Chapter 27

Unique Livestock Resources of Mountain Farmers and the Compatibility of On-farm Conservation Efforts with Livestock Development Approaches

B. R. Joshi and D. P. Rasali

The Unique Livestock Resources of Mountain Farmers

Biodiversity of Farm Animal Genetic Resources in the Himalayas exists in the form of variety and variation in species, sub-species, breeds, types, varieties, strains, and lines, and in some specific population groups and sub-groups, or even at the individual level. All these represent unique genotypes or forms of gene constructs evolved through natural or artificial breeding and selection over generations. These different animals have been evolved over time to serve man for specific purposes or uses according to the needs of specific agroclimatic regions. Description, documentation, development, and conservation of biodiversity of such animal genetic resources should, therefore, focus on their continuous use in an efficient, systematic and judicious way in order to ensure the sustainability of such resources for meeting all sorts of future needs.

The spectrum of farm animal biodiversity in the Himalayan and sub-Himalayan region of the Indian sub-continent is wide, rich, and varied. This is evident from the presence of a number of types or breeds of sheep, goats, horses, cattle, mithun (ox), yaks, and even camels. These types seem to have been developed through breeding and selection over time. Some salient features of the status of farm animal biodiversity in the Himalayas, as well as its changing pattern, are well described in Balain (1996). Some of the different breeds of animals are described in the following.

Yak

The yak or grunting ox *(Bos grunniens L.)* is a native of Tibet and surrounding countries in Central Asia. It is found at elevations of from 4,000-6,000 masl. In

India they are found in the Ladakh plateau, the valleys of Panni, Chini, Lahaul, Spiti and Sangla in Himachal Pradesh, the Garhwal hills in Uttar Pradesh, the West Kameng and Tawang districts of Arunachal Pradesh, and the northern district of Sikkim. About 39,000 yaks are distributed in the above hill states of India, of which 15,000 are present in Ladakh alone. The yak is an excellent pack animal in the hypoxic environment of the high altitude mountains of the Himalayas. The domesticated yaks are relatively small and of variable colour. Yaks provide milk, meat, hair, hide, and wool to the highlanders. At lower altitudes and in valleys, the yak is now being increasingly crossed with local cattle in order to produce different types of hybrids for agricultural operations.

Mithun

The mithun (*Bos frontalis*) is considered to be a ceremonial ox by tribesmen in the north-eastern hill states of India and adjoining areas of Burma, Bhutan, and the Chittagong hills of Bangladesh. They are raised under semi-wild conditions and are generally found at altitudes between 600 and 1,500 masl. The largest populations of mithun are found in Arunachal Pradesh and Bhutan. Mithun crosses are also maintained for milk.

Manipuri Horse

This breed has been found in Manipur and Assam for many centuries. It is very well known for its elegance, shape, and surefootedness on sloping hill terrain. The breed is in great demand for polo, racing, and military transport in the hills.

Spiti Horse

This breed of ponies inhabits the Spiti Valley of Himachal Pradesh. The animals are hardy and sure footed like other hilly horse breeds. The breed thrives in the cold arid region of the Himalayan mountains and can withstand adverse climatic conditions. No more than a few thousand pure-bred Spiti horses survive in the breed tract, and it is now considered to be an endangered breed.

Zanskari Horse

The Zanskari breed of horse is one of the rare breeds that can survive under the hypoxic conditions of Ladakh. It is found in the Zanskar Valley in the Kargil district of Ladakh. The horses are used for transport, riding, and polo. Sure-footedness makes it a useful animal for hill terrain and transport on snow. Only a few hundred horses survive today, and this breed needs to be considered seriously for conservation.

Box 27.1
The Mithun

In areas where the *mithun* is found, it is an indicator or yardstick of social status. The wealth of a person can be ascertained by the number of mithuns in his possession and by counting the number of preserved horns or skulls on public display on the veranda wall or elsewhere near the house. The mithun is the animal of choice for sacrifices made at religious festivals to increase the productivity of crops and livestock, to improve the well-being of the village society, and to save the human race from natural catastrophes such as floods, famines, and epidemics of disease. Every community celebrates their annual religious festivals – the *Nyokun Yullo* by the *Nishi*, the *Mopin* by the *Adi*, the *Dre* by the *Apatani* - and the mithun finds a central place in the ceremonies. Since mithun is the most valued animal in the life of the people of Arunachal Pradesh, it is also a popular gift at marriages, generally made by the groom's family to the parents of the bride.

"*The economic utility of mithun encompasses payment of fines for social and legal obligations, as per the direction of the village elders in settlement of disputes. Mithun has its highest value on the barter table. It finds utility in the purchase of land, property and foodgrains. In the case of costly items such as jewellery and ornaments, a series of Nyeda (number of barter exchange trips) may have to be performed by the buyer to the owner's place to reach the required number of mithuns. In commercial trade, the mithun keepers of Arunachal Pradesh have a relationship with the people of Bhutan. There mithuns are generally utilised for cross breeding with the indigenous Siri cattle to obtain hybrids of economic importance*" Taba Heli, 1993 [sic].

As a result of its overall importance in society and the deep-rooted relationship with it, people have evolved suitable animal husbandry practices for rearing mithuns. The success of the age-old practices are reflected in the fact that nearly 75 per cent of the mithun population in India is found in Arunachal Pradesh. Management alone is of little consequence for healthy proliferation of a species unless a suitable habitat is maintained. The most important component of mithun habitat is the forests. Detailed research work (Heli 1993) has revealed that the mithun browses on leaves from nearly two dozen natural species of trees, shrubs, and bushes. The animals generally do not tolerate heat and retire to the deepest parts of the forest during the noon hours in search of water, particularly that oozing out from salt licks close to small ponds or streams, to quench their thirst. They have a habit of visiting such streams or ponds often after browsing in nearby forests and thus these are an important part of the habitat. Such spots are referred to by different names in different dialects, for example *Shi* in *Nishi*. In the traditional free range system of management the mithun spends a large part of its life in the forest. The owner makes periodical visits, usually once a month, to the forest with a package of salt to feed it. This retains the link between owners and their mithuns. If the owners miss a couple of visits with salt, the mithuns visit them.

