

Pastoralism in the drylands of Latin America: Argentina, Chile, Mexico and Peru

J.M. Grünwaldt ^{(1)*}, G. Castellaro ⁽²⁾, E.R. Flores ⁽³⁾, C.R. MoralesNieto ⁽⁴⁾, R.D. Valdez-Cepeda ⁽⁵⁾, J.C. Guevara ⁽¹⁾ & E.G. Grünwaldt ^{(1)*}

(1) Instituto Argentino de Investigaciones de las Zonas Áridas, Av. A. Ruiz Leal s/n, Mendoza, Argentina

(2) Universidad de Chile, Av. Santa Rosa 11315, La Pintana, Santiago, Chile

(3) Universidad Nacional Agraria La Molina, Apartado 12056, Lima, Peru

(4) Universidad Autónoma de Chihuahua, Periférico F.R. Almada Km 1, Chihuahua, Mexico

(5) Universidad Autónoma Chapingo, Cruz del Sur 100, Col. Constelación, Zacatecas, Mexico

*Corresponding author: egrunwal@mendoza-conicet.gob.ar

Summary

This article discusses various aspects of pastoralism in the Latin American countries with the largest dryland areas. The topics covered include: social, economic and institutional issues; grasslands and their carrying capacity; production systems and productivity rates; competition for forage resources between domestic livestock and wildlife; and the health status of livestock and wildlife. Most grasslands exhibit some degree of degradation. The percentage of offspring reaching weaning age is low: 47–66% of calves and 40–80% of lambs. Some pastoralists adopt patterns of transhumance. In the main, pastoralists experience a high poverty rate and have poor access to social services. For many pastoralists, wildlife is a source of food and by-products. Argentina, Chile, Mexico and Peru have animal health control agencies, are members of the World Organisation for Animal Health (OIE) and have signed the United Nations Convention to Combat Desertification. Pastoral systems subsist mainly on income unrelated to pastoral farming. The OIE recognises all four countries as free from infection with peste des petits ruminants virus, and from rinderpest and African horse sickness. It is difficult to predict the future of pastoralism in Latin America because the situation differs from country to country. For instance, pastoralism is more important in Peru than in Argentina, where it is a more marginal activity. In the future, lack of promotion and protection policies could lead to a decline in pastoralism or to an adverse environmental impact on drylands.

Keywords

Animal health – Domestic livestock and wildlife – Drylands – Grasslands – Latin America – Pastoralism – Social and economic aspects.

Introduction

In this article ‘pastoralism’ refers to livestock grazing on natural grassland (1) in Latin American drylands (classified as such according to an aridity index) (2). Areas categorised by the aridity regime as xeric, hyper-arid and arid cover 12.4% of Latin America. Table I shows the size of the drylands in Latin American countries (in square kilometres and as a percentage of total land area). The aim of this article is to study various aspects of pastoralism in the four Latin American countries with the largest dryland areas: Argentina, Chile, Mexico and Peru.

Social, economic and sustainability aspects of pastoralism

Pastoral production systems may be defined as those in which at least 50% of gross household income comes from pastoralism or related activities (3).

In Argentina, pastoralists experience a high poverty rate and have poor access to social services. Families manage livestock themselves, except in Andean Patagonia, where

Table 1
Latin American countries with the largest dryland areas

Dryland surface areas and the percentage of total land area that they cover in each country

Country	Dryland area (1,000 km ²)	Percentage of total land area
Argentina	1,120	39
Mexico	635	32
Chile	281	39
Peru	190	15
Bolivia	188	18
Paraguay	63	16
Brazil	23	0.3
Venezuela	16	1.7
Colombia	11	1
Ecuador	5	2

Source: Adapted from Verbist *et al.* (2)

they often hire other farmers to care for livestock (4). Off-farm income (government jobs, casual employment in regional agribusiness, and state subsidies) makes up 60–90% of total revenues (5). In west central Argentina there are two major production systems: subsistence and commercial (6). Under the subsistence farming system, the main source of livelihood is goat production, where the farmer lives on the farm, provides all or most of the labour required, is low-skilled and attaches no importance to plant resource conservation. Under the commercial production system, in line with Snyman's principles of sustainability (7) the farmer lives away from the farm, pays employees to manage it, and farming is only one of the farmer's economic activities. Virtually all commercial farms produce only cattle. There is a direct relationship between land tenure and investment in infrastructure. Commercial farmers are progressive and provide for plant resource conservation.

