cattle. Some farmers in Lantang VDC claim form their experiences that the best milk producer are the back cross of the F4 and F5 generation.

The breeding patterns in local yak farming systems match very well to transhumance grazing strategies, which reflect the seasonal availability and climatic variation. The mating season occurs during July to late October or early November, when the yaks are herded the high quality summer pasture. Parturition occurs during April to July, when the yaks are grazed in the lower elevations, close to the home villages in cold season. In Langtang, the local farmers herd one pure yak bull, 10 - 15 Zebu cattle cows, one Tibetan cattle bull, 10 - 15 pure yak cows (nak) and 10 - 20 chauri cows in a mixture group on summer pasture for mating. In Dhnche and Gatlang, the local farmers keep one yak bull and herd it together with 10 - 15 Zebu cattle cows, 20 - 30 chauri cows for mating. In some cases, several households with small scale herds (5 - 6 animals) graze their livestock together to share the same bull, which is selected based on its body size, conformation and daughters' milking performance and castrated as draught and pack animal when it is intractable.

Normally, local farmers let the male and female animals mate freely when they become mature. The first mating for female yak (nak) occurs at about 3 years of age and first calving at about 4 years of age. The yak bull can start mating at the age of 3 year old and reach their peak ability at 6 - 7 years old. In the history, the local farmers imported yak bulls and Tibetan cattle bull for cross breeding. After the closure of the Tibetan border to livestock movement in 1980s (some farmers claim 1960s), local farmers have had to concentrate some of their own breeding efforts on maintaining a stock of both male and female yak and Tibetan cattle bull from which they can then obtain cross breeds. With the small herd size of pure parent types, inbreeding continues to occur harming for genetic diversity and local farmers complain that the inbreeding has been resulting in poorer quality stock.

Stock feeding and calf rearing

Local farmers graze the yak and chauri whole year round following the traditional transhumant grazing system. In summer, there are few opportunity of supplementary feeding for the stocks, except they are fed monthly with salt to supply the minerals. In lean/winter period, some supplementary feeds, mostly the roughages are provided for the stocks. In Langtang, some farmers harvest the surplus of forage from summer pastures and produce hay to feed the grazing yaks in the harsh time. In Gatlang, local farmers preserve 2 large temperature pastures surrounded by forestry near their village and produce hay as the winter supplements for the chauri herds, which, together with cattle are sometimes supplemented with millet straws in winter. In Dhunche, local farmers cut green fodder tree foliages and dry grasses from the Langtang National Park and supplement the chauri herds, which are grazed in the forestry near their village and on crop stubble of their own farmlands.

Although the cultivation of forage grasses or plantation of fodder trees for hay conservation is new to most mountain farmers in Nepal, some farmers in the case sites grow oat, barley or turnip for hay production under supervision of local forage or pasture professionals. The cultivated forages are usually harvested and piled in the trees or the roofs of houses for air drying and supplied to the animals as supplementary feeds together with native grass hays or straws in feed deficient winter. The herds are sometime supplemented with a small amount of concentrates in harsh lean period. In agro-pastoral areas like Dhunche and Gatlang, barley flour and millet are sometimes provided for the herds, especially the cows which have given birth and in late pregnancy or those which are sick or weak in body condition. In pure pastoral area of Langtang, the dried turnip slices or barley flour are sometimes given to the herds, particularly the cows in produce or pregnancy. Salt is provided monthly to the herds, either together with concentrates or separately.

F1 hybrid calf, which is either produced by female yak with Tibetan cattle bull or by female Zebu cattle cow with yak bull is reared very carefully by local farmers. The new-born calf and the dam are normally separated from the other herds and are fed in the stall or grazed around the village for the first 7 days at the birth. The calf gets first the colostrums, which, in local farmers' opinions, is very important for calf's health and then all the milk from the dam. The dam is not milked for 10 days to half month after calving. When the dam starts to be milked (morning and evening, twice daily), the calf continues to suck and graze along with the dam after it starts to nibble grass at 7 - 10 days old. Weaning of the calves is generally around at the age of 10 - 12 months. During harsh winter season, the dam is not milked and calf can get a small amount of milk by suckling. The supplementary feeding to calf over the first winter are stressed by local farmers. F2 hybrid calf, the offspring produced from back crossing either by female churi with yak bull or Tibetan cattle, is generally considered as unproductive and killed or left to die a few days without any rearing. From local farmers' indigenous knowledge, maximum milk production can be utilized by killing the unproductive offspring of back crossing.