There are many salient aspects of biodiversity conservation inherent in the traditional practice of rearing mithuns. The mithun is distributed throughout an altitude range of 500-2,700m and can even be found up to 3,000m, overlapping the habitat of yaks. The mithun has a wide range of preferred fodder species, depending upon the forest type. The need for large shade trees in the mithun habitat has already been mentioned. The delicate question of availability of water in forest streams and ponds and proximity of salt-licks is very much related to the pristine environment of the forest ecosystem sites.

Source: Rastogi and Pant 1996

Asses

About 8,000 small-sized asses can be found in the Ladakh region of the Himalayas. They are mainly located in the Indus Valley of the Leh and Kargil districts and are used for carrying bricks and other building materials for houses in the valley. In body features they appear similar to the Tibetan breed of asses.

Double-humped Camel

About 54 double-humped camels (*C. bacterianus*) are reared by a few nomadic families in the Nubra Valley of Ladakh. These animals are thought to be stock left over from the camels that traversed the silk route from China and Mongolia through the Himalayas.

Chanthangi Goats

The Chanthang region of Ladakh, which lies more than 4,000 masl, is inhabited by the Chanthangi breed of Pashmina goat. About 51,000 animals of this breed are found in this region.

Chegu Goat

Chegu is another Pashmina goat breed found in the Lahaul and Spiti valleys of Himachal Pradesh, Uttar Kaski, and the Chamoli and Pithoragarh districts of Uttar Pradesh bordering Tibet. The estimated population is about 92,000.

Gaddi Goat

This is a medium-sized goat found in the Chamba, Kangra, Kullu, Bilaspur, Simla, Kinnaur, Lahaul, and Spiti districts in Himachal Pradesh, and the Dehradun, Nainital, Tehri Garhwal, and Chamoli districts in Uttar Pradesh. Its numbers have been estimated at 770,000.

Kashmir Merino Sheep

In the last three decades or so, large-scale crossbreeding of local sheep breeds such as Karna, Gurej, and Poonchi of Jammu and Kashmir with Russian Merino and Rambouillet sheep has resulted in a large population of crossbreeds in the state. After several generations of such breeding and selection, a new breed, the Kashmir Merino, has evolved. Its population has been estimated at around 1,050,000. This breed produces fine wool for clothing and is well adapted to the climate of Jammu and Kashmir.

Gaddi Sheep

This breed is found in the Chamba, Kangra, Kullu, Bilaspur, Kinnaur, and Lahaul Spiti districts of Himachal Pradesh and in the Nainital, Tehri Grahwal, and Chamoli districts of the Uttar Pradesh hills. Its numbers have been estimated at around 517,000.

Rampur Bushair Sheep

This breed is found in Shimla and Rampur Bushair and the Kinnau and Lahaul Spiti districts of Himachal Pradesh. Some animals are also found in the Chakra and Nainital districts of Uttar Pradesh.

Changthangi Sheep

This breed is found in the Changthang region of Ladakh. Its population has been estimated to be around 56,000.

Bonpala sheep

This breed is found in the southern districts of Sikkim. Its numbers have been estimated at around 6,000.

Tibetan Type Sheep

These are found in Sikkim and the West Kameng district of Arunachal Pradesh. Some animals are also found in the Ladakh region of Jammu and Kashmir. Its numbers have been estimated at about 19,000.

Siri Cattle

Siri is a prominent breed of cattle in Sikkim, the upper reaches of Darjeeling in West Bengal, and Bhutan. The breed tract lies between 1,300 and 3,300 masl. The Siri breeding tract has steep hills with narrow valleys.

Cattle in the Sikkim Himalayas are either the Siri type or are nondescript and crossbreds. Although the total population of cattle increased by 6.28 per cent between 1982 and 1988, the population of Siri did not show a comparable increase. The population increase resulted from an increase in the number of crossbred animals (by 30.98 per cent) in this period. Crossbreds constituted almost 19 per cent of the total population in 1982, 23.4 per cent in 1988, and 29.7 per

cent in 1995. This resulted from the emphasis on crossbreeding of Siri cattle with Jerseys.

Trends

Animal breeding and, for that matter, animal production systems in the entire Himalayan ecosystem need to be looked at and evaluated from a scientific point of view. Breeds should be assessed not only on the basis of morphological attributes, physical fitness, and utility of different types of animal genetic resources, but also on the basis of their economic viability, either as such or as a part of the farming system as a whole. Almost all local or indigenous types or breeds of animals, though better adapted to local conditions of harsh environment and capable of producing under difficult and low input conditions, are fast declining in number. This is by and large the result of the easy availability and introduction of good genes from high producing breeds from various places in the world through cross breeding. As a consequence new, highly productive types of sheep breeds, cattle, and yak have been developed

All such changes need to be assessed in a realistic manner in any study of the present status of biodiversity of animal genetic resources, especially the usefulness of the existing breeds vis-à-vis the role of the new genotypes in present day animal production and farming systems. It would, therefore, be proper to initiate appropriate programmes aimed at conservation as well as improvement of different types of animal genetic resources in a holistic manner.