The predominant production system in Mexico is calf breeding under communal and private systems of land tenure. Intensive and semi-intensive systems, dedicated to fattening, are associated more with private tenure. Industrial farms use grasslands in rotational grazing but with little sustainable management of natural resources.

The pastoralists of northern Chile (high plateau), from the Aymara and Atacameño ethnic groups, live a life of hardship, experience high poverty rates and have poor access to social services. Their income derives from marketing wool and selling animals not intended for household consumption. In most cases it is women and children who care for livestock. Many families and young people migrate to the cities, creating informal settlements in the suburbs and depopulating the Andean foothills and high

plateau, leading to population ageing. In the Coquimbo region, herds are owned by some 6,000 smallholders; less than 5% of goats are owned by medium- and large-scale farmers. Smallholders contribute significantly to goat milk production. A large number of smallholders occupy around 1 million hectares designated 'agricultural communities' (organisations of poorly educated farmers united by ties of kinship and friendship in common ownership of an undivided land area). These lands exhibit advanced stages of erosion, partly as a result of overgrazing (8). There is little likelihood of reversing this situation in the short or medium term because there tend to be no public policies specifically for this sector. In the Magallanes region, even though the production system is extensive and retains the key features of pastoralism, owners of livestock enterprises tend to have a fairly good standard of education and living, offsetting the low income produced per unit area by owning large areas with many animals. Such farmers do not live on the farm themselves but instead employ a few farm workers who live as pastoralists.

In Peru, common lands are administered as cooperative farms or managed by individuals with usufruct rights (rights to use the land and to prevent others from using it). Cooperative farms occupy less than 5% of the land, with the remainder assigned to individuals. Cooperatives have the right to farm the land as long as community obligations are met. On average, cattle, sheep and camel herds on cooperative farms do not exceed 1,500 ewe equivalents. These farms are managed by a community-elected livestock committee and revenues are used for livestock and pasture maintenance, administration, and protecting the community's rights and interests. Pastoralists who hold individual usufruct rights keep mixed herds of 20–61 sheep, 16–97 alpacas, 3–11 llamas, up to seven cattle and between one and two draught horses. The number of herds and their composition are regulated by charging fees for use of pasture, with higher fees for cattle and horses than for sheep. If the herds are small they fail to generate enough revenue to cover household expenses, so farmers are obliged to form groups of four families to take turns in caring for animals or else to jointly carry out collective tasks. This solidarity enables them to supplement their income with trade or mining jobs. In most cases herds are small, as is the land area they occupy (9).

It is not easy to assess the future of pastoralism in the countries under study because the situation differs from one country to another and is closely linked with the importance of such practices in the various societies. In Peru, where pastoralism is more important and higher-profile, the future appears to be clearer and the sector is expected to benefit from political protection and/or promotion. In Chile and Argentina, pastoralism is a marginal, subsistence activity that could go into decline if no protection policies are implemented (4).

Grasslands, prescribed burning and water points

Most grasslands exhibit some degree of degradation. Overgrazing, wildfires, oil operations, mining and the removal of wood for fuel are factors that have triggered the degradation process.

For ecological and economic reasons, prescribed burning is used for some plant communities. While it is a widespread range management practice, it does not come without risk. In 2013, there were 641 wildfires in the Argentine Monte region, affecting 98,000 hectares. Of these, 137 were caused by negligence, 303 were intentional, 57 were natural and 144 stemmed from unknown causes (10). Mexico experiences around 8,900 wildfires every year: 27% in forested areas and the remainder in scrub and grasslands (11). In Chile, most wildfires are anthropogenic, although prescribed burning is not commonly used to control vegetation; no wildfires have been recorded over the past five years, except in the Coquimbo and Magallanes regions, affecting 561 hectares and 3,590 hectares respectively. In Peru, prescribed burning is prohibited in protected areas but is common in farming communities, where it is carried out at varying intervals depending on the region, the average being every two to five years (12).

