Land Use in the Andes in the Colonial Period

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The scientific concept of the Anthropocene is still under construction and entails a new way of understanding the impact of humans on the biosphere. Currently, signs such as the increase in the planet's average temperature and alterations in the functioning of ecosystems lead us to reflect on the consequences of human activities on the environment. Thus, the use of fossil fuels or the conversion of natural habitats into agricultural land has had a negative impact on the biosphere, resulting in the loss of biodiversity or global warming. This impact is not only a current problem but has been occurring throughout the world's long history. It is from this perspective that this article seeks to unravel the impact that European colonization had on the Andean region.

The Andean space crosses a vast territory from the páramos and valleys of Colombia and the western region of Venezuela to the desert and high mountains of northern Chile and Argentina, with an approximate length of 7,000 kilometers. The vast belt of the Andes Mountains has shaped the life of human beings for thousands of years, from the arrival of the first *homo sapiens* dedicated to hunting and gathering to the more than fifty million citizens living in the region today. Historically, it can be noted that the mountain range and its western and eastern slopes were the cradle of some of the most important cultures of the continent, which can be illustrated in the traces of the route that remains to this day of the so-called *Qapac Ñan* or royal road of the Incas.

Geographic space, transformed into territory by human action, occurs at different scales and largely explains the characteristics of each society through a triple command of territory: as the basis of livelihood, as the foundation of social organization, and as the support of hegemony (Soux 2012). This paper will analyze the first perspective, addressing the changes and permanence in the social use of land during the colonial period, taking into account the context of the Andean region from what is now Colombia to northern Argentina and Chile.

The starting point will be the land use situation prior to the arrival of the Spaniards in the region, using the geographic-ecological classification of Carl Troll (1980) and Olivier Dollfus (1981); later, the impact of the conquest will be described and analyzed not only in relation to the change of concepts and practices on land

ownership and use, but also to the maintenance of forms of social organization that allowed the preservation of Andean forms of food resource use. The third part of this chapter will focus on the analysis of the ecological articulation between the use of Andean products and the introduction of new agricultural and livestock resources; finally, the changes produced in land use in the new regions "colonized" in the eighteenth century in the foothills will be addressed.

The Andean Space in History: Geosystems and Cultures

Before addressing the issue of changes and permanence in land use during the colonial period, it is important to understand the ecological characteristics of the native cultures that experienced these changes. For this purpose, this chapter takes into account the study by Olivier Dollfus who, in his book *El reto del espacio andino* (1981), classifies the geosystems present in the intertropical region, a perspective essential for understanding the issue of land use. The geosystem or geographic system is understood here as the combination of a *géome*, i.e. a fragment of the earth's surface, and a biocenosis, i.e. the set of living communities that occupy it and on which anthropic action exerts its effects. For example, a geosystem could be the puna or high-altitude grass steppe. Dollfus, like Carl Troll (1980), divides the Andes into two ecologically distinct regions: the equatorial Andes and the tropical Andes. The former are located in what is now northern Ecuador, Colombia, and western Venezuela, and the latter are located south of the equator in what is now Ecuador, Peru, Bolivia, and the north of Chile and Argentina. In this vast area, defined as the intertropical Andes, the geosystems depend on factors such as latitude, altitude, or thermal gradient and the slope on which they are located in relation to the mountain range.

In general, the equatorial Andes are characterized by large valleys with altitudes ranging from around 1,000 meters above sea level, such as the Cauca valley, to almost 3,000 meters above sea level, such as the Hunza valley. While various sierras range in altitude from 700 to more than 5,000 meters, there is a narrow cordillera about 250 km wide with volcanoes of up to 6,000 meters above sea level in Ecuador. In the latter region, an arid western slope and a humid eastern slope begin to differentiate. The tropical Andes are characterized by a wide mountain range with peaks of more than 6,000 meters above sea level surrounding a plateau or Altiplano. There is also a marked contrast between the western desert slope and the eastern jungle slope.

In these large regions, marked by latitude, altitude can be added, which is fundamental in determining the climate. In the equatorial Andes, there is an archipelago model made up of mountain ranges and valleys of different altitudes, generating a diversity of landscapes ranging from cold páramo geosystems to warm valleys. In contrast, cold steppe geosystems cover almost half of the surface in the tropical Andes. These characteristics were important at the time of European colonization,

which had to adapt to the specific ecological conditions. The main characteristic of the entire region is verticality. With the exception of the great high plateau and the bottom of the valleys or basins, the rest of the territory is long slopes, some of them very steep, where runoffs and erosion are common. These valleys, except those that were extremely wet or dry, were transformed from very early on for the agriculture of corn and other plants. To prevent runoff, techniques such as the construction of agricultural terraces were developed.

In the tropical Andes, the geosystems influenced by altitude are known as ecological floors and assume specific names that in some cases identify the people who lived in them. Among the cold geosystems are the *puna* and the *suni*. The first was used by hunter/gatherers and later by camelid herders and farmers, although the latter had to adapt to frost and poor soil fertility. The *suni* (Quechua) or *taypi* (Aymara) is the intermediate strip between the puna and the temperate geosystems; it is found on the shores of Lake Titicaca or in the "headwaters" of the valley; the exploitation of both was ancient, varied, and intensive. At a lower altitude and with a temperate climate is the densely populated *Quechua* floor, where the Quechua-speaking Inca culture developed; on this floor, the land was adapted through the construction of terraces. Below the Quechua floor are the *yunca* or yungas floors, dry on the western slope and humid on the eastern slope; these geosystems vary from warm to hot and were used by the native peoples for the extraction of timber and certain specific products such as coca, yucca, and medicinal plants. In the dry yungas, a great variety of chili peppers and peanuts were cultivated during the pre-Hispanic period. The final geosystem is the Pacific coast desert. Of the coastal ecosystems, the most populated since pre-Hispanic times were the irrigated valleys, where cultures such as Lima, Paracas, and Mochica flourished, characterized by the use of complex irrigation systems and an organized use of water.

These were, broadly speaking, the landscapes that Europeans encountered upon their arrival in the Andean area. The production possibilities in the different ecological levels and geosystems were taken advantage of by these men who, in turn, brought their own agricultural and livestock culture. Over the next three hundred years, there was an articulation between the Andean cultures and the new colonizers, which gave rise to new forms of land use, the adaptation of new plants and animals, and new forms of property, ultimately giving rise to a new rural culture.

