PART C

PREREQUISITES FOR INTRODUCTION

Feeding Strategies and Ecological Environmental Need for Habitat

A review of the existing literature on the nutrition of the *llama* (*Lama glama*) and *alpaca* (*Lama pacos*) revealed that these South American camelids are better adapted to the harsh environment of the Andean Region than are other domestic ruminants. Moreover, with their outstandingly efficient digestive system, the *alpaca* and *llama* survive on coarse native grasses, wire sedges, and rushes. Thus, in contrast to sheep and cattle, they require no pasture improvement or other modifications in the unique, high altitude environment. Also, they thrive on sites where phosphorous and copper are so severely lacking that sheep and cattle suffer debilitating deficiency diseases.

As mentioned earlier South American camelids have been introduced to completely different environments of the world such as those of Spain, Russia, England, Israel, the United States, Ecuador, New Zealand, and Australia. The great differences in climate, soil, and vegetation, between these widely varying countries, are self-evident. When the lamoids were imported, feeding was not a real problem, since the importing countries had other domestic and wild ruminants, and they were sure that the new residents would have enough grass, shrubs, forb, perennial grass, annual grass, natural pastures, and many types of cultivated forage. Consequently, no problems were encountered with feeding the animals whether they were kept in pens, corrals, stables, or grazed on natural pasturelands.

When *alpacas* and *llamas* were exported from Chile during the early 1980s, the lamoids were kept in corrals and artificially fed with alfalfa for the first time in their lives because they had to be quarantined. *Alpacas* and *llamas* quickly accepted this new forage as they became accustomed to it, and the owners reported that these animals gained weight.

During quarantine periods, at the point of disembarkation (importing country), the animals were fed with ample quantities of cultivated forage, such as alfalfa hay, or fresh green alfalfa, oat hay, whole corn, barley hay, Dactylis hay, oat silage, etc. In some cases, the animals were put on cultivated pastures (ryegrass + clover, dactylis + clover, or dactylis + alfalfa). In many cases, concentrated salt pellets were made available as loose salts in some kind of container. In reality, feeding options are virtually unlimited.

Therefore, we think that it is useless to list and describe the great number of plants that are palatable to the lamoids in the Andean Region and in other continents. It is most important to know that lamoids will eat the same plants as other herbivores.

Lamoids, in general, are relatively tolerant to a degree of water deprivation; depending on activity and environmental temperature, the intake will vary from four to eight per cent of body weight.

In the case of importation of lamoids by the Government of Nepal, we made the following recommendations in reference to feeding strategy.

A. During the quarantine period, animals should be fed on some kind of very good quality hay; alfalfa or oat hay are very good choices. Fresh and free water supply should be available at all times as well as some kind of mineral supplement.

B. After quarantine, the animals should be put in grazing paddocks at the research station or any place chosen in advance. The animals should not be grazed on ranges containing poisonous species and they should not be forced to remain on the range after they have used the good forage species.

C. The people in charge of the herd should acquaint themselves with the toxic plant species in their area or region that cause the symptoms of poisoning. A close vigilance should be maintained for some months after the animals are introduced to the new environment and during the development of the herd.

Large human populations are living in high altitude ecosystems (Andes, Himalayas, etc), and they rely on some type of animal breeding for their subsistence, since agricultural productivity is very low. The Andean people domesticated the *llama* and *alpaca* and the Himalayan people the *yak* (*Bos grunniens*).

The most appropriate ecological environments that can be recommended for breeding lamoids are given below.

D. Cold and very cold ecosystems, highly susceptible to degradation, as a result of the extreme climate and sparse vegetation (tundra).

E. Ecosystems above 3, 000 with low atmospheric pressure (low oxygen availability), intense solar radiation, low organic content of the soil, and hence, poor-quality, highly lignified pastures (High Andes, High Himalayan Mountains, etc).

F. Many other cold and very cold ecosystems, with fragile and unstable vegetation (Alpine meadows, semi-desert steppes).

G. Temperate, cold, and very cold semi-desert areas of the world, and any temperate or cold marginal pasturelands.

We are sure that hundreds of thousands of hectares in the Hindu Kush-Himalayan Region can be easily classified under any one of the ecosystems described above . Cold, high altitudes, poor-quality forage, dryness, and marginal lands are constraints that lamoids can overcome.