Drinking water for livestock – at natural and artificial water points – comes from harvesting rainwater, groundwater and, in the case of Argentina, Chile and Peru, snowmelt from the high Andes. These water sources are channelled in different ways to ensure a supply. In Argentina, there is one livestock water point for every 2,030 hectares of natural grassland, or 47 animal units (AU) per water point (13).

Number of domestic livestock and wildlife: stock-carrying capacity

In 2002, Argentina's drylands were home to cattle, small ruminants, horses and South American camels totalling 2.6 million AU, or 6.7% of the country's total. For this estimate, 1 AU was considered to equal one beef cow of 454 kg live weight (98.4 kg metabolic weight), with calf at foot. The AU equivalents for other species are:

- sheep and goats: 0.16 AU
- horses: 1.2 AU
- donkeys: 1.1 AU

- llamas: 0.23 AU
- alpacas and vicuñas: 0.18 AU.

The average density of livestock and wildlife in Argentina's drylands is estimated to be 2.3 AU per km², with a stocking density of 43.7 hectares AU⁻¹ (14).

In 2012, Mexico's drylands were home to 13% of the country's total population of cattle, 20% of its sheep and 37% of its goats (15). The area required to sustain 1 AU for one year, without degradation of vegetation, varies from 5.1 hectares AU⁻¹ to 61.2 hectares AU⁻¹ (16).

According to the 2007 agricultural census, Chile's drylands (17) were home to 1.6% of the country's cattle, 64.6% of its goats, 22.6% of its sheep, 89.5% of its donkeys, 70.6% of its mules and 10.8% of its horses. Ninety-five percent of Chile's vicuña population is concentrated on the high plateau (*altiplano*) of the Arica and Parinacota region (18), and 81.8% of its guanaco population is found on Isla Grande de Tierra del Fuego (19). The stock-carrying capacity is less than 0.1 AU hectare⁻¹ year⁻¹ in the tundra region of the high plateau AL; up to 0.3 AU hectare⁻¹ year⁻¹ in summer mountain pastures (*veranadas*); 0.1–0.2 AU hectare⁻¹ year⁻¹ in xeric savannah; and an average 0.6 ewe equivalents hectare⁻¹ year⁻¹ in Patagonian tussock-grass prairies (*coironales*) (20, 21, 22).

In Peru, the current stocking rate is 0.3 AU hectare⁻¹, compared with the recommended 0.2 AU hectare⁻¹, indicative of high grazing pressure. In 2010, Peru's livestock population on the 8.1 million hectares of arid grasslands that are suitable for grazing (accounting for 40% of all grasslands) was equivalent to 2.4 million AU. More than 80% of the cattle, small ruminants and camels are concentrated in the Puna grassland ecoregion at altitudes over 3,800 metres above sea level (masl) (23).

In recent years, the trend in the dryland livestock population has differed from country to country. In Argentina, between 1988 and 2002, the cattle and goat populations increased, while the sheep population decreased. In Mexico, between 2005 and 2012, the cattle and sheep populations increased, while the goat population remained virtually unchanged. In Chile, between 1997 and 2007, the number of all species increased, with the exception of sheep, which declined by 5%.

Production systems and production rates

Argentina: Cattle breeding is characterised by low investment in infrastructure and little use of technology;

17% of farmers use natural mating and 8% diagnose pregnancy by rectal palpation. Continuous grazing predominates, using mainly European and zebu breeds and their crosses. The weaning rate across the drylands as a whole is 47% (14) but, with a higher level of technology, it rises to 66%, with meat yields of 11–12 kg hectare⁻¹ year⁻¹. In Patagonia, sheep's wool is the most important production sector, using mainly the Australian Merino breed. Weaning ranges from 0.4 lamb ewe⁻¹ to 0.8 lamb ewe⁻¹, with an average wool yield (≈ 20.5 micrometres [μm]) of 3.6 kg animal⁻¹ (24). Goats are produced on a subsistence basis, with the farmer living on the farm and providing all or most of the labour required. Although the system is geared primarily to meat production, goat hair from the native (Criollo) and cashmere breeds is important too (4). In indeterminate breeds, weaning is 0.8–1.6 kid goat⁻¹ and, in the Angora breed, it is 1.1 kid goat⁻¹. Mohair production from crossbreeds varies from 0.9–1.2 kg goat⁻¹, potentially rising to 5 kg goat⁻¹ in the Angora breed.