The Impact of the Conquest and Changes in Land Ownership

There are several elements to take into account when analyzing the impact of the arrival of the Spanish army in the Andes region in relation to land ownership and use. These include the following:

- The demographic impact on the Indigenous population that left large territories practically unpopulated.
- The dismantling of the forms of control and domination of the population by the Incas and other hegemonic groups.
- The difference in the ways of life and control of space between the native peoples and the European newcomers.

Regarding the demographic impact and the emptying of the territory, the importance of regional studies due to the impossibility of carrying out general studies should be noted. Thus, for example, according to Kalmanovitz (2015), the Spanish conquest in the region of Colombia was devastating for the Indigenous peoples. The population around 1535 to 1540 stood at about 3 to 4 million. Twenty-five years later, this figure fell to an approximate 1,260,000. Moreover, this crisis lasted until the seventeenth century in some regions such as Tunja, where Muisca communities lived.

Tab. 1: Demographic Decline in New Granada. 1535 and 1560

Region	**1535–1540**	**1560**
Atlantic Coast	500,000	60,000
Valle del Cauca	1,200,000	160,000
Upper Magdalena	300,000	120,000
Magdalena Slope	400,000	180,000
Central Highlands	1,200,000	400,000
Southern Highlands	400,000	140,000
Marginal areas (Llanos, Chocó)	200,000	200,000
Total	**4,000,000**	**1,260,000**

Source: Kalmanovitz (2015).

In relation to the territory previously occupied by the Tahuantinsuyo, it has been possible to establish that, based on the Inca imperial *quipus*, the number of inhabitants would have been approximately ten million at the time of the Cajamarca encounter. Thirty years later, the demographic situation was as follows:

Tab. 2: Population in the Viceroyalty of Peru by Province in the Sixteenth Century

Province	**1561**	**1586**	**1591**
Quito	240,670	118,141	24,380
Cuenca	1,472		
Zamora	11,222	8,100	685
Loja	9,495	16,000	2,849
Jaen	10,000	11,397	2,654
Puerto Viejo	2,297	4,102	1,253
J. Salinas		40,000	
J. Moyobamba		3,993	678
Piura	16,617	12,818	3,537
Guayaquil	4,742	7,355	2,198
Trujillo	215,000	79,670	17,597
Chachapoyas	58,397	40,311	7,045
Huánuco	118,470		18,089
Los Reyes	99,601		30,708
Jauja	17,248		
Huamanga	112,520	153,495	26,054
Arequipa	201,830	93,975	19,794
Cuzco	267,000	400,075	74,977
La Paz	150,655	131,189	27,837
Charcas/La Plata/Potosí	232,800	144,436	31,671
Chucuito	81,698	17,779	13,364
TOTAL	**1,851,734**	**1,282,836**	**305,406**

Source: Author's own elaboration based on Contreras (2020: 545).

Throughout the Andean region, the Spanish Crown planned visits to contrast and update information. In relation to resources, visits such as those of Huánuco (1562), Chucuito (1567), or the general visit of the Viceroy Toledo (1570) sought, in addition to demographic numbers, information regarding the "number and amount of land planted with corn, potatoes, quinoa, cotton, or other products, and the number and type of livestock; in short, all the information necessary to establish the tax quota as a whole" (Cook 2002: 18).

According to Mamani, the visits, which could be general or particular, also served to define the territorial space "since delimiting the properties to be owned by Spaniards and Indians contributed to the separation between the Republic of

Spaniards and the Republic of Indians" (2012: 71). The causes of the demographic crisis have been varied; in addition to Indigenous exploitation, Nicolás Sánchez Albornoz (2015) emphasizes the issue of diseases and points out that the first smallpox epidemic in Peru occurred in 1524–1526 before the arrival of the Spaniards; typhus followed in 1546, influenza in 1558–1559, the plague in the following two years, and the great epidemic of 1585–1591 in which smallpox, measles, typhus, and influenza were intertwined.

From the present interest in land use, the importance of these early visits to the ancient Inca territory to carry out a policy of land appropriation and the consolidation of private forms of property can be noted. In the case of the Andes, the demographic decline in part allowed the establishment of policies such as the reduction into villages and the consolidation of haciendas or *chácaras* stemming from the idea of the existence of vacant lands. In the case of present-day Colombia, according to Urrego Mesa (2014), the impact depended on the demographic density. Thus, the highlands with a high-density and fundamentally agrarian population were settled primarily by agricultural units. This region was in the process of social hierarchization and had a political organization based on chiefdoms sustained by tribute. In contrast, the lower and warmer lands with less population developed livestock activities.

From the social point of view, the Spanish conquistadors, who brought with them other ways of thinking about property and work, modified the life of the region's native inhabitants, either by establishing new forms of land tenure or by modifying the meaning of others that were maintained. For example, Nathan Wachtel (1976) points out what the dismantling of the Inca political and social system entailed and how the principle of reciprocity was disrupted. Thus, although the legal fiction maintained a pact system with the King and his representatives through tribute payments in exchange for the possession and ownership of the land, the lands of the Sun, the Inca, and the community were rethought as royal lands, belonging to the king as sovereign, given as a gracious concession from the Crown to the Indigenous tributaries.

Royal Lands, Grants, Reductions, and Compositions

In order to understand changes in land use and land tenure, it is important to distinguish three forms of land control. The first is the control of the territory, which manifested in seizing possession of territories in the king's name, thus creating a relationship between the sovereign and the subject. The second was population control, as seen in the encomienda, which placed the Indigenous population in a dependent relationship, delivering a tribute (in labor, goods, or money) in exchange for evangelization. Although it was not directly related to land use, it did embody a

form of usufruct of Indigenous labor in favor of the encomenderos. Finally, a third form of control was that of the land, in the sense of ownership of its use. In many cases, the encomienda and land ownership were intertwined because, although laws prohibited encomenderos from having a farm near where they had their encomendado (entrusted) Indians, in practice, encomenderos acquired nearby lands through grants and took their encomendado Indians to work on them (Soux 2012: 33).

At the same time, it is important to establish the legal relationship between the king's dominion over the territory and land ownership. According to the legislation, the *tierras realengas*, which had been consolidated in Castile as the king's own, both as lord and monarch, were also recognized in America. As Juan de Solórzano y Pereira noted in his work *Política Indiana*, all lands, waters, mountains, and pastures were considered to be the king's "outside of the lands, meadows, pastures, mountains, and waters that by particular grace and mercy are granted to the cities, towns, or places of the Indies or to other communities or individuals" (Bonifaz 1956: 162). Thus, land ownership was conceived as a gracious concession by the Crown or the King.