Indigenous Livestock in Nepal and a Strategy of Conservation

Nepal

The livestock population in Nepal in relation to the arable land per person is one of the highest in Asia (LMP 1993). The estimated livestock population in Nepal is about 6.2 million cattle, 3.1 million buffaloes, 5.4 million goats, 0.9 million sheep, 0.6 million pigs, and 13.5 million fowl. In addition, there are a small number of ducks, equines, yaks (*Bos grunniens*), and *chauries* (the crossbreeds of yak and domestic cattle) (LRMP 1986, DFAMS 1991). Farm animals in Nepal are reared for various reasons, but principally for the livestock products, farm manure, and land tillage. Most crop cultivation is based on farm livestock, which in turn are fed upon crop by-products produced from the fields. Thus the subsistence agricultural system and the livelihood of some 90 per cent of the population is based upon livestock rearing. In economic terms, livestock contribute about 15 per cent of the national gross domestic product, equivalent to about 28 per cent of agricultural GDP (LMP 1993) and about 20 per cent of household cash income in the hill and mountain regions of the country (Nepal

Rastra Bank 1988). It is expected that the share of livestock in agricultural GDP will increase by 47 per cent by the year 2010 (APP 1995), this will require a significant improvement in livestock production in the country.

Despite the large livestock population, Nepal imports a significant amount of dairy products and live animals, and almost all of the wool requirements for the carpet industry (LMP 1993). The reasons for this are numerous, including the subsistence farming system and lack of market orientation, insufficient infrastructure, and average poor productivity of indigenous stock—largely as a result of insufficient nutrition, healthcare, and management. This situation clearly indicates the need to increase livestock production within the country and to establish efficient support services for its development.

In an attempt to boost livestock production in the country, various exotic breeds reported to have high productivity were imported as live animals or as cryopreserved semen to be introduced into the native population. It was expected that, with the introduction of high-yielding, exotic genetic material, livestock production in the country could be increased significantly within a short space of time. Thus, the thrust of national livestock development programmes has been aimed at and geared to the production of crossbreds in almost all species of farm livestock.

The results of this approach have started emerging slowly and gradually. There were some visible impacts in urban and semi-urban areas, but the vast rural areas (almost 90 per cent of the country) remained largely untouched even after the efforts of three decades. Despite the introduction of exotic stocks, the need to import livestock products for the urban population has not decreased. Therefore, it can be said that the introduction of exotic stocks has neither served the rural communities nor satisfied the needs of the small urban population. In other words, the programme of introduction of exotic stocks has been less than successful in meeting the targets set forth by its proponents.

Several other factors have emerged as the principal constraints limiting the productivity of the exotic or crossbred populations. These are sub-optimal nutrition and management, greater susceptibility to prevailing diseases and pests, poor utilisation in other agricultural activities, and lack of an organized marketing structure. Although these constraints were omnipresent in Nepal, their effect became much more evident and obvious with the high value of exotic and cross-bred populations. The result was poor dissemination and adoption of these animals over a wide area. Although milk yield performances of crossbred cattle and buffaloes were marginally better than those of the native population (Rasali *et al.* 1995), farmers complained that it was only at the cost of higher feed intake and health care management. Similarly the performance of exotic or crossbred goats has also been found to be little better than that of the indigenous population (Oli 1987), and, despite a 150 per cent increase in wool increment from the exotic

Polwarth x native Baruwal crossbred sheep, these animals were not adopted in the prevailing management conditions and were eventually rejected by farmers (personal observations). The only enterprise in which exotic germplasm can be regarded as reasonably successful is that of urban poultry production, perhaps because the other requirements, such as health care, nutrition, and marketing, have been met concurrently in this enterprise. The success may also be because the enterprise has been run by the urban people for the urban population, and urban people are more knowledgeable about market economics.

The introduction of exotic stock has not been without its deleterious side effects. As the panacea for increasing livestock production was considered to be the introduction of exotic stocks (which were readily available in the international markets, albeit at a comparatively high price or as charity); no attempts were made to evaluate the genetic potential of indigenous stock in their prevailing environments or under optimum conditions. Thus, the whole livestock population of the country remained neglected and unevaluated, being commonly referred to as 'nondescript breeds with low production potential'. These inferences were drawn by comparing the production performances of high yielding exotic breeds under their optimal nutritional and management conditions with those of underfed indigenous animals. In this way, decisions were always in favour of exotic animals. Thus all exotic stock are referred to as '*bikase*' and all indigenous stock as 'local' or 'undeveloped'.

Indigenous Animal Genetic Resources and Their Potential

The large livestock population of Nepal is composed of various breeds and strains in different livestock species. The naturally isolated areas of the mountainous country have produced many different environments and ecological niches, resulting in a tremendous biodiversity in animal genetic resources across the ecological zones of the country (Pradhan and Rasali 1995). Epstein (1977) described the breeds of domesticated livestock species in Nepal, and later workers characterised some of the breeds (Keshari and Shrestha 1980). It is likely that some additional breeds or strains would be identified if a more comprehensive study were to be made.

The 6.2 million cattle are mainly hill cattle (62%) and *Terai* cattle (30%) (Pradhan and Rasali 1995). Other breeds such as *Lulu*, *Achhame*, and *Siri* constitute only an insignificant proportion of the population. The population of these three breeds, although not known exactly, is thought to be extremely low and on the verge of extinction, largely as a result of negligence and a lack of conservation strategies. Similarly, hill buffaloes (*Lime* and *Parkote*) constitute around 58 per cent of the 3.1 million buffaloes, the rest are *Terai* breeds and crossbreds with different Indian breeds.