Mexico: 49% of cattle are of the Criollo breed, 27% are European breeds, such as Aberdeen Angus, Charolais or Hereford, and 24% are crosses between Criollo and European breeds (25). The genetic diversity and prevalence of Criollo breeds influences productivity indicators. Farms in northern Mexico using the traditional production system have a stocking rate of 10–12 hectares AU⁻¹, 48–52% of their calves are weaned by the time they weigh 130–150 kg, their cows are aged 36–42 months at first calving and the calving interval is 600–620 days (26). Sheep production is a side line. The main breeds for kid production are Anglo-Nubian, Granadina, Alpine and Criollo, and they are sold at 8–40 days of age at a live weight of 6–12 kg.

Chile: Extensive farming systems predominate, with low production rates, little investment in infrastructure and limited use of technology. In northern Chile (high plateau), continuous grazing is used and the stock-carrying capacity is exceeded. Fertility rates are low: 0–60% in alpacas and 60% in llamas, with an estimated productivity of 8.5 kg of meat hectare⁻¹ year⁻¹ and 2 kg of alpaca wool (average diameter 22.5–26.5 μm) hectare⁻¹ year⁻¹; in vicuñas, the annual production of super-fine wool (≈ 13.7 μm in diameter) is 199 g per animal (27). In the Coquimbo region, kids are obtained with a live weight of 20 kg at 3–4 months of age (28). Criollo goats produce 1.5 litres of milk day⁻¹ at the peak of lactation, which lasts 150 days with a maximum yield of 120 litres per milking. Sheep production is the most important sector in the arid south, where the Corriedale breed predominates on continuous grazing with a stocking density of one ewe equivalent hectare⁻¹ year⁻¹, which exceeds the stock-carrying capacity. The flock reproductive rate is 65–70%. The average weaning weight of lambs is 26 kg, with a meat yield of 18 kg hectare⁻¹ year⁻¹ and a wool yield of 3.6 kg hectare⁻¹ year⁻¹ (29).

Peru: Production systems are mainly extensive with continuous grazing and, in most cases, the stock-carrying capacity is exceeded. Investment in infrastructure is low and there is limited use of technology. Respective production rates for Criollo cattle and sheep are as follows: birth rates of 50% and 70%; birth weights of 22 kg and 3 kg; weaning weights of 80 kg and 15 kg; and mortality rates of 10% and 50%. Under improved conditions with proper management practices, these cattle and sheep parameters improve significantly, with respective birth weights increasing by 40% and 14%, birth weights by 36% and 33%, and weaning weights by 25% and 33%. A significant decrease in mortality rates has been seen in both species (30).

The aforementioned production rates for the four countries correspond to existing production systems in areas with natural pastureland classed under the aridity regime as xeric, hyper-arid or arid.

Transhumance and grazing on public and common land

Argentina: Private ownership predominates, with land titles or occupants holding recognised rights, along with tenant farming and sharecropping systems. There are public lands for community use and some aboriginal groups have collective land titles. Lack of title and undivided estates are land tenure problems that undermine legal certainty, access to credit, land improvements and long-term planning. A successful scheme has been implemented in Mendoza to settle *puesteros* (caretaker farmers running part of a large ranch) and their families on non-irrigated public land, in abandoned buildings and on land owned by adverse possession (31). Some pastoralists adopt patterns of transhumance. In Argentina and Chile, summer pastures and winter pastures (*invernadas*) are used, with cross-border movements between the two countries. In Argentina, summer pastures are located in the highest valleys (at 1,200 masl in Patagonia and 3,000–4,000 masl in the Puna ecoregion). Winter pastures are situated in the plains and lowland valleys (800–1,200 masl in Patagonia and 2,000–2,800 masl in the Puna ecoregion).

Mexico: Overgrazing is a serious problem on communal grazing land. Although decisions regulating the stocking rate are taken in meetings of communal landowners, they are rarely complied with. Transhumance is practised with cattle and goats, especially on communal grazing land.