From these gracious concessions arose the concept of grants (*mercedes*), which are considered to be the Spaniards' first form of private land ownership. The grant was a cession (*entrega*) of land by the King to the conquerors or those who requested it, either for life or in perpetuity. The property acquired in this way was established with the occupation by the beneficiary, which shows, precisely, the existing relationship between territorial domain and the conformation of a private and individual property, whether in the form of a hacienda or *estancia* (Glave 2014).

There is no general study on the expansion of grants in the Andean area, although data from Peru, Charcas, Quito, and New Granada show that this gracious transfer of land had taken place since the sixteenth century and affected royal lands in regions of agriculture and livestock where it was feasible to introduce plants and animals of European origin. The grants also characteristically accompanied a process of border expansion, as was the case in Valledupar (Colombia) with the expansion of cattle ranching, which lasted until the eighteenth century (Sánchez Mejía 2012).

In the case of Charcas and Peru, grants were exclusive to the sixteenth century and were generally found in areas close to the cities where farms were established. However, in places such as the yungas of La Paz or Cuzco, large extensions were given as grants. In the region of Quito, for its part, land grants were more widespread; between 1583 and 1587, a total of 264 grants were awarded. According to Donato A. Gonzáles, "as the encomienda became scarce as recompense after 1550, land constituted the most useful reward. It is from this perspective that the grant was the first mechanism for accessing land ownership" (1998: 198).

The cession of grants led to a series of abuses committed especially by the *cabildos*. The Viceroy Toledo responded to this by establishing that the ownership of these lands, which had previously been Indigenous property, should be consolidated through a *visita de tierras* (land visit). In compliance with this, beginning in 1580, vis-

itas de tierras were carried out throughout the viceroyalty. This was a two-pronged approach; on the one hand, land was divided in favor of the Spaniards to consolidate their property; on the other hand, it was distributed at the request of the Indigenous communities through their authorities. In both cases, titles were given out, thus settling the issue of land ownership.

With the visitas de tierras there were also abuses by the conquistadors who exploited, on the one hand, the decrease in the Indigenous population and the existence of vacant lands and, on the other hand, the reduction of the Indigenous population into Indian villages, which entailed the concentration of the dispersed population and, therefore, more vacant lands. In this way, the visit, through the act of distribution, recognized the Indigenous people's ownership of their lands, but only those that were considered in production; the rest was given, through a composition of lands, to the Spaniards who requested them. This could lead to lawsuits, as in the case of the Siporo hacienda (Potosí) between Diego de Robles Cornejo, who argued that the lands were vacant (*baldías*), and the Potobamba Indians, who demonstrated that the lands were part of their *ayllu* (Crespo et al. 1984).

The visitas de tierras took place throughout the seventeenth century and even up to the beginning of the eighteenth century, with characteristics that differed depending on the region. In this way, for example, the visit of Geronimo Luis de Cabrera to the Altiplano region north of Titicaca in the mid-seventeenth century resulted in the return of lands to the communities and *ayllus*, whereas Juan Bravo del Rivero's visit at the beginning of the eighteenth century, covering more or less the same area, served to consolidate new haciendas to the communities' detriment.

With regard to the lands owned by Spaniards or Creoles, it is important to point out that the lands given in grants were used for both livestock to supply the cities' meat production and agriculture to diversify production with cereals and other products. In some cases, the cattle ranches gradually gave way to larger estates and farms owned by small landowners, as was the case in Yamparaez, Bolivia (Escobari 1995) or the broad Colombian valleys. In these haciendas, depending on the region and production, different forms of labor were employed: slave, servile or *yanaconaje*, free wage labor, or peonage. Production could be managed directly by the owners or by third parties, either through leasing or sharecropping.

Finally, it is important to note that the above were not the only forms of land appropriation or cession in the Andes, since, as Karen Spalding points out, the purchase and sale of land and leasing were also common forms that eventually also led to the development of individual properties. In these transactions, the Indigenous people were not left out, especially the *curacas* or *caciques*, who entered the land market at an early stage; the colonial authorities themselves also took part, taking advantage of their power to appropriate the most productive lands (Spalding 1970).

In one form or another, it can be concluded, on the one hand, that the changes and permanencies in the issue of land ownership were directed towards the consoli-

dation of private and individual property, either through grants, land compositions, or the appropriation of vacant lands. On the other hand, the property of Indigenous communities was recognized through *revisitas de tierra*, although the extent of their land was usually reduced, generally losing the scattered lands that they had in other ecological floors.

Technological Changes and New Products

Changes in land ownership and tenure were accompanied by other technical and economic processes that profoundly modified land use and landscape in the Andean regions. In this regard, two aspects will be taken into account: the modification of agricultural technologies and the introduction of new products. Both had an impact on the relationship between humans and their habitat, causing changes that affected the inhabitants of the Andean region both positively and negatively.

One of the first elements to consider in relation to pre-Hispanic and colonial production strategies was the expanded use of different ecological floors, known in John Murra's studies as the "vertical control of ecological floors," a strategy that existed in various forms and dimensions. In this regard, while Murra sees in this system a strategy of social organization and control (Murra 1975), the German anthropologist Jürgen Golte (1987) emphasizes the strategic character of the vertical geography's rational use, which for the author would explain its permanence over time. Indeed, vertical control continues to this day in the communities of various regions of the Puna Andes, such as northern Potosí and some communities in Cuzco; however, it should be noted that this strategy was limited by the colonial system. Thus, numerous cases are known in which the valley lands, mainly maize producers and dependents of the highland lordships, were given in grants or *composicion* to the conquistadors and their families, breaking the vertical articulation and the use of products from other ecological floors. In this way, for example, the Lupaca lordship lost land in the valleys of Moquegua (Murra 1975). The Carangas lordship also lost part of his territory on the western slope of the Codpa valley (Hidalgo, Castro, and Gonzáles 2004), although he maintained and even expanded his lands in the valleys near Potosí (Medinacelli 2010). These changes occurred most strongly in valleys that were shared by several ethnic groups and lordships, such as Cochabamba (Larson 2017, Jackson and Gordillo 1993). As a result, the highland communities lost part of their corn-producing land.