Preferable Farming Economies

In their long history of domestication and rearing in the Andean Region, *llamas* and *alpacas* have been an integral part of the peasant family's agropastoral subsistence economy. They are imbedded in the subsistence strategies of the highland herder to such an extent that the *llama* and *alpaca* are perceived as members of the family. Although pasturelands may be communal property, or subject to suprafamily control and management, the flocks are family owned and animals are dependent on their owners. Flock management is a family (be it either nuclear or extended) affair. Despite colonial and early republican development of large landholdings (*haciendas*) or the promotion and development of SAC breeders' co-ops, the old traditional Andean system of raising SACs remains a basically peasant family endeavour. Wherever suprafamily ownership arrangements have been promoted or imposed, such as *haciendas* and co-ops, the herder's family has ultimately been the unit effectively in charge of the proper rearing of the animals, with very few exceptions. Furthermore, the failure of several SAC breeders' co-ops, promoted by the Peruvian government in the early seventies, could be attributed to either poor enterpreneurial qualifications and/or disengagement of the peasant family from the actual rearing of the animals. The more successful SAC rearing operations at the suprafamily level in rural Andean society have been those which have heavily relied on the pastoral family as the basic operational herding unit.

This statement certainly cannot be extended to contemporary SAC rearing operations conducted under substantially different socioeconomic and technological conditions by wealthy farmers in Europe, North America, or New Zealand. Everyone of these operations could be classified as unique, welfare style, high-energy input experiments, most of which have been very successful under specific conditions. In almost all these countries, SACs are bred as pets, not as work animals and not within the traditional framework of peasant economies which operate under the constraints of the harsh highland habitat. It is our belief that, despite knowledge gained from rearing SACs under novel conditions in Western countries, their experiences cannot be emulated in the rural environments of the Hindu-Kush-Himalayan Region.

First of all, rearing SACs is an efficient adaptive response of rural inhabitants to the cultural ecology of mountain environments. They play a key role in a typical, mountain-oriented, mixed- agropastoral peasant farming strategy aimed at diversification. They are an efficient response to the characteristic mixed multicyclical strategy designed to optimise labour use in a diversified "vertical" environment (Guillette 1986). As such, raising SACs in traditional rural societies living in mountain environments is usually carried out in combined herds similar to many areas of the Hindu Kush-Himalayas, where goats, sheep, and cattle are reared and graze (see Part A) together.

The Andean, agropastoral strategy is based (as noted in Part B), as in the Himalayas, on transhumant activity. Whereas in the Andes, flock movement is related to the seasonal wet and dry periods (upper and lower areas), in the HKH Region the cycle oscillates between winter (when the animals are taken to the lowlands) and summer (the season when upland grasses grow due to the rains and animals are taken uphill). The basic difference in seasons between the Andes and the HKH Region is related to their tropical and subtropical characteristics, the southern Andes being closer, in terms of alternative options, to the HKH Region. Possibly the environment more suitable for a trial experiment in raising SACs in the Himalayas would be the areas in which *yak* and their hybrid offspring thrive. The Khumbu area of Nepal, inhabited by Sherpas (Brower 1990), appears to have conditions suitable for both *llama* and *alpaca* rearing. Sherpas seem to be open to alternative subsistence options, and their pastoral traditions correspond closely to those in the Central Andes.

The persistence of communal control over land resources, particularly pastures (the *di* system of the Sherpas as described by Brower), increases the potential of rural Himalayan societies for adequate breeding of SACs. Similar communal regulations and ordinances dominate the social environment of Andean rural communities. The Himalayan community officer *-nawa-* described by Guillette (1986) as the individual responsible for careful observance of communal regulations regarding proper use of grazing lands - is surprisingly similar to the *arariwa*, the traditional Andean rural appointee in charge of similar functions.

Taking into account the weather patterns prevalent in the HKH Region, the western areas (Kashmir, Himachal Pradesh, Mustang) as well as the Tibetan Plateau, with conditions, that are drier than other HKH areas, appear to have more suitable conditions for *llama* breeding. In addition, these are areas where caravan trading is important and where the craft of carpet-making could profit from *llama* fibre. On the other hand, the wetter slopes of southeastern Nepal and Bhutan appear to be more suitable for the breeding of *alpacas;* without disregarding *llamas*.

