
Lama (*Lama glama* L.) and Guanaco (*Lama guanicoe* M.): General perspective

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The highlands of South America form a special ecosystem with an important biodiversity. Since 4 000 or 5 000 years ago, two species of domesticated camelids have developed in this region: the llama and the alpaca, as well as two non-domesticated ones, the guanaco and the vicuña. During the Incas period, these genetic resources played an important role in the development of this ancient culture, but the protagonistic role of Camelids ended abruptly with the Spanish conquest of that South American region five centuries ago. The Spaniards initiated their colonization with the systematic elimination of the camelids and replaced them with their own domestic species, principally sheep and cattle. Along with the Spanish conquest, the mines period begins in these highlands as well; the mines' development requested not only an important quantity of camelids' meat, vegetables and natural energy but also large llama caravans, in order to transport the mines products from highlands to the coast. However, the pastoral communities in those high-risk environments have played a major role in conserving the llama, alpaca, guanaco and vicuña species. The mining activity along with human pressure on the fragile ecosystem resulted not only in an important loss of biodiversity but also, and most importantly, in the reproduction of poverty. Consequently, today like five centuries ago, the highlands of South America are characterized by three elements: poverty, soils of low quality and camelids. And it is through these elements that they try to resolve their main problem, that is poverty. The analysis of market trends, the review of the historical context of the use of native breeds, and the efforts of highlands people suggest that the rational use of South American Camelids, both domestic and wild ones, can be an economic alternative in many production systems in the South American highlands, on the condition that the regional governments in co-operation with the producers are able to find new markets with fair prices and improve the quality of camelids' products.

Keywords: llama, guanaco, highlands of South America ecosystem, poverty and economic alternative.

Summary

South America Camelids habitat

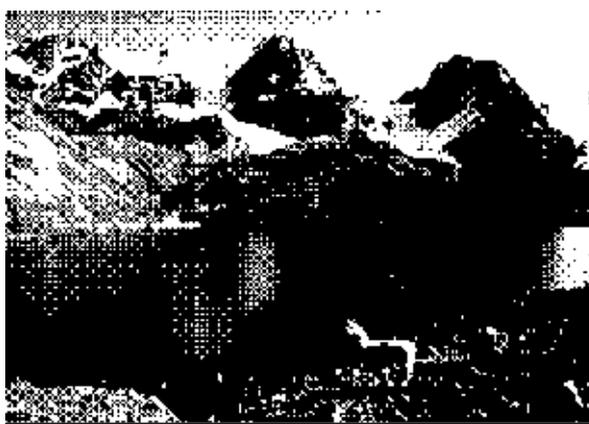
The habitat of South American Camelids is located between 2 800 to 5 000 meters of altitude in areas of Peru, Bolivia, Chile and Argentina.

The Highlands of the Andes form a special ecosystem with an important biodiversity. The temperature is usually below 0°C, the fluvial precipitation has an average of 300 mm of rain, and the natural fertility of the soil is low, characterized by Ca and Mg deficiency. Under these conditions biomass production is reduced and located to a rainfall station.

There are two species of domesticated Andean camelids, the llama and the Alpaca, as well as other two, non-domesticated ones, the guanaco and the vicuna. Both domestic and wild camelids use the same pastoral areas. All camelids of the Andes are perfectly adapted to life at altitudes above of 4 000 m, having evolved many physiological adaptations in order to produce in the highlands of South America. For example, they have an unusually high number of small, elliptical red blood cells, which offer them a greater capacity to carry oxygen. The camelids' regional population was estimated at near 5 millions, (Campero, 2004).

In the last centuries, the grazing area has been reduced as a result of the introduction of bovine and sheep. According to the opinion of many researchers, the reduction of the llama populations during the last century was about 80 % of the original population present in the last part of the 18th century.

The presence of sheep and cattle populations in the highlands ecosystem increased the degradation of natural resources. Besides, the irrational management of llamas and the low prices for its products led to the development of a poverty cycle for poor livestock keepers.



The problem

Five centuries ago, the protagonistic role of Camelids ended abruptly with the Spanish conquest of that region of South America. The Spaniards initiated their colonization with the systematic elimination of the llamas and alpacas and replaced them with their own domestic species, mainly sheep and cattle.



The European stock displaced the native camelids from every part of the region save the highest parts of the Puna where the foreign livestock had no chance of survival because of the harsh climate.

The llama and alpaca were exiled to the upper

regions of their natural territory, while the sophisticated husbandry and management systems were lost due to Spanish prejudice and lack of understanding.

Along with the Spanish conquest, the mines period begins in the highlands of South America. The mining activities requested not only an important quantity of meat, vegetables and natural energy but also large llama caravans in order to transport the mines products from highlands to the side coast.