Health care

Although yak herds are rarely received regularly healthy care and services in the transhumance grazing system, local farmers use their indigenous knowledge and experiences to reduce the risks of health problems. Routine movement under complex sets of arrangement and schedules is one of indigenous practices that local farmers adapt for centuries to avoid the accidental consumption of poisons plants by grazing animals. In Gatlang village, the farmers protect their animals from grazing on the white clover dominate pastures, which resulted from 1970s' Napali government project of reseeding degraded grassland with introduced white cover and ryegrass, in early spring to avoid the problem of bloating. Two of the primary healing techniques originated from Tibetan veterinary science, moxibustion and blooding-letting are employed by local farmers to heal broken "wind" fatigue from work, decrease edema and to build natural defenses.

Likewise, although specialists in veterinary care do not exist throughout the Himalayan ranges, local farmers are very knowledgeable in disease record, poisonous plant identification and disorder remedies for their herds. Similar to other researcher's findings of survey (Joshi et al., 1997), the farmers in Rasuwa district in this survey reported that they were aware of many diseases which most frequently affect local populations, including bacterial diseases of anthrax, black quarter, brucellosis, HS, John's disease, mastitis, tuberculosis; viral diseases of FMD and rinderpest; Parasitic diseases of lice, ticks, mites, parasites, worms and protozoan parasites and anomalous diseases of bloating, ketosis, milk fever and poisoning. On the other hand, the farmers in this survey said that they had never tested yak blood or stool sample for any disease diagnosis and a high number of livestock died of disease outbreak.

In most cases, local farmers treated the sick animals by traditional healers. Herbal remedies for various diseases, pests and plant poisoning are good examples of indigenous knowledge applied by local farmers. Traditional veterinary medicines in Nepal recorded by FAO/APHCA (1991) are mostly used by local farmers for treating the animal health problems (Table 3). Moreover, taking bath for animals in the clean water and de-worming are extensively used by local farmers for animal health care. Local farmers are cautious about the quality of drinking water. They indigenous farmers think that the water drunk by buffalos are not drinkable for yak. In Gatlang and

Table 3. Traditional remedies for diseases, pests and poisoning in livestock farming system.

Scientific name	Common name	Parts used	Conditions
Pedicularis siphonantha	Halhale/Ponki	Roots	Plant poisoning
Citrus limon	Nibuwa (Lemon)	Fruit	Plant poisoning
Citrus aurantifolia	Kagati (Lime)	Fruit	Plant poisoning
Delphinium denudatum	Nirbishee	Roots	Plant poisoning
Schima wallichi	Chilaune	Bark juice	Internal parasites
Alstonia scholaris	Chhatiuman	Bark juice	Internal parasites
Juglans regia	Okhr	Bark juice	Internal parasites
Allium sativum	Lahasun (Garlic)	Roots	Plant posioning, colic, timpany
Zanthoxylum axyphyllum	Siltumur	Seeds	Poisoning, timpany
Piper nigrum	Marich	Seeds	Poisoning, colic, timpany
Cinnammum zeylanicum	Dalchini	Barks	Indigestion, diarrhoea, colic
Curucuma domestica	Besar/haldi	Roots/Rhizome	Indigestion, wounds
Picrorhiza scrophulariiflora	Kutki	Roos	Fever, diarrhoea
Bergenia ligulata	Pashanved	Roots	Ticks, lice
Lynonia Ovalifolia	Angeri	Leaves	Ticks, lice
Sodium chloride	Nuun (salt)	Chemicals	Ticks, lice
Emblica officinalis	Amala	Fruit	Poisoning

Source: Traditional veterinary medicine in Nepal (adapted from FAO/APHCA, 1991).

Dhunche VDCs, some farmers build shelters (stone wall covered by plastic) to protect the animal from cold stress in winter and hot stress in summer.