The large population of 9.3 million bovines (cattle and buffaloes) is further supplemented by small numbers of yaks/naks (*Bos grunniens*) and chauries (crossbreeds of yaks and zebu cattle), which are reared in the high altitude areas of the Himalayan mountains. Although the combined population of yaks/naks and chauries has been estimated to be about 58,600 (CBS 1994), the population of purebred yaks/naks was estimated to be only about 8,600 animals (Joshi 1982), and this number has further declined at a fast rate (Shrestha 1995). The last remnant populations of wild buffalo, *Arne* (*Bubalus arnii*) and wild cattle, *Gauri Gai* (*Bos gaurus*), are being kept in wild life conservation parks

Half of the national goat population is composed of the *Khari* breed followed by *Sinhal* (35%) and a smaller number of *Terai* goats (9%), *Chhyangra* goats with the fine inner coat 'Pashmina' comprise only about six per cent of the population. Similarly, 63 per cent of the sheep population are *Baruwal* sheep, followed by 21 per cent *Kage*, 12 per cent *Lampuchhre*, and only four per cent of the fine wool breed *Bhyanglung* (LMP 1993). Wild relatives of sheep and goats, including the blue sheep (*Pseudois nayuar*), are found in the high altitude regions of the Himalayan mountain range, but their exact population is not known.

Rasali et al. (1995) estimated that 57 per cent of the pig population consisted of domesticated native hill pigs, which are called *chwanche* by the *Magar*(s), *sungar* by other people in the western hills, and *pundi* in the eastern hills. The rest of the population is made up of *hurrah* and many local types that have not yet been characterised for their breed types or their production potential (Shrestha 1995). Wild pigs are present in most parts of the country, especially in the protected areas, and their meat is regarded as a delicacy.

The large population of 13.5 million poultry is largely comprised of native birds, called *sakini* (84%), and commercial flocks with various imported breeds that comprise about 16 per cent of the total population (LMP 1993). Although wild jungle fowl are still present in most parts of the country, the numbers are declining steadily as a result of the decrease in the forest areas. Although the population of indigenous poultry is considerably higher than that of commercial birds, the thrust of development strategies is concentrated towards imported commercial birds. This fact was highlighted by the statement of LMP (1993) that "*in the poultry sector, the commercial birds are economically the most important*", which indicates that government programmes will be focussed on commercial exotic birds and the large population of native birds will be neglected. There is a considerable variation in the plumage colour of native birds, and farmers report that birds with a particular plumage colour, for example black, are more productive than others. This possibility, however, has not been investigated so far and needs further study.

In general, the indigenous livestock population is regarded as unproductive or as having a very low production potential, mostly as a result of the reasons

already described. However, it has frequently been observed that some animals within the population have a substantially higher productivity than the average; hill buffaloes are a good example. Moreover the productivity of indigenous stock can be improved significantly with better nutrition, management, and health care, as was shown, for example, by a 150 per cent increment in egg production by native chickens provided with adequate nutrition and health care (Oli 1985). Some of these observations indicate that the indigenous livestock population has not been evaluated properly for its productivity potential under optimal conditions, and there is a need for proper evaluation of the potential of indigenous livestock. It must be emphasised, however, that the value of indigenous stock lies not only in its production of milk, meat, or eggs, but also in its ability to thrive under poor nutritional conditions and to withstand and survive the prevalence of various diseases and parasites endemic in Nepal. This fact is well illustrated by the resistance of native cattle against tick infestation to which exotic cattle are very susceptible. Native stock can also be used for agricultural and other activities, for example, the sheep and goats used as pack animals in the Jumla and Darchula areas. This should also be regarded as a special characteristic of indigenous stocks against the background of difficult mountain environments.

Evaluation of the genetic potential of indigenous livestock will also provide an opportunity for the identification of superior genotypes and the development of conservation strategies for those breeds or strains that are known to possess a comparatively high productivity potential but which are threatened by extinction if some immediate steps are not undertaken. The need for proper evaluation has been indicated by a number of researchers (Shrestha 1995, Joshi and Rasali 1996). This threat to the indigenous stock has arisen as a result of the lack of breeding and conservation strategies, changes in the farming environment, and the development of alternative opportunities for employment and income generation. An attempt to conserve rare breeds would not only benefit the survival of genetic material with distinct merit, but also benefit overall livestock development in the country, as these endangered breeds possess some of the important qualities needed for survival in the hills and mountains of Nepal.

The Threats

The changing agricultural and economic environment of the country; opening up of national and international boundaries for trade, tourism, and employment; lack of profitable economic return from the indigenous livestock rearing systems; disinclination of the new generation to maintain the traditional method of livestock husbandry (with its supporting role in crop production); and the lack of any policy and programmes from national institutions for the conservation and development of indigenous animal genetic resources have created the situation of gradual depletion of the indigenous animal genetic resources. All these factors have