A different case was that of the Mantaro Valley, today one of the most productive regions of Peru. The valley was populated by the Huancas. This group suffered through the Inca conquest during the time of Pachacutec, which would explain the early alliance of the native inhabitants with the Spanish conquerors. According to Bonilla (2010), "perhaps this explains the hospitality that the Spaniards found in the

valley, which together with the characteristics of the dry and temperate climate, typical of the Quechua region, led them to settle in a hamlet in 1533 that the Huancas called Hatum Xauxa and that the Spaniards called Jauja" (232). This city was the first capital of the viceroyalty before the foundation of Lima. In this case, production was fundamentally colonial and, as in Cochabamba, adapted to European products. *Mestizaje* was common. Among the products are some of pre-Hispanic origin and others of European origin: potatoes, corn, onions, beans, wheat, barley, oats, cabbage, squash, lettuce, carrots, peas, and others. Fruit trees were also important, both native and imported, such as tumbo, sour cherry, apple, peach, fig, and plum trees.

A central element in agricultural and livestock activity is water, which constitutes "the axis of the system, the thread that builds the networks of interconnection" (Rodríguez Gallo 2019). From the valleys and savannahs of Bogotá, in the Colombian Andes, to the narrow valleys of the Peruvian coast and the slopes of the yungas region, water was and is fundamental for the emergence of productive activities and the construction of the landscape. Throughout the long history, the forms of water use were diverse: from the use of *camellones* in the Bogotá savannah, *sukakollus*, *waru warus,* camellones, and *qochas* in the Titicaca region, and camellones in the Moxos savannahs to the use of advanced irrigation technologies in the Pacific coast valleys. The use of water allowed the development of great cultures such as the Muisca, Paracas, Nazca, Huari, or Tiwanaku, which were exploited by the Incas and, later, by the colonial system itself. Despite this, Spanish landowners and ranchers did not develop new irrigation systems or new water use techniques. On the contrary, they stopped using some of the previous ones, which were only rediscovered in the twentieth century.

In relation to the regulation of water use, both pre-Hispanic cultures and Spanish norms considered water as a common good that should be used for the benefit of all. In spite of this, the ideal norm was not always complied with. The old customs of water shifts or *mitas* and communal work, such as the construction and repair of irrigation ditches, were modified by the presence of landowners who sought to take advantage of their position to break the balance between common and individual use (Bustamante et al. n.d.: 21).

In the case of the valleys of the western slopes of Peru, the colonial system took advantage of the great advances of the native cultures, reusing water intakes, camellones, irrigation ditches, and dams. Despite this, it is important to point out that the landowning power sought to take advantage of some of these customs. For example, there were lawsuits regarding water use and mitas in which the new owners sought to increase their time of use to the detriment of others. Something similar happened in the region of Tunja, Colombia where, in 1592, the Indians complained to the authorities, stating "that we are in possession and ownership of all the waters, springs, and streams that pass and go through our lands with which we have irrigated our farms, and as the said individuals have interfered with us, they have dispossessed

us of said waters and the irrigation ditches that we made with our hands" (AGN, RB, T.3, f.348r. cited by Mora Pacheco 2012).

Another change, this time in agricultural techniques, was the implementation of the use of the Roman plow and the tilling of soils. Previously, the land was prepared for agriculture with the "foot plow" or *chaquitaclla*. The use of this implement, described by chroniclers and drawn by Guamán Poma de Ayala himself, was common throughout the Andean area and was adapted to the diverse ecological conditions.

In the colonial period, the *chaquitaclla* was replaced by the Roman plow pulled by a team of oxen. This change involved not only the use of animal power, but also the construction of furrows and a different movement of the soil. While possible in flat lands and rich soils, it was difficult to replicate in hilly terrain or in poor soils near the agricultural altitude limit, most of which are located on the slopes of the mountain range. There is no specific study on the use of the Roman plow and the yoke that analyzes their environmental impact in the colonial period. However, current studies on new technologies for soil tillage show that it is not possible to use the plow at high altitudes and on sloping terrain, such that even today, the *chaquitaclla* is still used.

Finally, it is important to analyze the impact that the "importation" of new European annual and perennial plants had on agriculture in the Andes. Among the former are some forage plants, including barley; cereals, such as wheat and oats; leguminous plants, such as beans and peas; and vegetables, such as carrots and onions. The latter include stone and citrus fruit trees, as well as grapevines. Finally, it is important to note that sugarcane was adapted to the warmer regions.

In relation to the annual varieties, each plant adapted to the Andean regions according to its characteristics, becoming part, in some cases, of the ancient systems of crop rotation and rest periods. Thus, for example, in the Altiplano, barley, beans, and peas were added to potatoes and other Andean tubers in the crop rotation of individual (*sayañas*) and common plots (*aynoqas*), generally following the succession of potato-barley-legume and several years of rest or fallow. In other areas, alfalfa was introduced as a perennial alternative for feeding the new livestock.

With characteristics similar to the Castilian plateau, the dry valleys of the eastern and western slopes of the Andes from the savannah of Bogotá or the Tunja region in Colombia to the dry valleys of southern Charcas and Salta were the first to be used for the adaptation of European varieties. Consequently, they were also the first to be transformed into individualized lands. In these valleys, wheat was sown throughout the Andes as a fundamental product for the production of bread. Fruit trees, vines, and olive trees were also planted, depending on the characteristics of each species. Despite an initial ban on importing perennial species, by the end of the sixteenth century, they had become established and were thriving. In some regions, the new products displaced traditional crops and in others they coexisted with pre-Hispanic crops, especially corn – essential in the Indigenous diet – and chili peppers – im-

portant in regional cuisine. The cultivation of some of the European products was intensive in the irrigated valleys near the cities and on the coast, where vines, sugar cane and fruit trees were planted to supply a wide region with wine, brandy and nuts. This was the case, for example, in the regions of Pisco and Moquegua, today in Peru, which not only exported wine and liquor to the rest of Peru but also chili peppers, jams, and other processed products.

In the same way, some new products, such as sugarcane, initially displaced coca production in a few regions of the eastern humid valleys or yungas, as occurred in the yungas of the Peri River of La Paz. The same was true of grape vines in the Mizque valley in Cochabamba, an area close to the ecoregions populated by unconquered peoples, such as the Chiriguanos or Chunchos (Barragán 1994).

It can be concluded that the colonial system took advantage of the advances made by the native peoples in relation to land use, water use, and adaptation to a vertical geography, adding some variants such as the plow. However, there were changes in land use with the transformation of much of the richest land into individual properties. Said transformation automatically modified the rhythm of land use and the ecological balance, resulting in the desertification and erosion of the most fragile lands, as occurred, for example, in the valleys near the new colonial cities.