Constraint, challenges and opportunities

Although the interview and survey results indicate that most farmers believe their indigenous yak and chuari management systems are moderately efficient in converting the physical, climatic and other constraints into opportunities, there are still some problems and limitations for optimizing their yak and chauri management systems. Firstly, physical constraints such as lack of trails, bridges, fuel wood and drinking water in some high altitude summer pastures limit their access to good grazing lands, which results in unevenly utilization of pasture resources. Secondly, environmental problems of deforest, overgrazing and landslides result in reduced pasturelands (especailly in Langtang), increased weedy and poisonous plants (especially in Gatlang) and degraded grassland resources (especially in Dhunche). Thirdly, economic constraints of poor marketing systems (no market in Gatlang, unstable market in Langtang and lack of multiple markets in Dhunche) limit the sustainable development of yak farming system. Fourthly, technical weaknesses of poor animal health care, animal breeding, forage cultivation and preservation associated with inadequate public services as well as low institutional and human capacity-building confine the promotion of yak farming. Lastly, social problems including conflicts between different VDCs or between different users' groups about use of pasture land due to unclear land tenure and ownership (e.g. conflicts between Gatlang and Chilime VDCs for sharing Sanjen pastureland) and conflicts between buffer zone villages and Natioal park over rangeland resource utilization and conservation (e.g. conflicts between Lantang village and Lantang national park) decrease the developing potentials of yak farming system.

According to the farmers' survey and interview, it can be found that not only the constraints and problems but also some changes do affect sustainable development of yak farming system in mountain areas of northern Nepal. There is a common concern among most farmers over the decline in quality of breeding yak stock. In the past, the borders between Nepal and Tibetan autonomous region of China were more open and there were more free movements of the animals and greater exchanges of breeding stocks. After closure of the border from China side in 1980s (some farmers claim 1986s), inbreeding is becoming a big problem in yak farming system in case site due to declined genetic exchange. The farmers in Dhunche and Gatlang claim that the numbers of chauri herding households increase greatly and those of sheep raising households decrease significantly in recent years as dairy products are highly demanded by domestic residents and overseas travelers. This change may increase the pressures and stresses of overgrazing on pasturelands. In Langtang, some farmers have shifted from livestock production into hotel management or other tourists-related business as Himalaya trekking and moun-

tain exploring is becoming more and more popular in this area. This is a disrupted of traditional subsistence livestock production system driving by commercially-oriented business.

On the other hand, local farmers points out that there are great potentials to convert these constraints and problems into opportunities. In recent years, local farmers have got significant benefits from central and local governments, NGOs support programs of education development, poverty alleviation and infrastructure improvement, which are not only the driving forces for the improvement of their livelihoods, but also for the development of their livestock production systems. However, this programs are either short-term plans or small scale projects, these external supports (specially from governments) are not enough to mitigate and eventually eradicate their problems and constraints. In local farmers' opinion, there are great opportunities to increase yak and chauri productions through better breeding, feeding, herding and health care management of livestock and improved management of pastureland and fodder resources. However, most technical approaches developed in the past have failed to produce satisfactory results from a development of view as these approaches paid little attention to local farmers' needs, ignored their indigenous knowledge and traditional practices, neglected their social and cultural particularities of livestock production. Local farmers expect more participatory planning, research and management in the project implementation and more involvement in decision and policy making to increase the potential and priority of livestock production. However, little attention has been paid to mobilize people at the grass-root level to manage the process of development themselves and to strengthen their capabilities to manage the livestock production system better.

DISCUSSION

Indigenous knowledge and resource use practice has been defined as a cumulative body of knowledge and beliefs handed down through generations by cultural transmission about the relationship of living beings with one another and with their environment (Gadgil et al., 1993). Indigenous knowledge is local knowledge unique to a given culture or society, it contrasts with the international knowledge system generated by universities, research institutions and private firms. It is regarded as the basis for local-level decision making in agriculture, pastoralism, food preparation, health care, natural resource management and a host of other activities in rural communities staying very close to the nature (Farooquee et al., 2004). In the biological sciences, studies of indigenous technical knowledge, not least in the sphere of natural resource management are coming to an overdue realization that many unschooled-but far from uneducated rural people possess an invaluable fund of knowledge about the environments in which they live and the management of natural resource base on which their livelihoods depend (Gill, 1993).