Reproductive Adjustments

We mentioned that the breeding season and birthing season overlap in lamoids due to the long gestation period (345 days). Therefore, under natural conditions in the highlands of the Andean Region, where males and females are together all year round, both the birthing and breeding season last from December to March, the warmest months, when it rains and there is green forage. This is also true of the wild SAC species. However, when females are kept separate from males and mating is allowed only once a month,

both sexes are sexually active during the entire year. Thus, natural conditions in Peru are a consequence of food availability and management.

Observations in zoological parks throughout the world indicate that lamoids are year-round breeders, but with higher parturition rates in the summer months of each particular region of the world. It has been argued that the superior quality of zoo diets, and their consistent availability, may influence certain natural seasonal breeders to distribute the birth season throughout the year.

The most complete information on the birthing season of *llamas* in the United States came from the Rocky Mountain *Llama* Association; out of 467 births registered, 61.4 per cent occurred in the warmest months, from May to September. Only 14.1 per cent of all births were recorded during December to March. In this case, matings and births occur throughout the year, although the summer months have the highest parturition rate.

For good reproductive management in some domestic animals (sheep, goats, beef cattle, lamoids), births should take place during a few weeks or months of the year and in such a way that the litter will be more or less uniform in size and only a short period of labour-intensive investment will be required. Furthermore, in lamoids, parturition and mating seasons should coincide with the best time of the year.

Therefore, we are sure that the lamoids that are transferred to the Himalayan Region will experience a shift in their birthing and breeding seasons to the warmest months of the year in that place, unless another reproductive management is wanted. Regarding this topic, our recommendations are given below.

H. Males should be separated from females and allowed to mate only during the best time of the year, and under close supervision of the veterinary service. An "alternative breeding system" for 60 days is the best choice.

I. The reproductive cycle in the transferred herd of lamoids, after adaptation to the new environment, should start with the mating period. Therefore, the import of pregnant animals is not recommended, due to numerous reasons, which are explained further on in the text.

J. The adaptation period for the *llama* herd in Nepal, before starting the reproductive cycle, should be for at least two or three months.

Species, Herd Size, and Management Conditions

Considering all the advantages and disadvantages of the two domestic species, *alpaca* and *llama*, and the need for an animal that can produce medium to coarse wool for tapestry or Persian rugs, the following recommendations have been made.

K. We recommend the *llama* species and the *Chaku* or woolly type of breed (also named *Tajulli* in Chile and *Thampully* in Bolivia). The colour of the fleece should be chosen according to the favourite colours of the tapestry industry.

Regarding recommendations concerning the herd size, we have to consider the following aspects.

Budget Investment

The number of animals that are to be imported has to be considered while estimating budget investment, and this is entirely dependent on the requirements of the importing country.

Facilities at the Research Farm

Depending on the facilities available at the research farm of the importing country for handling the animals and the capacity of range sites, the herd size should be calculated.

Labour

This variable depends on the number of animals that have to be managed. In general, labour investment is higher for large ruminants, and lower for small ruminants. It is estimated that one person, full-time, can handle around 150 to 200 *llamas*.

Cost of Transportation

This variable depends on the mode of transport (by air or by sea), the number of animals that have to be transported, and the distance. The best route is by air, but it is costly. However, an average cargo plane can carry around 300 to 350 lamoids. Moreover, the air route is quick, without problems of feeding and watering and there are less health risks.

Experiences

The first introduction of exotic animals to a given country is not without risk because the importers will obviously lack experience, Therefore, the first introduction should be of a small or medium-sized herd. As an example of the size of herd to be imported to the Himalayas, the following size is recommended.

L. A total of three hundred-fifty (350) *llamas*, which is a fair-sized herd, should be imported. Yearling females (two year old females) should form the breeding stock, selected by an expert hired for this task (from a group of females presented by the seller). No pregnant animals should be transported, for two reasons: (1) females can abort during the trip, and this may pass unnoticed with grave health risks, and (2) it will be difficult to identify the father of the *cria*.

M. Ten per cent of the herd should be breeding males of about four years, and they should be selected by an expert. Attention should be paid to the phenotypic conformation and genital soundness.

The management of the herd is difficult to delineate without knowledge of the climatic conditions of the importing country (distribution of rainfall throughout the year, temperature fluctuation during the year and during the day, humidity, altitude, etc). However, some basic guidelines can be given.