The New Livestock Farming

Unlike in Mesoamerica, the raising of large domesticated animals, such as the llama and alpaca, was fundamental to the economy and social organization in the Andes. Both camelid species were domesticated from wild species such as the guanaco and the vicuña. According to Hahn, quoted by Troll (1980), the area in which the llama and alpaca are used as domestic animals is smaller than the natural distribution area of the camelids; thus, llama breeding was confined to the Peruvian cultural area, while alpaca breeding was limited exclusively to southern Peru and the Peruvian-Bolivian circumlacustrine Altiplano. For the author, the presence of the llama in regions such as the highlands of Chile and Ecuador at the time of the conquest was due to its relocation during the Inca period. In one form or another, both species are typical of the dry puna steppes of the tropical Andes. Troll establishes four uses for these animals:

- Wool. Alpaca wool, which made finer fabrics, proved more important than llama wool, which was used in coarser fabrics and ropes. This is not to forget vicuña wool, which was the most valued, hunted or trapped using the *chaqu* technique.

- Cargo. This was exclusive to llamas. Although they lacked a large carrying capacity, this could be compensated by large herds, their frugal diet, their resistance to cold, and adaptation to high altitudes.
- Manure (or *takia*), used as fertilizer and as fuel in places where there was no firewood such as the Altiplano. Its use was fundamental in mines, such as Potosí, and Andean cities until the twentieth century.
- Meat, the least important but fundamental in times of crisis. Drying it makes *chalona*, an important food in the Andean inhabitants' diet.

There is no reliable data on the number of heads of each of the four groups of camelids that lived in the Andean area at the time of the conquest; however, it is possible to get an idea through secondary data. According to Lamo (2011), in the case of vicuñas, for example, there is talk of *chacus* (herds) of more than 30,000 vicuñas, which implies that the number of heads was much higher; in the same way, there are colonial records of the authorities' concern about the death of about 80,000 vicuñas annually. The data on guanacos are even scarcer, although the study of the pastures where these animals grazed gives an approximate number of between 30 and 50 million heads.

The domesticated llamas and alpacas that were of such social and symbolic economic utility for the Andean culture immediately caught the attention of the conquistadors who called them "rams of the earth" as a form of cultural transference. In this way, llamas accompanied the advance of the new inhabitants through the puna lands and both species of camelids were included in the tribute to the *encomenderos* and the Crown; this would explain the fact that the Lupaca lordship, on the banks of the Titicaca, the richest due to its large camelid herds, was entrusted (*encomendado*) directly to the Crown. Regarding the number of llamas at the time of the conquest, there is no specific data. Nevertheless, it is important to note that a single Lupaca cacique, Don Juan Alanoca, owned a herd of 50,000 rams in 1571. In the same way, the payment of tribute in the territory of the Huancas reveals the great number of camelids at that time, according to the following table:

Tab. 3: Tribute in Huanca Camelids

Years	**Parcialidad**	**Tribute**
1533–1544	Huancas de Hatum Saya	58,673 llamas and alpacas
1533	Saya Urin Huanca	514,656 animals*
1534–44	Saya Urin Huanca	27,958 llamas and alpacas

* Amount delivered for the rescue of Atahuallpa
Source: Guerrero Lara (1986).

Much of the value of camelids was due to the fact that their breeding was deeply intertwined with the practices and rationality of Andean organization (Golte 1987). This organization included the articulation of community breeding, the control of various ecological floors, and a system of reciprocity with other ethnic groups. For this reason, the colonial system did not substantially modify the issue of camelid herd ownership. Rather, these herds became a substantial part of the pact established with the highland ayllus, either through the payment of tribute, their contribution to road travel, or the transfer of goods. As Luis Miguel Glave has shown in his book *Trajinantes* (1989), much of the colonial trade was done with llamas; some caciques even enriched themselves by taking advantage of this trade. In the same way, according to Ximena Medinacelli (2010), the Carangas took advantage of the control they had over their llamas to obtain new lands near Potosí, where they grazed their herds that carried products such as *taquia* (camelid dung used for fuel) and salt to Cerro Rico.

Alpacas are not pack animals and their greatest value is wool. Despite this, the herds were also kept in the hands of the high-altitude herders under communal control, because the main interest of the Spaniards was not to appropriate the animals but to take advantage of the tribute in textiles and the use of Indigenous labor, both in the *mita* of Potosí and in the silver mines of the region. Thus, according to Assadourian who analyzes the visit to Chucuito of Garci Diez de San Miguel in 1567:

> Chucuito was also to provide 1,000 dresses per year. On average, it took each weaver two months to make a garment. The contract was established between the encomendero and the traditional chief of the village. The Spaniard gave the *kuraka* two pesos for each dress, which he then sold at a much higher price to the Indians of Potosí. The Andean social structure, the role of ethnic authority, and traditional forms of exchange served to support colonial pressures, creating interfaces between one system and the other (Del Pozo-Vergnes 2004).

According to Christiana Borchart de Moreno, who studies the region of the Audiencia de Quito, the Incas brought camelids as part of the state-owned livestock to support the wars. Thus, the first Spaniards who arrived could still see large herds, and the encomenderos' tributes were established. For several communities, this tribute was in pieces of *cumbi*, i.e., quality wool fabrics. The highest density of animals was located in the highlands of Chimborazo. However, the herds were disappearing rapidly, mainly due to the violence of the conquest, natural disasters, and, from 1580 onwards, their slaughter as a way of fighting idolatry (Borchart 1995: 165).

The decline in the number of camelid livestock was due to several factors, including the slaughter of adults and young for meat, the use of camelids in the Potosí mines as pack animals, the obligation of the Spanish to sell camelids and introduce

sheep, and, finally, the great scabies plague of 1544–46 that depleted the Altiplano population.

In all the puna and páramo, the "Castilian sheep" were introduced early, and, apparently, the pastures, watering hole, and bofedales where the camelids fed became shared. However, it was in the higher altitude lands where reserves of alpaca finally settled, while the llamas remained in the more arid regions of the central and southern Altiplano. Sheep were introduced as early as the 1530s, albeit sporadically, and it was not until around 1550 that the first permanent flocks were established.

The environmental impact of their introduction has not yet been analyzed, and positions remain divergent. While for Del Pozo (2004), who works in the Puno region, the introduction of sheep did not pose major problems because the Indigenous population quickly understood the multiple advantages of this type of animal, for Borchart (1995), in the Quito region, sheep breeding was directly connected to the Spanish neighbors, which would entail the distribution of land, the establishment of *obrajes* (textile workshops), and, therefore, a fundamental change in property and production relations.