Since last decade, it has been realized by the scholars and researchers that indigenous knowledge systems should constitute the core of development models in the third world (Long and Long, 1992; Hobart, 1993; Dudley, 1993; Tamang et al., 1993; Brush and Stabinsky, 1996). Because indigenous knowledge has permitted its holders to exist in 'harmony' with nature, allowing them to use it sustainability, it is seen as especially pivotal in discussions of sustainable resource use (Compton, 1989; Flora and Flora, 1989; Ghai and Vivian, 1989; Moock, 1992; Sen, 1992; Inglis, 1993). Indigenous systems have no set menu of standard practices or processes. They are flexible systems that address the needs and preferences of the users of an area and have the capacity to capitalize on the particular biophysical niche or advantages that exist in that area. The flexibility demonstrated by these systems to change and adapt seems to be a major feature of strength of these systems (Tamang, 1993).

Studies of indigenous management systems show that there is an enormous gap between what is practiced by the majority rural population and what is known by the minority policy makers, planners, researchers and so forth (Gill, 1993). To a large extent, the knowledge, skills and experience of the rural people in natural resource management go unacknowledged or are excluded and not utilized in the planning, implementation and evaluation process at all levels of government, non-government, bilateral and multilateral organizations (Tamang, 1993). There is a need to form a network of interested researchers, professionals and others to promote a balanced view (that considers both the strengths and weaknesses, sustainable and non-sustainable aspects) of indigenous management systems of policy makers, educational institutions, project planning and implementtation organizations. The major focus of the promotion being to create awareness of indigenous management systems and the need to build upon these (Tamang, 1993).

The physical, climatic and vegetation variations in Nepal are usually viewed as constraints and problems. However, indigenous management systems have used these multiple variations to their own advantage and have converted constraints into opportunities. There is no other system that can effectively utilize the multiple variations to their own advantage and not view them as constraints and problems (Tamang, 1993). This can be testified from the traditional yak and chauri management in high mountain areas of northern Nepal, which has some similarities with other yak farming systems neighboring countries and regions (Cai and Wiener, 1995; Winener, 2001), especially Tibetan autonomous region of China, the origin of yak raising (Zhang, 1990), but more unique and typical practices and strategies evolved and formed from long history.

The seasonal movement of animals from one ecological zones to another according to climatic condition and feed availability recurrent feature of indigenous yak and chuari grazing management system in Nepal. Such movement is routine but farmers operate under complex sets of arrangements and schedules (Thapa, 1993). This grazing practice is not only an a good adaptation to climatic variation in mountain areas, but also an ideal strategy of well balancing and efficiently utilizing different feed resources. Rotational grazing of the pasturelands according to feed availability in indigenous yak and chuari farming system is a good practice to protect rangeland conditions and increase forage productivity at the same time. It was reported by other researcher that when farmers made to follow a rotational grazing cycle, forage production went up by as much as 40% compared to those areas where this traditional practice was disrupted (Alirol, 1979).

Indigenous cross breeding of yak with cattle is an active good practice which can benefit from higher performance of due to hybrid vigor and better adaptation of crosses to intermediate altitude (Robison, 1993). The hybrids are more productive than either parents and more adapted in the intermediate zone between cattle and yak natural habitats (Robison, 1993; Joshi et al., 1994). A major advantage of yak hybrids is their ability to utilize grazing lands which are too low in elevation and too high for cattle (Joshi et al., 1994). The breeding patterns in local yak farming systems reflect the seasonal availability and climatic variation, matching very well to transhumant grazing strategies. Similar to other researcher's report (Pradhan et al., 2002), it is found in this survey study that the yak and chauri mate during July to October when they are still in the high quality alpine pastures and produce during April to July in the lower elevation closer to the home village. Both yak dam and calves can take advantages of good climate, enough food and safe guard from this good indigenous breeding strategy. Indigenous selection of breeding bull from other herds or different locations is good way to reduce the risk of inbreeding. As Joshi et al. (1994) pointed out that the Langtang valley of north central Nepal supplies yak breeding bulls to the surrounding areas for production yak hybrids and therefore to maintain livestock production over a much wider geographical area.