During the last two centuries, the mines publishers developed the idea that the llama meat was "Indian meat", thus it was easy to prohibit its marketing in the urban centers. This idea was associated to the existence of sarcosistiosis in the meat. With such strategies, the miners not only could assure the meat provision but could also buy it in low prices.

Moreover, the pressure on natural resources has increased due to the high rate of human (2.9% per year) and livestock (2%) expansion. Consequently, the ecosystem presents an important rate of degradation of its forests, water and soil resources and cultural values. This process evolved along with the mines development in the highlands. The lost soil was estimated at 14 000 kg per hectare/year.

This erosive process resulted in an important loss of biodiversity and, most importantly, in the reproduction of poverty. People in those regions have only two means of production: soils of low quality and camelids. It is with these that they reproduce poverty. The llama and alpaca became animals of the poor and formed the base of a subsistence culture for the natives of the High Puna.

Bolivia is the country with the largest number of llamas in the world. There are 3 million animals, most of them bred in small family herds and graze on wild pastures. Fifty four thousand poor livestock keepers depend on camelids production.

The socio-economic framework of many people living in the Altiplano region indicates a rather alarming situation which can adversely affect its socio-cultural future. This socio-economic situation is characterized by low education levels, limited access to basic services (health, communication, energy), and soil erosion by overgrazing.

However, the camelid breeding activities and the development of a fair market for its products are the principal opportunity that many Andean people have in order to increase the family income.

Development perspectives

The use and conservation of South American camelids, both domestic and wild animals, is seen optimistically as an economic alternative to many production systems in the highlands of South America.

In this context, the management of natural resources has to take into consideration that important quantities of South-American camelid meat and fiber are sold in both local and international markets at attractive prices. This is the only way for the highlands of South America to cope with their social problems, above all poverty.

Domestic camelids

The pivotal role that llamas and alpacas played in the Incan civilization and its economy naturally elevated their status. In that historical period, very sophisticated ways of management and care were developed for both domestic and wild camelids.

The Alpacas were selected mainly for fiber production. On the contrary, the llamas were selected according to meat and traction criteria. The llama's adaptability and efficiency as a pack animal in the mountainous terrain of the Andes made it possible to link the zones of diverse altitude and to cover the great distances of the region.

The Llama

The *llama* is the most common and also the strongest of the Andean camelids. It has a slender shape and it can be found in up to 16 different colours. The llama has long legs, neck and face, and may reach a height of 1.9 meters.

As a pack animal, the llama can carry a weight of about 25 kg through long journeys, and up to 40 kg in short ones (Riera *et al.*, 1972). The llama's average weight as an adult varies between 80 to 115 kg. The newborn llamas weigh 12 kg on average. The gestation period lasts about



348 days. The female llama reaches sexual maturity at one year of age, but in South America it is usually not bred until two or three years of age. Males reach sexual maturity at about three years of age.

There are two breeds of llama traditionally recognized - the Q'ara and the Thampulli. Their fiber (technically it is called "fiber" and not "wool") is less dense than that of the alpacas, and averages about 28 microns of diameter (Riera *et al.* 1972).

The llama was selected specifically to produce a large and strong animal for packing. On the other hand, the alpaca was bred to make use of its naturally finer fiber. Today in Bolivia, the harvest of this fine fiber is the base for a significant textile industry whose products are conquering new markets.

The Andean countries, especially Peru and Bolivia, have lately recognized the importance of native camelid species for their culture and rural development.

Rediscovery of the alpaca's fine wool by the international textile market in the late 1800s led to a higher level of interest in the alpaca, consequently leading to increased management, research, and selective breeding activities. On the contrary, the llama continued its obscure existence until about 30 years ago. (Campero and *et al.*, 2004)

Research into management and breeding of the llama has been instituted and carried on in conjunction with current alpaca research. Obviously, modern transportation has reduced the importance of the llama as a beast of burden. Nevertheless, today the development of industries involved in fiber and meat production is considered pivotal for the rural development of the western regions of Bolivia and Peru.

Today in this country, great emphasis is being laid on this animal as a fiber producer, with meat as a secondary function. In 2003, the production of fiber was 720 tons. This production was 125 % higher than in 1998. The llama fleece has two components: fiber and hair.

The llama fiber is a modulated natural protein with no lanolin or grease, and is classified as a specialty fiber. The llama fiber is characterized as fine, strong, comfortable, warm and lightweight (good warmth to weight ratio), and is available in 16 natural colours, (Campero, 2002). The main negative characteristic of this fiber is its low elasticity.