Table 27.1 **List of Animal Populations under Threat in Nepal**

Species/Breeds/Strains	Special Traits	Threats
Yaks and **Naks**	• Adapted to high altitude climates • Reasonably high milk yields	• Declining population • Crossbreeding with zebu cattle • Physically difficult and unattractive management system for the new generation
Cattle *Lulu, Siri* and *Achhame*	• Smaller body weight • Somewhat higher milk yields than other breeds • Ability to withstand diseases to a greater extent than exotic stock • Survival even under extremely poor management	• Extremely low population • No attempts or strategies for conservation • Crossbreeding with zebu animals • Lack of identification of commercial value • Other employment opportunities available, like tourism
Buffaloes High yielding hill buffaloes	• Considerably higher milk yield than the average population • Better utiliser of fibrous feed	• The small genetic pool is being diluted in the population • No strategy for identification, conservation, or improvement
Sheep *Bhyanglung*	• Survival ability under extremely poor conditions • Only one fine wool breed present in Nepal	• No information on the population and its dynamics • No strategy for conservation and development
Goats *Chyangra* Highly prolific individual animals in different breeds	• Fine inner coat production • In great demand as meat animals • High productivity	• Small population • No strategy for conservation • No study on population dynamics and its socioeconomic correlation • Small genetic pool rapidly diluted in population • No strategy for conservation and development
Pigs Indigenous domesticated pigs *Chyaunche* and *Hurraah* and wild pigs	• Superior disease resistance • High value meat from wild male pigs, '*Bandel*'	• Low social status • No information on health and management systems • High rate of close inbreeding within the population
Poultry *Sakini*	• High disease resistance • Preferred taste of meat and eggs • Adapted to poor management • Considerable genetic variation • High consumer demand with higher market price than commercial broilers	• High influx of commercial breeds • Lack of conservation and development strategies.

contributed to the decline of the potential genetic pool present within the country. The following are the imminent threats if conservation strategies are not adopted.

- Extinction of the species/breeds/strains which are at present endangered
- Dilution and disappearance of potentially highly valuable genetic material in the population
- Loss of diversity in the indigenous animal genetic pool
- Loss of genetic material for future use, thus limiting the genetic base for facing future challenges
- Increased dependence on exotic stocks for fulfilling the needs of the country
- Increased population of monospecific animals, thus creation of a population susceptible to a common disease

These threats are of considerable importance and signify the need to implement programmes for the conservation of indigenous animal resources for the sustainable development of livestock in the country.

Conservation Issues

The widely accepted definition of 'conservation' is the management of the human use of livestock so *"that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations"* (Bodo 1990).

In Nepal, conservation is mainly needed for the following.

- Conservation of livestock breeds with populations that have reached an endangered level and which will otherwise be lost forever.
- Conservation of individuals/strains with superior production potential, disease resistance, or other useful traits within a breed; so that the superior genetic pool can be conserved and used for breeding and breed improvement. This is particularly important as these individuals/strains have evolved over centuries under the poor nutritional and health conditions normal in the country and are still able to maintain a significantly better production than the average population. In the absence of any action, the immediate likelihood is that this superior genetic pool will be diluted in the main population, never to be retrieved again.

Considering the above, the main needs are the protection of breeds or species from extinction and the selection and promotion of superior genotypes. Both of these programmes would require a great deal of long-term planning and commitment by national institutions and local-level organizations, as well as the support of international institutions.

Conservation Aims

The importance and need for conservation of domestic animal genetic resources in the form of breeds and individuals will vary according to the situation of a particular country. Henson (1990) has suggested the following primary aims of any conservation programme.

- Conservation of unique and endangered populations as a genetic resource for future livestock breeders and biotechnologists.
- Conservation of historically important, culturally interesting, and visually unusual and attractive populations for education, tourism, and leisure.
- Conservation of non-selected populations for research, or as control populations for comparison with others.

In Nepal conservation should also be aimed at the preservation of hardy and environmentally adaptable breeds and animals.

In competitive environments, breeds or individuals generally become rare or endangered because they cannot compete with commercial breeds (Henson 1990). In Nepal, however, the danger of extinction seems to have arisen more as a result of the lack of proper evaluation of indigenous stock, lack of recognition of the importance of characteristics specifically suited to the difficult conditions of the country, and failure to develop breed improvement strategies. Conservation is needed not only to save animals or breeds from extinction, but also to develop a sustainable broad base for the improvement of the livestock population and its productivity in the country. This approach, though long-term and less spectacular, would be more sustainable in the difficult environment of the country than focussing on the introduction of imported exotic stock.

Hence, the objectives of the ideal conservation programme could be summarised as follows.

- Conservation of the biodiversity of valuable and endangered animal genetic resources

- Development of indigenous animal genetic resources for sustainable livestock development

- Identification, selection, conservation, and development of more productive indigenous livestock breeds

To meet the above objectives, conservation strategies would need to be directed towards the following.

Conservation of Endangered Breeds

Three cattle breeds, namely, *Lulu, Achhame,* and *Siri* and one wild buffalo breed, *Arne* (*Bubalus arnee*), need urgent conservation if they are to be saved from extinction. The small, isolated populations of these three breeds are confined to specific ecozones in the country. *Lulu* is found only in Mustang and *Achhame* and *Siri* are found only in some pockets of Achham and the hill districts of Mechi Zone. There is no population census or record of trends for these breeds because the livestock census is taken according to species not breeds. *Lulu* cattle have been estimated to comprise about 0.2 per cent of the 6.2 million cattle in the country. A recent informal survey carried out by the District Livestock Service Office, Mustang in 1996 showed the total population of these animals to be only 3,301 head, distributed over the 12 village development committee areas (VDC) in the district (Table 27.2).

Although, the alarmingly low population of only 3,300 head of *Lulu* cattle is very worrying, the situation is even more critical for *Achhame* and *Siri* cattle as nothing is known about their current population dynamics. It is thought that 'true

Table 27.2: Population Distribution of Lulu Cattle in Mustang District

VDC	Adult male	Adult female	Male calf	Female calf	Total
Marpha	70	85	27	27	209
Jomsom	76	130	26	31	263
Kagbeni	99	133	27	25	284
Muktinath	82	141	26	26	275
Jhong	74	105	23	24	226
Chhusang	65	115	17	33	230
Ghemi	98	150	22	31	301
Charang	94	126	24	38	282
Surkhang	84	130	20	37	271
Lomanthang	181	145	20	35	381
Chhonhup	127	144	22	35	328
Chho-sher	74	126	22	29	251
Total	1124	1530	276	371	3301

Source: District Livestock Service Office, Mustang (1996)

to type' populations of these animals might be even lower than that recorded for *Lulu*.