Analyzing both positions, two different types of strategy can be seen: on the one hand, the authorization of the Indigenous people to raise sheep from Castile with the objective of maintaining the textile tribute and establishing obrajes (Salas de Coloma 1995); on the other, the importation of sheep in lower altitude lands that had lost their agricultural quality. Both strategies occurred in different regions of the Andes. It is important to point out that, as has been demonstrated in specialized studies, the shape of the hooves and the grazing process is different between camelids and sheep. Thus, it is very possible that the expansion of sheep farming has affected the watering places and wetlands of camelids. There are no archaeobotanical or archeoecological studies that allow us to confirm the degree of degradation of these soils due to sheep farming.

The importation of pigs apparently occurred prior to the importation of sheep, mainly because of their great energetic value and their fundamental role in the conquistadors' diet. In spite of this, the data on their breeding in the Andes are limited. Both Francisco Pizarro in Peru and Sebastián de Benalcázar in Quito and New Granada took large herds on their first trips and these were distributed in the first encomiendas, leaving their care in the hands of the Indians. According to the author:

> From the end of the 1530s, the lands immediately surrounding the first Peruvian establishments were filled with pigs, producing better bacon and pork legs in the highlands than in Spain itself. [...] In Quito, the multiplication was so rampant that, in 1538, the Cabildo ended up prohibiting the residents from having more than ten head of pigs for their food. Certainly, a few years after the end of the conquest – in 1541 –, the city [Quito] already had enough livestock to provide Gon-

> zalo Pizarro with the nearly 3,000 pigs he took on his expedition to the Cinnamon Country (Del Río 1996: 23).

In the most arid lands, such as those inhabited by the Uru Chipaya in the Poopó region (Bolivia), the cession of herds to the Indigenous peoples meant the possibility of articulating their production with other economic activities of colonial origin such as sheep breeding and some pre-Hispanic activities such as flamingo hunting, fishing and the gathering of totora (Wachtel 2022: 157). This experience shows us that raising pigs was a positive option for the poorest native peoples due to the animal's reproductive capacity and adaptability to extreme conditions. In some cases, however, these peoples' method of raising the pigs destroyed bofedales, transforming them into mud flats.

Cattle were raised extensively, especially in the valleys and savannahs of the equatorial Andes, becoming the basis of the economy in regions such as the Colombian savannah and other open valleys of the Andes. In marginal regions, such as the pampas of Río de la Plata and the Moxos and Chuiquitos regions, cattle breeding was central to the leather industry. Although the sources indicate the early arrival of the first cattle, it can also be said that their extensive breeding was largely due to the advance of the colonization frontier. For this reason, production grew mainly during the eighteenth century in new regions of colonization, many of which were subject to the missionary system.

In relation to the breeding of equines, although their areas of development are in regions outside the Andean space, it is important to take into account their presence due to the permanent trade in the cities that employed them and the use of horses and mules in transportation. Thus, for example, the Jesuit estancias established in Córdoba (today Argentina) were the main breeding grounds for horses and mules, which were essential for colonial trade and commerce. Cattle on Jesuit ranches were classified into rodeo cattle (*ganado de rodeo*), oxen, horses, mares, foals, mules, donkeys, and sheep (Cuervo 2014). At the time of the expulsion of the Society of Jesus, more than one million head of cattle, horses, mules, and sheep were found.

In the highlands and valleys of the Andean region, livestock raising was more an initiative of the peasants themselves, who generally had a few specimens to support their agricultural work and food. Nevertheless, it is important to mention their breeding because it modified certain practices. Thus, the use of the Roman plow required the use of oxen, and the transportation of products required the use of donkeys and mules. In this way, the ownership of some of these animals became a sign of wealth in the Indigenous communities.

In relation to the impact on ecosystems, although there are no specific studies, it can be pointed out that, just as in the case of pigs, cattle raising destabilized the fragility of wetlands and other humid terrains near rivers and lakes. Complaints can

be found attesting to the way in which cows trampled the flooded lands, destroying its productive capacity.

The Impact of Colonial Mining on the Landscape and the Environment

Mining was a fundamental activity in the colonial economy of the Andes. Large populations formed around the mining centers of Potosí and Huancavelica. At the beginning of the seventeenth century, 150,000 inhabitants lived in the former, making it one of the most populated urban centers in the world. This is not to develop a history of mining but to focus on establishing the impact that these activities had on the environment. Three aspects will be taken into account: water use and pollution, energy use, and air pollution.

In relation to water, its use was indispensable for the processing of both silver in Potosí and quicksilver in Huancavelica. In Potosi, the technological change from the *guayra* system to amalgamation led to the establishment of numerous ore processing mills and the intensive use of water for the movement of large hydraulic mills or for the actual process of ore separation using mercury. For this purpose, a complex of lagoons was built in the upper part of the Villa to supply water to the mills through an artificial river called the Rivera. The passage of water through the various mills and through the city itself produced a process of water contamination that came from four sources: the mines, domestic consumption, processing, and the effect of the great hydraulic catastrophe of the San Ildefonso lagoon (Serrano 2005). In the first case, the water that came from the pits was already contaminated by the mineral; meanwhile, the more than one hundred thousand inhabitants of the Villa Imperial added waste of all kinds to the Rivera itself. This was in addition to the water used in the mills, especially those originating from the mercury separation process. Finally, Serrano describes the impact of a specific environmental event, namely the flooding suffered by the Villa and the mines due to the collapse of the San Ildefonso or Karikari dam, which practically destroyed the city and the mills. According to Claudia López Pardo (2010), the waters coming from the mines were called "copajira waters," acidic waters that contained dissolved salts and metals such as copper, lead, arsenic, etc. On the other hand, those coming out of the mills carried mercury and other chemicals such as copper, iron, lead, and tin. It is logical to think that, in the case of Huancavelica, the main mining center producing quicksilver or mercury, water contamination was directly related to the toxicity of the ore extracted and processed.

In the case of Colombia, alluvial gold mining was carried out in an artisanal manner until practically the eighteenth century. Using very simple instruments and tools, such as pans and rods, the metal could be extracted. This does not mean, however, that there was no environmental impact, since the course of the rivers

was affected by the continuous activity of Indigenous miners and slaves. Those who worked the gold deposits, known as *mazamorreros* or *barrequeros*, worked either individually or in groups (Lenis 2020). Many were slaves, while others were free laborers. The names of the various jobs are still used today.