N. Various management practices are suggested for proper care of lamoids.

Shearing. This should be carried out annually, before the summer months (to avoid heat stress). The animals can be sheared by scissors or mechanically. Sheep are sheared by one person; a *llama* needs two persons.

Bathing or Spraying against Ectoparasites. External parasites , especially sarcoptic mange, can be controlled more effectively after shearing; the medical compound should be sprayed near the skin for better pharmacological action.

Pregnancy Diagnosis. Pregnancy can be diagnosed by rectal palpation, progesterone levels, or the behavioural response of the females to the presence of the male. Pregnant females should be kept in a separate herd or group and sent to the best grazing places.

Parturition. Special attention should be paid during this stage. It is not necessary to confine the females in stables or pens, unless the weather is severe. Open field parturition under close observation is recommended in order to help the mother (difficult birth, retained placenta). Inmediate care and inspection of the neonate should include navel dipping in seven per cent tincture of iodine, drying, weighing, a brief physical examination, and close inspection for evidence of nursing.

Postpartum Period. Mating of females is recommended within 15 to 20 days after giving birth in order to obtain good fertility rates and avoid metritis.

Breeding Season. Yearling and open adult females should be mated first during the sixty days of the breeding season. The "alternate breeding system" (described in Chapter 10) is the best alternative. Females with *crias* at foot are eligible for breeding after a rest of 15 to 20 days. Sluggish males should be replaced.

Weaning. Weaning is commonly carried out at seven to eight months. In one selected day, all the *crias* (young) are weaned. There should be a 60 day difference between the first born *cria* and the last of the season. All the weaned animals should be kept in one herd, and in good pastures, until they complete one year.

Deworming. Depending upon the type of pasture, stocking rate, and climatic conditions, internal parasites can become a major health concern. No one deworming schedule can be recommended. Deworming frequency should be determined by the factors just mentioned and by routine faecal checks. The animals should be dewormed once or twice a year, which may be sufficient. Otherwise, deworming should be carried out every two or three months. It is important to give anthelmintics at regular intervals to the animals.

Vaccination. Herd health programmes for domestic SAC in the Andean region do not have any kind of vaccination. However, when the animals leave their natural environment, they are prone to suffer different bacterial or viral diseases. Therefore, several vaccines have been advocated for use in *alpacas* and *llamas*. To date, however, little is known for sure concerning which products are efficacious and what the proper vaccination schedule might be.

As a rule, SAC importers do not like any type of vaccination, because vaccines can mask a real disease and many countries require negative serologic tests. However, a vaccination schedule in the new environment depends largely on the prevalence of the disease in endemic areas. As a rule, vaccination programmes are designed by the Animal Health Department or Division of each particular country.

Record Keeping. Keeping records is very important for proper management of an animal farm. The following information, i.e., the number of animals, date of birth, weight, breed, colour, weight at one year, date of breeding, yield of fibre, health problems, and deworming dates should be recorded.

Genetic Resources

As mentioned earlier (Genetic Diversity), variation, or genetic diversity, is the raw material available to the breeder for herd or flock improvement. Also, inbreeding will be promoted if new blood lines are not incorporated into the stock of the herd. Therefore, inbreeding, with hazards well known to breeders of other domestic animals, should be avoided by introducing new genotypes. However, with several sires, a herd can be closed for many generations before the average inbreeding reaches a dangerous level. Anyhow, South America will provide new genotypes, in case the inbreeding coefficient reaches high levels.

Developing Animal Health Care Capabilities

Infectious diseases affect domestic animals and play a prominent role in the economy of animal production. Therefore, each country has developed special programmes for prevention, diagnosis, and treatment of animal diseases. The Veterinary Services or Animal Health Programmes are implemented by the agricultural ministries or agricultural secretariats, depending on each country.

The Animal Health Programme of each particular country conducts investigations on diseases affecting different domestic and wild animals living in their territories and provides animal health information, concerning endemic diseases and their control, to any organisation, national or international. Also, it must be able to clinically and serologically diagnose the most common and prevalent diseases that affect livestock.