Chile: The private ownership system predominates and this is the system used for sheep production in the Magallanes region. In the high plateau, grazing usually takes place in national parks, although Aymara communities hold titles

of ownership of these sectors, in some cases subject to litigation. In the Atacama and Coquimbo regions, while some grazing takes place on public lands, increasing use is made of private land. In the Coquimbo region, 34% of the goat population is transhumant. In the Magallanes region, transhumance is regularly practised with sheep. To a lesser extent, camel and sheep herds from the Andean foothills of northern Chile graze on high-altitude grasslands during the summer rainy season.

Peru: No public land exists as such, but there are conservation areas that are designated by the State in consultation with communities. There are ancestral property rights to most grazing lands, established during the colonial period and protected by constitutional rights. Year-round grazing is enshrined in ancestral property rights. During the rainy season, livestock remain in lowland areas where rainfall is lighter, and during the dry season they graze highland areas where water is relatively abundant (30).

Indigenous and exotic wildlife of economic interest and competition between wildlife and livestock

Argentina: The vicuña (*Vicugna vicugna*), guanaco (*Lama guanicoe*) and llama (*Lama glama*) are a source of food and byproducts, with management plans in place for preserving and utilising them. Guanacos and domestic livestock both eat rare plant species, so there is a risk of species loss from overgrazing. The introduction of sheep has contributed to a decline in these plant species. Ninety-five percent of llamas are owned by smallholders concentrated in north-western Argentina. Although introduced species such as the European hare (*Lepus europaeus*) and red deer (*Cervus elaphus*) are a valuable economic resource (meat, hides, fibres, byproducts, sport hunting), they compete for food with livestock and damage crops (24).

Mexico: In compliance with Mexico's General Wildlife Law, hunting tourism is practised in designated areas known as Environmental Resource Management Units (UMA in Spanish), which are designed to ensure the sustainable use of wildlife resources. Hunting tourism involves several bird and mammal species and is a significant source of annual revenue.

Chile: Vicuñas and guanacos are protected by law, hunting them is prohibited, and systems for the sustainable use of their products, including wool, meat and hides, have been

proposed (27, 32). The vicuña is important in northern Chile, and the guanaco is important in southern Patagonia; both compete for forage resources. The taruca (*Hippocamelus antisensis*), or north Andean deer, interacts with domestic livestock and damages crops in the Andean foothills of northern Chile. With respect to introduced wildlife, in northern Chile, wild donkeys (*burros*) cause conflict in coastal areas and the Andean foothills, as they damage crops and compete with other species (G. Castellaro, personal communication, 2015). Hares (*Lepus capensis*) and rabbits (*Oryctolagus cuniculus*), which are distributed nationwide, cause damage, and hunting of both species is permitted throughout the year.

Peru: Wildlife is of cultural and economic value to rural communities, which use it to supplement household income. Some of the commonest species are vicuña, northern viscacha (*Lagidium peruanum*), chinchilla (*Chinchilla chinchilla*) and taruca. There are no effective control mechanisms, except in the case of vicuñas, which the central government has controlled through vicuña committees operating within communities. These state-supported committees are allowed to install enclosure systems (fenced areas of 500–1,000 hectares) or systems for managing vicuña in the wild (33). In enclosures, poaching is rife and there are no proper control systems. In free-range management systems, the implementation of management and capture programmes has led to a situation in which abundant forage is available and competition with domestic herbivores is limited or controlled. In both livestock and range management systems, predation by the fox (*Pseudalopex culpaeus*) and puma (*Puma concolor*) poses a threat to livestock. Wild birds, such as the partridge (*Perdix perdix*), are freely exploited, except in protected areas.

The regulation of tourism and hunting in pastoral lands provides opportunities for regional development, especially in some rural communities, and encourages related service industries, such as travel, tourism and hospitality. The downside is that intermediaries and other stakeholders sometimes take the lion's share of the benefits. Demand for rural tourism in pastoral areas should therefore be monitored officially in order to help pastoralists to derive more direct benefits from the contribution of pastoral systems to tourism. Enhancing the organisation of pastoralists could increase their bargaining power and improve the distribution of income from tourism. There is evidence to suggest that Mexico's hunting tourism generates significant revenues (US \$155 million a year), although no information is available to ascertain whether pastoralism is more economically advantageous than tourism, or vice versa.