The situation of the wild buffalo *'Arni'* is particularly alarming as it is estimated that the last remnant population consists of only approximately 100 animals, kept at Koshi Tappu Wild Life Reserve in Eastern Nepal (Yonzon 1994); and these may be lost at any time.

Although the need for conservation of all breeds can be questioned; it is reported that all three cattle breeds described above have a higher productivity potential than the more common hill or *Terai* breeds (Rana et al. 1996). The body weight of Lulu cattle is about 32 per cent lower than that of hill cattle, but milk production data recorded under farmers' management show that the milk yield of *Lulu* cattle per body weight is 94 per cent higher than that of hill cattle (Rana et al. 1996, Joshi et al. 1992). The milk yields of the *Siri* and *Achhame* breeds have not yet been recorded, but they are considered to be higher than those of common hill cattle. These three breeds of cattle have a number of characteristics that offer advantages in comparison with exotic cattle and their crossbreeds: superior genetic potential; superior production performances under poor nutritional and management conditions; lower body weight requiring less nutrients for maintenance/production; and better adaptation to steep mountainous and hill regions for both working and grazing. These highlight the urgent need for conservation of endangered cattle breeds. It is thought that the productivity of these breeds could be improved significantly with better nutrition and health care, and this also needs to be investigated.

The critical population size at which breeds should be declared 'endangered' under European conditions has been calculated to be below 1,000 cows or 500 ewes or she-goats or 200 sows (Maijala 1990). In the U.K. the Rare Breeds' Survival Trust classifies breeds as rare when the number of breeding females is below 750 for cattle, 1,500 for sheep, 50 for pigs, 1,000 for horses, or 5,000 for goats (Alderson 1981). The FAO (1989), however, has suggested that the population sizes applied in Europe to classify breeds as endangered need to be doubled or even tripled for developing countries because of the sub-divisions and genetic isolation of nomadic populations, harsh climatic conditions, and big disease risks. The FAO proposes as a working rule that *"when a population size approaches 5,000 breeding females, the survival risk of the breed should be studied and appropriate actions initiated."*

Applying these criteria, all three cattle breeds (*Lulu*, *Achhame*, and *Siri*) come under the endangered category, requiring urgent attention for conservation. Although the last remaining population of some 100 wild buffaloes, *Arni*, are kept for protection in a wild life conservation park, there is a danger that these

animals could be lost forever for any of a number of reasons – including a disease epidemic. Application of cryopreservation technology could be particularly useful for the preservation of these animals, and the feasibility of this needs to be explored.

Selection and Conservation of Superior Genetic Material

The superior pools of animals present in most of the species/breeds of farm livestock in Nepal require urgent action for conservation. Although the average productivity of indigenous livestock breeds is very low compared to that of exotic animals under optimum management conditions, a fairly significant number of animals within different species and breeds shows considerably higher productivity. These elite pools of animals within a breed/species could be identified, selected, and conserved for the improvement of the breed. The selection and identification of individuals with superior genetic potential would depend upon the genetic variability present within the breed. The observations so far indicate that considerable genetic variation exists in buffaloes and goats, whereas the situation for other farm livestock is not known. In buffaloes, the breeds identified in the hills and mountains are *Lime* and *Parkote*, both generally regarded as breeds with low productivity. However, some individual animals have been reported to yield more than 10 litres of milk a day (Joshi and Rasali 1996), which is comparable to the productivity of any improved buffalo breeds under village management conditions.

Some female goats of the *Sinhal*, *Khari*, and *Terai* breeds are also known to be very prolific; regularly producing and rearing triplets at intervals of eight to nine months. This level of productivity could be regarded as very satisfactory under the prevailing management conditions in the hills of Nepal. The population is very low, however, and is being diluted rapidly, thus there is an urgent need for action for their conservation.

Rasali and Joshi (1996) have suggested a strategy for buffalo improvement in the hills of Nepal, and a similar strategy could be adopted for the goat breeds present in the country. It is expected that using this strategy it would be possible to develop a long-term sustainable approach for livestock development in the country.

Conservation of Animals with Unique Characteristics

In the diverse ecological environments of Nepal, some animals with typical and unique characteristics require strategies for conservation. These include the yaks/naks reared in the high altitude ranges of the Himalayan mountains, the fine wool sheep, *Bhyanglung*, and the 'Pashmina' goat, *Chhyangra*. These animals have unique production characteristics not present in other populations in the

country. This unique and superior productivity potential could be conserved and used for specific outputs. For example, the wool from *Bhyanglung* is in great demand in the carpet industry and *Chyangra* meat is always in very great demand during the *Dashain* period (a Hindu festival). The population of these animals, although not at the endangered level at present, is certainly declining (Shrestha 1995) and thus needs conservation strategies.

Indigenous pigs and poultry have evolved under the continual pressure of the various diseases and parasites prevalent in the country. Thus it is expected that the population has developed a considerable resistance against these diseases. This needs to be investigated and the resistant traits identified so that the superior genetic material can be conserved and used in future.

Conservation Strategy and Methods

Primo (1987) suggested four stages of conservation for animal genetic resources. They are:

- surveys and identification,
- characterisation,
- evaluation, and
- conservation

Surveys and identification would identify risk populations and their dynamics. Proper characterisation is essential to identify the future potential of the animals. It includes morphological description, cytogenetic studies, and even blood typing. It would also be important to identify the genetic distance from the other nearest breeds available. Evaluation of the adaptive and genetic potential would determine the value of the animals for future use. And conservation, either *in situ* or *ex situ*, would depend upon the population size and other available facilities. Turner (1987) and the FAO (1980) further suggested that only genetically distinct groups with a reasonable prospect for a production system should be considered for conservation.