The same basic principles of disease prevention, diagnosis, and treatment ensure herd health in domestic lamoids as well as in other livestock species. However, some factors make lamoid herd health unique. This is because lamoids, in general, are considered exotic animals, and their diseases are unknown outside the Andean Region. This is partly because much of the information concerning the *alpaca* and *llama* has been reported in journals published in Spanish in South America. However, very recently, two books about *Llama* Medicine have been published in English in the United States, and those interested in this topic can read the bibliography published by the Information Centre on South American Camelids at the IVITA Research Centre at San Marcos University, Apartado 4270, Lima, Peru and the Red De Rumiantes Menores (RERUMEN), Apartado 110097, Lima 11, Peru.

Meanwhile, there are some suggestions we would like to make concerning the establishment of a Lamoid Health Programme before the animals are imported.

O. At least two veterinary practitioners from Nepal should receive special training in *llama* medicine and *llama* herd health, including animal management and production of *SACs*. This report can be read as an introduction and later theoretical knowledge should be acquired from English, as well as Spanish books and pertinent information gathered through Peruvian institutions.

P. A study visit should be arranged for veterinary practitioners and animal husbandry officers to one or more of the South American camelid producing countries: such as Peru, Bolivia, or Chile. We recommend Peru, for its large lamoid population, experience, and institutions directly involved in camelid production and medicine. Different short-term courses on domestic SACs, medicine, production, genetics, selection, herd management, handling, and restraints are offered in some Veterinary Medicine Faculties (Lima, Puno, and Cusco) some practical work and studies at some of the Camelid Research Stations in Puno, Cusco, and Arequipa are also conducted. An eight-week study visit is sufficient to gain knowledge and experience.

Q. After the *llama* herd is imported in Nepal, we are sure that most of the health afflictions will be related to management or environment and possibly some infectious diseases not known to occur in lamoids will be transmitted from other Nepalese domestic or wild animals. Therefore, clinicians should be alert in recognising and dealing with the presence of undiagnosed infectious diseases in *llamas*, and with emergencies. Knowledge of the most important bacterial and viral diseases of Nepalese domestic animals is imperative for all the technical personnel engaged in *llama* breeding.

In general, we have to take into consideration that a *llama* or *alpaca* is a mammal and, for the most part, they react as other mammals in their physiological response to disease states. The same basic medical principles are generally applicable to the SAC species that are applicable to others; in most cases, only the normal baseline value may be different and training and interest will enable the veterinary practitioners to gain the necessary competence to overcome any health problem.

Export - Import Procedures

SAC Exporting Countries

The Andean Region of South America is the most important breeding area for the *alpaca* and *llama* in the world and, hence, the most important SAC exporting countries are located there. Chile started commercial export in 1980 to different countries in America and Europe as well as to the Far East. They established very well organised exporting agencies with adequate funding and preparation, pre-quarantine selection of animals, legal quarantine procedures, government regulations, and a general policy regarding international exportation. It is the most experienced country by far in exporting lamoids. Before 1980, it was declared a foot-and-mouth disease-free country.

Bolivia is not a foot-and-mouth disease-free country. It recently started exporting *llamas* (since 1989), and, as far as we know, a few hundred animals were sent to some countries where there were no strong regulations concerning foot-and-mouth disease. But some problems arise from time to time as a result of the inefficiency of the exporting agencies and protests are made by some *Llama* Breeders' Associations against export of the *llama*.

Finally, Peru lifted the ban on export of domestic SACs and, just this year (1992), started exporting the *alpaca* and *llama* to Ecuador. One limitation is that Peru is not a foot-and-mouth disease-free country, but it has the advantage of having the greatest white *alpaca* population of superior genetic quality and a very good stock of *llamas*.

The United States, Canada, New Zealand, and England are able to export a very limited number of *llamas* and *alpacas* at very high prices. However, the genetic quality is inferior, and there are too many hybrids. They are free of foot-and-mouth disease, but these animals can carry many viral diseases that do not exist outside the United States.

Domestic Camelid Exportation Procedures and Issues

Exportation procedures must concur with the quarantine regulations and other rules set by the Animal Health Services of the exporting country as well as with those of the importing countries. According to the regulations of the exporting-importing countries, the animals must be free from specified diseases, must test negative to serologic examinations, and undergo clinical checkups. The minimum quarantine period for the animals is no less than forty days but, as a rule, it is longer than that.

According to the Peruvian regulations for exporting live animals, they must be free from tuberculosis, brucellosis, and all kinds of ectoparasites. During transportation, the animals can suffer from puncture wounds, therefore, they must be vaccinated with tetanus toxoid (about one month is required for antibodies to develop).