In relation to the energy issue, it is known that mining's environmental impact was very large. In the early years of production in Potosí, the use of the *guayra* technique entailed the intensive use of firewood from plants such as the thola or yareta. This resulted in large high slopes gradually losing their vegetation cover. The later use of amalgamation maintained the need for the use of energy sources mainly for metal smelting. For this purpose, taquia or llama excrement was used. In this way, traditional camelid herding was linked to mining activities. According to Chumpitaz (2015), the same occurred in Huancavelica. Here, firewood was scarce, with its nearest source about three to four leagues away (around 22 kilometers). Thus, the fuel for the ovens, especially the jabeca ovens that consumed large quantities of firewood, was supplied by taquia, cow dung, yareta (*azorella sp.*), and *champa* (a kind of peat formed by the species *Distichia muscoides* that grows around 4,500 meters in swampy areas without moss).

Finally, it is important to note the impact on health and the environment of air pollution in mining areas. The rarefied and acidic air in the pits and the use of mercury in the amalgamation process caused the death of thousands of mine workers, both *mitayos* (laborers in the Mita system) and free workers. This problem caused the Crown to exempt the mitayos affected by mercury from going back to the mita. In the case of Huancavelica, being a quicksilver mine, the impact was even more direct, such that the mitayos and other workers considered being sent to the quicksilver mines a death sentence.

The Export Market, Plantation Systems, and Cinchona Extraction

By the eighteenth century, two hundred years after the arrival of the Spaniards in America, the Andean spaces had already undergone major transformations due to the impact of new production logics. It is in these already modified landscapes that new forms of agricultural production emerged during the eighteenth century, mainly dedicated to the export market. On the coasts of Peru, in the valleys of Colombia and in other regions near the coast or with tropical climates, plantations arose that were distinguished from previous forms of exploitation by their extensive production and the key role of slave labor; in addition, it introduced or deepened the exploitation of new products, the main ones being sugarcane, grapevines, and tobacco (Chocano 2010: 59). This new production system generated the expansion of large estates, many of them belonging to religious orders or elite families, some of them ennobled.

Unlike traditional haciendas, the plantation production system required more capital, machinery for processing, and a large labor force. Due to their relationship with the export market, the plantations specialized in certain products, tending towards monoculture, while the labor force was mostly enslaved. In order to save transportation costs and to be able to enter the world market, plantations were established near ports or along an important river route. The environmental impact of the plantations was also great: soils were commonly depleted due to monoculture, so the plantations had to constantly expand the agricultural frontier.

From a different dimension, the eighteenth century saw the emergence of another economic activity, that of cinchona extraction. Tradition has it that cinchona bark or husk was discovered during the eighteenth century in the region of Loja (Ecuador), although it is logical to think that it was already known and used by the Andean peoples many years before. The use of cinchona and its active ingredient, quinine, as a remedy against malaria, was fundamental at a time when new explorers were entering the tropical lands of Asia and Africa, hence its extraction became an increasingly important economic activity, especially in certain parts of the jungle, such as Loja, Popayán, Lambayeque, or Apolobamba. In the case of Loja, the specificity of its location and the difficulty of its extraction made cinchona the new gold for many adventurers who, individually or in groups of laborers, went to extremely difficult areas to extract the bark. "As there is no cinchona forest in the wild, the laborer has to prospect vast areas. He usually sets out alone and collects bark for a day. He repeats this operation again for three or four months" (Petitjean and Saint-Geours 1998). The next stages, which had to be carefully controlled, were its drying, packing, and transportation to a port on the Pacific and from there to Cadiz.

The most important region for this industry was Loja, where the extraction of cascarilla or quina caused a short-lived economic boom. As with tobacco, the Bourbon State sought to control the extraction of cinchona from Loja, establishing a virtual monopoly on its export through regular officially directed shipments; however, this regulation caused either problems shortages or excess accumulation in the Cadiz market. However, the demands of the market, the difficulties of extraction and processing, and the overexploitation of the trees exhausted the region and new and more inhospitable areas had to be harvested.

The environmental impact of the extraction of cinchona meant the rapid deterioration of the forest in the producing areas. The forests were ravaged without the thought of conserving or, at the very least, replacing the trees; in the long run, this entailed the continuous movement of the exploitation frontier that would continue until the end of the nineteenth century in the different nation-states.

Conclusions

This study seeks to analyze the transformations in land use as a consequence of European colonization and their impact on the environment. In general terms, it is shown that the processes, trajectories, and intensities of territorial transformation have varied greatly in the different regions of the Andean space, depending on the demographic density of each region, its fragility, and the diverse implementation of modifications and adaptations. In this sense, despite the changes brought about by colonization with the implementation of new forms of work organization, changes in land ownership, extensive population movements, and the introduction of new agricultural and livestock products, in most of the territory, the adaptation to pre-Hispanic forms of cultivation and raising of livestock prevailed. Thus, for example, European products were added to the pre-Hispanic crop rotation systems, and community forms of production organization were maintained in practice, in which the European and Creole settlers were often involved.

In the same way, the land compositions maintained two ways of conceptualizing land ownership. On the one hand, they conformed haciendas for the use and ownership of the Creole or Spanish population. On the other hand, however, the revisitas de tierra consolidated the property of the old ayllus that had become communities. Finally, the raising of new animals was also linked in some regions to the ancient camelid herding. Despite these forms of adaptation, there is no doubt that changes in land use occurred with the consequent environmental impact. Thus, the weakening of the old Inca state control led to the desertion of farmland, and the construction of camellones and terraces was abandoned; the planting of some crops of European origin, such as wheat, led to the displacement of others of higher caloric and energy value, such as corn; and the planting of fruit trees of European origin led to the emergence of privately-owned orchards in the outskirts of the cities. In terms of livestock, the raising of European origin animals such as sheep, pigs, and cows destroyed part of the fragile Andean pastures and bofedales that were used for raising camelids.

With regard to the areas of occupation, the most densely populated areas of the Andes largely maintained their population and social and economic organization. Instead, it was the marginal regions or those recently colonized by the great Andean cultures, such as the Incas and the Muiscas, that underwent the greatest changes during the advance of European colonization. This change has been greater in the foothills of the Cordillera towards the Amazonian lowlands, where the demographic impact of the conquest was more profound. It was there that missionary systems, large plantations, and extensive cattle ranches arose. This has occurred, for example, in the sub-humid and humid forests of the Colombian Andes and in the savannah lands of the Beni, which suffered a great demographic decline in the sixteenth century, leaving the great hydraulic culture that had developed in the region in ruins.