The characteristics that influence most the commercial value of a fleece are fineness and color. Fineness has always been correlated with higher prices in any type of fiber. Commercial buyers and processors prefer and pay a premium for white fiber because it can be dyed.

The average length of llama fiber is 6.8 ± 1.5 cm, and it is 1.1 cm shorter than its hair. These values are smaller than those reported for llamas selected in the Experimental Station of Patacamaya in Bolivia by Rodriguez (1992), that were 8.3 ± 0.7 cm. Nevertheless, this length is adequate for directing those fibers to industrial processes, and is similar to many sheep breeds of high production of wool as the Merino, that has

a length of 8.1 cm. The general average for “dirty” fleece weight was 1.2 ± 0.2 kg. However, this information does not take into account the age of the fleece or shearing frequency (Cardozo and Choque, 1988).

Llama meat

The consumption of llama meat in the highlands of South America is traditional and in Bolivia it represents near 17 thousand tons per year. In the last years, llama meat has been exported to special markets as exotic or organic meat (Campero, 2004).

The llama meat is similar to beef in taste and texture, but the protein content is higher and its fat level is lower than beef. Moreover, the consumption of llama meat does not cause formation of cholesterol. According to the actual level of meat production quality, the llama meat producers have to improve the quality in order to maintain the new markets.

The amount of cholesterol per 10 ml of llama serum blood varies between 20 to 50 mg while the same in beef is 200 mg and in sheep 300 mg.

Hence, there are many reasons that should permit to increase the presence of this meat in both national and international markets.



Wild camelids

In the last twenty five years, the populations of guanaco and vicuña have increased slowly but constantly. This successful process was only possible thanks to the establishment of natural reserves in Argentina, Bolivia, Chile and Peru. Besides, the control of furtive hunters was important too.

The focal point in this strategy was the role of many rural communities. It is proven that hunters provide illegal markets with animals in other areas far from the natural reserves.

The international markets for guanacos and vicuñas productions were banned by the CITE Convention. Argentina, Bolivia, Chile and Peru have developed plans of rational utilization and have gained the CITES approval. Consequently, these countries can export guanacos and vicuñas products made with fiber shorn of live animals.

In many cities of South America it is possible to find illegal markets of guanaco and vicuñas products. The main illegal markets are found in Buenos Aires, La Paz, Lima and Santiago. But, in some of cases, when the illegal products such as sweaters and shawls were controlled, it was found out that the material was fiber of llama or alpaca. This does not mean that there are no illegal markets in South America.

The guanaco has the widest distribution among all the camelids, ranging from the tip of Tierra del Fuego to the Andes.

The guanaco coat consists of a double layer. One layer is made of relatively short fibers (3.0 cm to 4.5 cm) which are fine and soft, while the other one is formed by long, coarse hairs. The guanaco fiber, with approximately 16 microns average diameter, is not legally traded in international markets



unless there is expressed authorization from CITES. Each animal can provide up to 500 g of fiber annually, its colour can be described as a cream tan.

Guanacos are somewhat smaller than llamas, but in general very similar to them. They have a different ear shape from the llama, while both have a similar colour

pattern, although the intensity of the pattern varies with the region. They have a brownish upper body and neck, with the front of the limbs coloured brown, and the back of the limbs, chest, belly, and anal region whitish to cream. This white area usually extends quite high to the flanks, as high as the point of the hip. The head is usually greyish to black.

In the last five years, the low demand of the fur industry in Europe has reduced the incentive to hunt newborn animals. In the last years of 70's,



the exportation of guanaco leather reached nearly 140 000 units. In many countries, the animals are once again viewed as a national treasure to be protected and promoted.

Preservation of wild herds of the nearly extinct guanacos has become a priority, and hunting bans have been imposed and enforced.

Guanacos

Conclusions

Llamas

1. The development of llama fiber and/or meat industrial/handicraft production is vital for many countries in South America in order to accelerate their rural development.
2. New markets situated in Europe, North America and Asia have demonstrated high interest in llama fiber and meat production. If certain problems mainly associated with sanitary standards can be resolved, these areas will be potential markets.
3. Many states have been working in order to develop the necessary conditions to improve the quality of llama products. This includes credits, technology assistance, disease control, market research etc.

Guanacos

1. The guanaco, both a grazer and a browser, is quite adaptable. There are guanacos that live in one of the driest deserts in the world (the Atacama in Chile), while others live in the wet archipelago of Tierra del Fuego, where rain falls all year round.
2. On the basis of the high prices of guanaco fiber in the market, it should be convenient to continue developing an offer of fiber with homogeneous quality since the shearing of live animals. This condition should allow to resolve the problem of hunting of guanacos in order to crop their fiber.

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