In Peru, the export of domestic camelids is authorised by the Director General of Livestock under the Ministry of Agriculture (Direccion General de Ganaderia del Ministerio de Agricultura), after a certificate is given by the National Council of Domestic South American Camelids (Consejo Nacional de Camelidos Sudamericanos Domesticos).

Chile and Bolivia have their own regulations for exporting camelids, but, generally, they are similar to the Peruvian regulations. However, regulations in the importing countries are more strict.

Importation Procedures

Importation procedures are very variable, and depend to a great extent on each importing country. Each country has its own health regulations and quarantine procedures. Some countries have strong regulations to avoid importation of animals from countries not free from foot-and-mouth disease, because these countries are free from that disease. But, in general, each country imposes regulations regarding animal diseases, vaccinations, and serological test controls against certain diseases, physiological examinations, pre-shipping conditions, etc.

The animal health authorities from Nepal should instruct lamoid-exporting agencies (see Annex 2) about special tests to prevent the import of sick animals, so as to avoid the potential danger of spreading diseases in the country of destination. Such tests might include those for tuberculosis, brucellosis, blue tongue, and any other tests requested by the animal health officials. These have to be submitted for diagnosis to competent laboratories.

Farm animals are routinely vaccinated for disease control in enzootic areas; several vaccines have been advocated for use in *llamas*. To date, however, little is known concerning products that are efficacious and the proper vaccination schedule. A prevention programme for animals that are to be exported is dependant upon the knowledge of the prevalent diseases and the strains known to occur in domestic animals in the country of destination. Whether or not lamoids are susceptible to a number of important infectious diseases of cattle and sheep is still unknown.

Pre-shipping conditions include deworming the animals against gastrointestinal parasites; and also against external parasites, such as mites, lice, and ticks.

Conclusions

Analytical Commentary on the Issue of Import in Terms of the Prospects and Problems

Herbivores are found in habitats as diverse as deserts, arctic tundras, and warm, mesic environments. Domesticated or semi-domesticated, they have a similar range of adaptability to that of man, so grazing herbivores are a feature of most societies. The ability to use fibrous feeds through their symbiosis with microbes enables the grazing herbivores to survive the often extreme variation in quality of the available feed through dry or cold seasons.

Over the last 500 years, European man has taken herbivores to populate South America, North America, Southern Africa, Australia, and New Zealand. In these new environments, these animals were able to utilise the native grasses to provide food and essential services to the pioneers in their development of these new territories.

All domesticated herbivores are multipurpose animals. The Western developed countries have tended to forget this, unlike the developing countries where the multipurpose role of the herbivores is still of utmost importance.

The natural habitat of SACs is a high altitude, fragile ecosystem where they are constantly exposed to cold, heat, intense solar radiation (ultraviolet), a dry and coarse diet, etc. It is under these conditions that the most of the present-day *llama* and *alpaca* production takes place. Herds of domestic camelids do, in fact, constitute the most reliable animal breeds in the highlands or *punas*. Introduced species, such as sheep, goats, and cattle, adapt poorly to the environmental stresses of high altitude regions and give reduced yields of inferior quality even after almost five centuries of acclimatisation.

It is in this context that experience and the results of biological research in the past 30 years clearly document the productive superiority of the *llama* and *alpaca* at high elevations. As an example, we must assume that the best place for SACs is a high altitude harsh environment. This is true, but not necessarily true in every case. Recent introductions of the *alpaca* and *llama* to the United States, Israel, Canada, and New Zealand have shown that they can be reared in areas outside the Andes with successful commercial production. Nevertheless, lamoids are undoubtedly more profitably raised on better-quality pastures and in native environments.

However, what really made the breeding of the *alpaca* and *llama* important is that they are perhaps the most environmentally gentle ruminant livestock in the world and, also, they have the capacity to utilise marginal pastureland that would otherwise be ungrazed or improperly used, resulting in great damage to the ecosystem.

Large human populations are living in high altitude ecosystems (Andes, Himalayas, etc), and they need to rely on some type of animal breeding for their subsistence since agricultural productivity is very low. The Andean people domesticated the *llama* and *alpaca* and the Himalayans, the *yak* (*Bos grunniens*). The *alpaca* and *llama* are remarkable animals upon which the survival of millions of the poorest peoples in Latin America depend.