Although in general the method of conservation of a particular breed or individuals should largely depend upon the population size, the only possible conservation approach in the Nepalese situation is the *in situ* method, until facilities for the cryopreservation of embryos or oocysts are developed at a national centre. Smith (1984) estimated the cost of *in situ* and cryopreservation of animal genetic resources and suggested that, although the initial costs of cryopreservation are higher, the maintenance costs are lower. *In situ* conservation needs a long-term commitment; but it might be the only possible approach for the remote villages of Nepal. The successful experience of community forestry and of nature conservation

areas are examples of the approach that can be adopted under the Nepalese system. This approach requires the mobilisation and involvement of local communities at every stage of the process and implementation of the programme with the active participation of local communities. Such activities could be carried out effectively by the local-level organizations involved in the conservation of natural biodiversity.

Thus the strategy for *in situ* conservation that should be adopted is as follows.

Surveys and Identification

Survey and identification of the animals/breeds to be conserved is the first step in the *in situ* conservation process. The initial survey should provide baseline information on the population size and dynamics of the existing animal population and record the production environment, current usage of the animals, and socioeconomic status of the human population in the area.. A detailed questionnaire for farmers on the previous population status, management and breeding systems, and other related information would need to be included in the survey. Once included in the conservation process, changes in a given time would also need to be recorded regularly.

It is also important that breeds selected for conservation should be 'true to type' and genetically pure. In general, it is suggested that a population is not worth preserving unless it is pure (Bodo et al. 1984). This concept can be disputed, however, and is sometimes ill-defined. Essentially, it implies that the population should be free from the influence of other populations. However, if the available population has already been influenced by other breeds, 'conservation with purification' would be the suggested strategy. It is essential that the population should not carry more than 20 per cent of foreign blood (Anderson 1981), which should be gradually taken out from the conserved population by selective culling of animals with foreign characteristics.

Characterisation

It is essential to characterise any breed selected for conservation. The minimum essential data set needed for breed characterisation is shown in Box 27.2. This protocol is sufficiently comprehensive for characterisation of a breed to be conserved. Rege (1994) has suggested the need to implement more comprehensive characterisation protocols that include objective measures of both inputs and outputs under the local production environment. He suggested that the initial emphasis should be on phenotypic characterisation, which should be followed by genetic characterisation including estimation of genetic distances between populations and quantification of genetic variation in adaptive characteristics.

Box 27.2

Minimum essential data for breed characterisation

Variable	Time and frequency of measurement
Physical traits	
- linear measurements	across the herd structure
- condition score	seasonal
Performance traits	
- milk yield	monthly
- body weight	weaning, post-weaning, mature
- fertility	
calving interval	two or more calving dates
number born	two or more
number weaned	two or more
- viability	young and mature
- fleece weight	once
Health	
- abortions	two or more calvings
- blood samples for monitoring disease	
- faecal samples	several depending on disease and season
- tick infestation	
- DNA extraction	once
Environment	
- location	farm or village by map reference
- climate	farm or village by map reference
temperature	seasonal
rainfal	seasonal
humidity	seasonal
- feed resources	
feed type	seasonal
feed availability	seasonal
- management	
shelter/housing	once
herding practice	once
watering frequency	seasonal
supplementation	seasonal
health intervention	seasonal
- herd structure	
animal movement in/out of a herd	seasonal and dates
- breeding structure	
number of males	once
number of females	once
castration practice	once
use of artificial insemination	once
age distribution	once

Source: Rege 1994

Evaluation

Most livestock in Nepal are reared under conditions of severe nutritional and disease stress that continue throughout life. Under these conditions animals will not develop their full potential, and the recorded production does not represent the true potential of the breeds/animals. Thus it is essential to evaluate the genetic potential of the animals under optimum conditions of nutrition and health care management. Such an evaluation will determine the true value, and demonstrate the scope for genetic improvement, of indigenous breeds. The failure to show real potential under normal conditions was shown clearly in a study in Ethiopia and Kenya, selected populations of *Boran* cattle achieved an average gain in body weight of about 100 kg compared to unselected populations (Rege 1994). Oli's (1985) findings with indigenous village poultry in Nepal show a similar effect.

Evaluation of the genetic potential of the breeds considered for conservation would be useful to determine their future potential.

In Situ Conservation

Various methods and approaches have been suggested for *in situ* conservation of domestic animal genetic resources. These are based on the success of one or another approach in the country concerned. As an example, national and government funded projects have been very successful in Hungary, whereas non-government organizations like the Rare Breeds' Survival Trust play the key role in the conservation of endangered animal genetic resources in the UK (Maijala 1990, Henson 1990). Living history farms organized at a private level have also been quite successful in some countries. These farms, although initially established by individuals for ethical reasons or for pleasure, later developed into important conservation sites and have also become important tourist centres. Cotswold Farm Park in the UK and Reilly Farm in Swaziland are two of the successful classical examples of this approach (Henson 1990, Setshwaelo 1990). Some rare breeds have been conserved through sponsorship by companies, for example, the Clydesdale horse by the Budweiser company (Henson 1990).

The types of approach outlined above are more appropriate in developed countries where the economic environment for agriculture is more favourable and the aim is to conserve primitive breeds without using them for agricultural production. This approach might not be suitable or successful in Nepal because here conservation has to be associated with improvement and/or development. The best possible approach to *in situ* conservation in the Nepalese situation is through participation of local communities.