Livestock and wildlife health

Argentina, Chile, Mexico and Peru all have agencies responsible for preserving and optimising their animal health status: Argentina's National Health and Agrifood Quality Service (SENASA), Mexico's National Health, Food Safety and Agrifood Quality Service (SENASICA), Chile's Agriculture and Livestock Service (SAG) and Peru's National Agricultural Health Service (SENASA). The World Organisation for Animal Health (OIE) recognises Chile and Mexico as countries free from foot and mouth disease without vaccination; it recognises Argentina and Peru as free countries with vaccination, although both countries contain free zones without vaccination. All four countries are free from infection with peste des petits ruminants virus, and from rinderpest and African horse sickness. Argentina is free from contagious bovine pleuropneumonia and has negligible risk status for bovine spongiform encephalopathy, as do Chile and Peru. In domestic livestock, a number of diseases, infections and infestations on the OIE List of notifiable diseases (34) are exotic to – or have never been described in – these countries, whereas others, such as bovine brucellosis (*Brucella abortus*), are endemic. Chile and Peru are free from anaplasmosis and babesiosis. Tuberculosis and rabies are diseases confined to one or more zones in all four countries.

Rabies in wildlife is confined to one or more zones of all four countries. Other diseases, such as bovine brucellosis (*B. abortus*), Aujeszky's disease (except Chile), bovine viral diarrhoea, trichinellosis and bovine tuberculosis are non-clinical infections which, in some cases, have been confirmed and, in other cases, are suspected or no information is available about them (34). Failure to confirm some wildlife diseases should not rule out their existence, as their occurrence in domestic livestock would suggest that some wildlife species are reservoirs of these diseases. Factors such as the climate and extensive production system in drylands have led to certain diseases – although present – being found at a lower prevalence than in other areas with higher rainfall.

Institutional aspects

Argentina, Chile, Mexico and Peru signed the United Nations Convention to Combat Desertification in 1994. They all have bodies considered as environmental enforcement and monitoring authorities, which work to improve overall social welfare through the ongoing conservation of natural resources, biodiversity and environmental services. While there tend to be no government agencies dedicated specifically to the study and improvement of pastoralism in drylands, Argentina, for instance, has national legislation to promote, modernise and improve sheep and goat production systems (5).

A common shortcoming is lack of up-to-date livestock census data. The latest censuses date back to 2002 in Argentina, 2007 in Chile and Mexico, and 2010 in Peru. Figures are also lacking on the number of pastoralists in operation over time, which would allow the evolution of these figures to be predicted.

Final considerations

Pastoralism plays an important role in improving the dietary quality of dryland inhabitants because meat is rich in such nutrients as essential amino acids, iron, vitamin B12, zinc and phosphorus. In some parts of Latin America's drylands, such as pastoral areas of Malargüe in southern Mendoza province (Argentina), there is no access to protein substitutes or plant micronutrients, so the diet is primarily meat-based.

Government policies should be developed to help to reverse degradation of the grassland ecosystem. In particular, there should be policies – coordinated by state institutions – to control the use of public land by means of appropriate stocking densities and controlled grazing. Grassland degradation could be mitigated by replanting with water-stress-tolerant forage species that provide strategic supplements during critical nutrition periods. Pastoral systems will become more sustainable as the capacity of farmers is enhanced through credit and technical assistance focused on the conservation and proper management of natural resources. Tourism and hunting provide an opportunity for developing pastoral communities, although official monitoring and control measures should be provided to improve pastoralists' use of these revenues. Government action is needed to promote pastoralism in areas where it is a marginal activity. In the future, the problem of land tenure could be resolved by promoting empowerment of farmers to build partnerships and improving productivity to enable them to increase their revenue *in situ*.

A shared shortcoming of Argentina, Mexico, Chile and Peru is the lack of up-to-date livestock census data and information on the contribution of pastoralism to regional economies. Pastoral systems subsist mainly on income unrelated to pastoral farming. There tend to be no government agencies dedicated specifically to the study and improvement of dryland pastoralism. Furthermore, there has been little applied research in the field of pastoral production. A misperception of pastoralists' activities has led to technical assistance being designed mainly for systems of settled crop and livestock production.

Agencies responsible for animal health should pursue their efforts to control and eradicate diseases of domestic livestock and wildlife.



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