Also, with worldwide concern for environmental degradation and unsustainable agriculture, it is vital to evaluate the role of the *llama* and *alpaca* in the fragile, high altitude ecosystems. We have already mentioned that these animals are possibly the most environmentally gentle ruminant livestock. With their soft-padded feet, they do not scour steep hillsides. With their sharp front teeth, they clip off grass rather than tearing it off like sheep and cattle.

Moreover, with their outstandingly efficient digestive systems, the *alpaca* and *llama* survive on coarse native grasses. Thus, in contrast to sheep and cattle, they require no pasture improvement or other modifications in the unique, high-altitude environment.

Taking into consideration all the advantages described here, lamoids would appear to be a reasonable substitute for the sheep that are presently grazing on the vast, arid lands of the Third World - with marginal profits. The adaptation of the *llama* to limited forage, scarce water supplies and high, arid lands, and its nutritious meat, its wool, which is used by artisans and modern textile industries, and overall hardiness and adaptability, make it a "super species" with fascinating qualities, and global utility.

In order to increase animal production in the last fifty years, impoverished countries of the Third World have been importing different livestock species from temperate, developed zones, and this strategy has usually met with failure. High-yielding milch cattle or sheep produce fine wool but had to confront poor feeding conditions, improper management, parasites, and difficult climatic environments in the importing countries, and they were unable to perform as they were used to in their countries of origin where they were bred with high quality, balanced diets and high-tech management.

However, there is already a tendency to avoid the ill-timed introduction of exotic domestic animals, particularly in environments already sensitive to ecological degradation. Such introductions are unjustified and, unfortunately, they are often facilitated by modern technical resources (freezing of semen, embryos, etc), the absence of resistance from traditional livestock-raising groups, or a thoughtless liking for novelty, coupled with ignorance of the world's genetic resources. So, instead of making further attempts to transplant unsuitable exotic breeds, it would make more sense to transplant domestic species suitable to harsh and high-altitude environments.

In the late 1970s, the U.N. Food and Agricultural Organisation defined the ideal animal of the future. The animal should be, said FAO, a ruminant, it should need little water, be highly fertile, and it should provide people with protein and other products. The *llama* and *alpaca* fit that ideal. To find the animal of the future, people need look no further than lamoids. Our strong feelings are that lamoids will adapt extraordinarily well to the environment of Nepal as well as to the socioeconomy and culture of the peasant communities. The *llama* does not compete with native sheep for grazing areas and complementary grazing can be considered on Himalayan rangelands with cattle, horses, or yak. They can be watered less frequently than other domestic species, and, therefore, the lamoids can be used in places where water supplies are scarce. Lamoids can easily be integrated into the farming system and economy of Nepal, because rearing lamoids requires very little investment in terms of labour and technology. The medium-fine quality of *llama* wool can be used in the famed local carpet industry in which the Nepalese people are skilful. Also, the animals can be used as beasts of burden for transporting goods over dangerous areas in the Himalayan mountains, as well as being used to provide meat.

After introducing lamoids to their new habitat, special emphasis must be placed on infectious diseases, transmitted by local livestock, and unfamiliar toxic plants must be avoided. If the animals are managed according to our recommendations and common sense, there will be no serious problems.

Suggested Systematic Steps for Introduction of Domestic South American Camelids

1. More theoretical knowledge about SACs is needed in Nepal.

2. A study visit should be arranged for ICIMOD professional staff and Animal Health Services' staff from Nepal, to one or more South American countries, in order to attend courses on lamoid medicine, production, genetics, and management.

3. During the study visits, information can be gathered on animal health regulations existing in the exporting countries as well as other administrative procedures.

4. ICIMOD should organise an inspecting, teaching, and study mission for Peruvian professionals in order to inspect the environment where the animals will be placed; teach medical care and camelid husbandry to the professional and technical staff engaged in the introduction of lamoids to Nepal; and study the prevalent animal diseases in Nepal and other risks for the introduced lamoids.

5. A complete list of the most important domestic and wild animal diseases in the Himalayan Region should be obtained to instruct exporters about the specific prerequisites needed by Nepalese Animal Health Officers. Likewise, comprehensive information on toxic plants that can eventually cause problems for newly-introduced animals should be obtained.

6. Contact should be established between the importers and the South American exporting agencies to procure information about species, prices, and other terms of reference.