The survey of the population structure and its dynamics, and characterisation of phenotype and genetic traits of the population provide the baseline information needed for conservation. Participation of local communities is of the utmost importance for implementing the conservation activities. It may not be easy to convince local communities of the need for conservation if no direct benefit is visible. Considerable effort will need to be put into training, demonstrations, and visits by representative members of the participating community. In some cases, subsidies for the maintenance and production of endangered animals might be an option. However, such an approach should be treated with caution and only used as a last resort. Legal support in the form of a ban on the introduction of other breeds into the conservation area would be an additional advantage, as would creation of awareness in the community about the importance of conservation of rare breeds. Selection of superior individuals from the conserved population and their maintainance on government farms in an optimal production environment would provide an opportunity for evaluation of the productivity potential of the breeds. It would also provide a means of demonstrating to local farmers the real potential of these breeds, and their advantages in comparison with imported exotics. The identified superior stock could be cryopreserved as embryos, oocysts, or DNA if the technology became easily accessible in the near future. The superior stock could later be supplied to other potential areas for breeding purposes and multiplication.

Participating Institutions and Their Responsibilities

Local, national, and international institutions have complementary roles to play in conserving biodiversity. Local-level organizations with a mandate for, and knowledge and expertise about, biodiversity conservation would be the ideal and effective institutions for creating awareness, carrying out surveys, characterising conserved populations, and carrying out community mobilisation programmes. These activities are the ground work or foundation for any conservation programme.

National institutes should support such activities by providing the necessary technical support. The national institutes should also have the responsibility for rearing endangered breeds/strains on farms or stations, so that the production potential of these breeds/strains can be evaluated and for popularising the superior breeds identified through experiments. *Ex situ* cryopreservation should also be undertaken by the national institutes.

Financial support from such international organizations as FAO, UNEP, IUCN, UNESCO, and WWF would be important for the successful implementation and continuity of the conservation programme. International institutions have an obligation to support these programmes as conservation of endangered populations is a common concern of mankind. The useful traits of the conserved

population, which otherwise would have disappeared forever, could be shared throughout the planet.

The Current Status of Conservation Programmes for Indigenous Animal Genetic Resources in Nepal

The concept of conservation of indigenous animal genetic resources is fairly new to Nepalese planners and policy-makers. Thus almost all the indigenous livestock population has been neglected since the beginning of livestock development planning in the country. On the other hand, farmers in some areas have always used conservation strategies for superior productive animals in one way or another. This was evident in a field survey in the Kaski and Lamjung district where farmers kept the male calves of very productive buffaloes for breeding purposes (Joshi *et al.* 1996). Such practices, however, are limited to only a few areas and adopted in an unplanned manner.

On the national scale, interest in the evaluation of indigenous livestock populations has begun rather late. Productivity studies have been carried out for some indigenous goat breeds (Oli 1987) and hill cattle and buffaloes and their exotic crossbreeds (Joshi *et al.* 1992, Rasali *et al.* 1995). All these studies have been conducted on a fairly small scale in small isolated pockets of the country and do not represent the situation present in other parts of the country. Some of these studies have indicated that there is a possibility for using the genetic variability present in the indigenous livestock population for livestock development in the country.

Interest in the conservation of indigenous livestock species in Nepal started to emerge recently (Shrestha 1995). However, the only activity in this direction so far has been an informal population census survey of *Lulu* cattle together with attempts to measure their production under farmers' management. This programme has not yet taken off as a result of various logistic problems (Breeding Division, Department of Livestock Services: Personal Communication). There is a particular lack of information on other breeds, such as *Siri* or *Achhame* cattle, or the population trends of yaks and naks. Similarly, there has been no attempt so far to identify and conserve superior strains and individuals of indigenous breeds to improve the production potential of these breeds.

The necessity for conservation of indigenous livestock resources has also been stressed by workers in India (Acharya1990) and China (Yaochun 1990). Acharya (1990) and Yaochun (1990) listed more than 18 and 48 endangered breeds in India and China respectively and indicated the need for their conservation. In India, a conservation strategy for indigenous breeds has been started. Cross breeding with exotic superior breeds will be confined to non-descript, poorly

producing animals. Descript breeds will be improved through selection within the breed (Acharya 1990). Embryo transfer technology will be used for conservation of high-yielding animals within the indigenous breeds.

Future Needs

Considering the availability of suitable genetic material adapted to the harsh mountain environment of the country, the subsistence farming conditions, the poor infrastructure available, the unsuitability of exotic stocks to the current climatic and economic environment, and the imminent danger of genetic erosion of some potentially valuable breeds/strains/individuals, it has become necessary to consider seriously programmes for the conservation and use of indigenous animal genetic resources. Such programmes are needed both to protect these breeds/strains and to ensure their sustained use and availability for future livestock development.

The need is thus:

- to identify the animal populations at risk,
- to study their populations and population dynamics,
- to identify superior genetic material for the prevailing environmental and economic conditions,
- to develop strategies for conservation of valuable populations,
- to develop a national conservation policy, and
- to educate communities on the value and use of the indigenous animal genetic resources.

This is the right time to initiate and implement programmes for the conservation of indigenous endangered breeds and the selection and development of highly productive indigenous stock suitable to our environment. The success in the conservation of wildlife and forests through conservation areas, buffer zone concepts, and community forestry have all relied on community participation. With the concerted efforts of international agencies, national institutions, and local level organizations, conservation of domestic animal genetic resources through active community participation appears feasible, and would enrich the biodiversity of the country and help in the development of sustainable programmes for livestock development.

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