In this study, we concluded that supplementing the yak and chauri with hay and straw in winter time is a traditional feeding strategy to maintain livestock body weight and productivity in northern Nepal. It was also reported by other researchers (Rai and Thapa, 1993) that harvesting indigenous grasses and legumes for hay conservation was traditionally popular among people who depend largely on livestock raising in most of northern regions of Nepal for centuries. Concentration supplementation is a traditional feeding practice in yak farming system of agro-pastoral areas. However, this practice is still in small scale and not widely applied by the farmers living in cold, landless alpine areas like Langtang. Killing F2 hybrid calf by paying no attention and careless rearing is an indigenous practice of Nepali farmers to improve the productivity of the yak and chauri herds. By adapting this strategy, the maximum milk production can be utilized in yak farming system (Robinson, 1993).

Careful grazing management and herbal remedies for various diseases, pests and plant poisoning are good examples of indigenous knowledge in yak and chauri health care. Similar to many regions of Nepal Himalaya and Tibet Autonomous Region of China (Goldstein and Beall, 1990; Mauer, 1995; Craig S., 1997), traditional Tibetan veterinary play a very important role in treating sick animals and building their defending ability to diseases. However, poor disease diagnosis is still a problem in indigenous yak and chauri health care according to the survey finding in this study. High loss of yak and chauri due to infectious diseases a common problem in most yak and chuari farming areas (Joshi et al., 1997) and other grazing herd faming systems such as transhumance sheep management (Sedhain, 1993). This is one obvious weakness of indigenous yak and chauri farming system and external supports are urgently needed to eliminate and eradicate this weakness.

Despite indigenous livestock production system used by local farmers in the local history are not perfect and have many weaknesses in some perspectives, it exhibits a somber picture of a stable, sustainable, self-contained and high productive system. It needs to be emphasized that there are no other systems more suitable to the varying climatic, biophysical conditions and ethnicity of local environment. Detailed, systematic and intensive analysis of the indigenous management systems in existence would contribute to a more complete understanding and appreciation of their contribution to the economical survival of the local communities. Making better use of the vast indigenous knowledge that the local farmers possess is necessary when making improved management plans for yak and chauri farming systems. As it becomes more available, scientific information will build upon and complement the indigenous knowledge systems, not replace it. Similarly, certain aspects of traditional management systems may offer considerable scope for improved management of livestock devolves to the communities. Central and district policy-level directives will be encouraged to give credence to indigenous knowledge and traditional management systems and ensure that they are given greater appreciation and consideration by professional staff.

Policy makers should be aware of the necessity of involvement of local farmers and incorporation of many indigenous management systems in the process of planning and decision making. These should include learning from indigenous knowledge and experience, recognizing indigenous organizations as effective intermediaries for livestock management and incorporating many of the traditional rights, rules and sanctions for live-

stock management. It should be realized by both district and central government officials, policy-makers and administrative managers that understanding the components of indigenous livestock management is a very important step in initiating and developing an appropriate policies and programs for the development of yak and chauri farming system. Scientists in livestock management should learn to begin all of their researches by finding out what the farmers already know about the issue under investigation. It is necessary to explore their perceptions, how they try to cope with problems and capitalize on opportunities, what type of end product they are seeking, what constraints they are facing in trying to achieve their goals and objectives. Once the issues have been identified, constant contact should be maintained with the indigenous herder groups in order to ensure that the research remains on track. Extensionists are needed to examine and understand the systems and work on the existing problems and possible solutions.

Indigenous institution development and farmers' capacity building are imperative for better planning and successful implementation of livestock management program. Participatory planning, research and extension network should be developed to encourage the farmers to work together with professionals for better integrating the indigenous skills with advanced technologies. Public services and supports from government, NGO and private sectors should be provided to sustain and improve the indigenous livestock management systems. Practical grazing, breeding, feeding managements and animal health care training should be to farmers to supplement the weakness of their indigenous skills and technologies. Stable and multiple marketing systems should be developed to ensure the sustainability of pastoral economy. Low credit or subsidy systems should be established to provide the economic incentives for local farmers in raising indigenous livestock such as yak and chauri production system.

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