Mining, the economic foundation of the colonial exploitation system, also led to the degradation of spaces, either by the excessive exploitation of firewood as a source of energy or water pollution. Finally, in the eighteenth century, two new forms of exploitation emerged. The first was the plantation that produced products such as cotton or sugarcane, emerging mainly in the warmer regions facing the Amazon or on the Pacific and Caribbean coasts. The other was the extractive exploitation of cinchona in the jungle. Both affected ecosystems, especially due to their expansive nature and constant broadening of the agricultural frontier. In conclusion, the impact of Spanish colonization in the Andean area was great. Although the systems of social organization and Indigenous agricultural and cattle raising practices were able to survive, the resulting landscapes at the beginning of the nineteenth century after three centuries of colonial domination were already very different. Erosion, the destruction of pastures, the expansion of the agricultural and cattle-raising frontier, and water pollution were already a reality in the Andean areas.

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References

Barragán Romano, Rossana. 1994. *"¿Indios de arco y flecha?" Entre la historia y la arqueología de las poblaciones del Norte de Chuquisaca (siglos XV-XVI)*. Sucre: Ediciones ASUR.

Bonilla Di Tolla, Enrique. 2010. "Una aproximación al paisaje cultural del valle del Mantaro." *Ingeniería Industrial* 28, no. 28; 229–242.

Borchart de Moreno, Cristiana. 1995. "Beyond the obraje: handcraft production in Quito toward the end of the colonial period." *The Americas: A Quarterly Review of Inter-American Cultural History* 52, no. 1: 1–24.

Bonifaz, Miguel. 1956. *Derecho Indiano*. Oruro: Departamento de Extensión Cultural UTO.

Bustamante, Rocío, and Daniel Vega. n.d. *Normas indígenas y consuetudinarias sobre la gestión del agua en Bolivia*. Programa de Gestión del Agua. Centro Andino para la gestión y uso del Agua. https://www.amazonia.bo/administrador/imgnoticia/29022012agua.pdf

Chocano, Magdalena. 2010. "Población, producción agraria y mercado interno, 1700–1824." In *Compendio de historia económica del Perú*. Vol. 3, Economía del periodo colonial tardío, ed. Carlos Contreras, 19–101. Lima: IEP/Banco Central de Reserva del Perú.

Chumpitaz Fernández, Juan Adriano. 2015. "Tecnología e invención: la metalurgia del azogue en Huancavelica (1630–1650)." Master thesis, Pontificia Universidad Católica del Perú.

Cook, Noble David. 2002. "Avances en el estudio de la población andina colonial." *Histórica* 26, no. 1: 15–81.

Contreras, Carlos, ed. 2020. *Historia económica del Perú*. Vol. 2. Lima: Banco Central de Reserva.

Crespo, Alberto, Florencia de Romero, Carola Echalar, Carola Muñoz Reyes, Maria Luisa Soux, and Cecilia Arauco. 1984. *Siporo, historia de una hacienda boliviana*. La Paz: Don Bosco.

Cuervo Álvarez, Benedicto. 2014. "Las misiones de los padres jesuitas en Latinoamérica (1606–1767)." *La Razón Histórica. Revista hispanoamericana de Historia de las Ideas* 27: 146–185.

De Lamo, Daniel A. 2011. *Camélidos sudamericanos. Historia, usos y sanidad animal*. Buenos Aires: Servicio Nacional de Sanidad y Calidad Agroalimentaria.

Del Pozo-Vergnes, Ethel. 2004. *De la hacienda a la mundialización*. Lima: IFEA.

Del Río Moreno, Justo L. 1996. "El cerdo. Historia de un elemento esencial de la cultura castellana en la conquista y colonización de América (siglo XVI)." *Anuario De Estudios Americanos* 53, no. 1: 13–35.

Dollfus, Olivier. 1981. *El reto del espacio andino*. Lima: Instituto de Estudios Peruanos.

Escobari de Querejazu, Laura. 1995. "Consideraciones sobre la movilidad de yanaconas y el control vertical en Yamparáez (Chuquisaca-Bolivia), siglo XVII." In *Colonización agrícola y ganadera en América, siglos XVI-XVIII: su impacto en la población aborigen*, ed. Laura Escobari de Querejazu, 291–330. Quito: Abya Yala.

Etter, Andrés. (2015) "Las transformaciones del uso de la tierra y los ecosistemas durante el periodo colonial en Colombia". In *La economía colonial en la Nueva Granada*, ed. Adolfo Meisel and María Teresa Ramírez. Bogota: FCE.

Glave, Luis Miguel. 1989. *Trajinantes: caminos indígenas en la sociedad colonial siglos XVI/XVII*. Lima: Instituto de Apoyo Agrario.

———. 2014. "El arbitrio de tierras de 1622 y el debate sobre las propiedades y los derechos coloniales de los indios." *Anuario de Estudios Americanos* 71, no. 1: 79–106.

Golte, Jürgen. 1987. *La racionalidad de la organización andina*. Lima: IEP.

Gonzáles, Donato Amado. 1998. "Reparto de tierras indígenas y la primera visita y composición general." *Histórica* 22, no. 2: 197–207.

Guerrero Lara, Raúl. 1986. "Los camélidos sudamericanos y su significado para el hombre de la punta." *Diálogo Andino* 5: 9–89.

Hidalgo, Jorge, Nelson Castro and Soledad González. 2004. "La revisita de Codpa (Altos de Arica) de 1772–73 efectuada por el corregidor Demetrio Egan." *Chungara, Revista de Antropología Chilena* 36, no. 1: 103–204.

Jackson, Robert H. and José Gordillo Claure. 1993. "Formación, crisis y transformación de la estructura agraria de Cochabamba. El caso de la hacienda de Paucarpata y de la comunidad del Passo, 1538–1645 y 1872–1929." *Revista de Indias* 53, no. 199: 723–760.

Kalmanovitz, Salomón. 2015. *Breve historia económica de Colombia*. Bogotá: Ministerio de Cultura.

Larson, Brooke. 2017. *Colonialismo y transformación agraria en Bolivia. Cochabamba, 1550–1900*. La Paz: Biblioteca del Bicentenario de Bolivia.

Lenis Ballesteros, César Augusto. 2020. "Oro, técnicas y sociedad en la historia de Colombia." *Agenda Cultural Alma Máter* 273: 22–25.

López Pardo, Claudia. 2010. "Aguas de copajira. Minería en el Potosí colonial." *Revista Letras verdes* 6: 3–5.

Mamani Siñani, Roger. 2012. "Tierras, litigio y títulos. La visita de don Gerónimo Luis de Cabrera y don Juan Segura Dávalos de Ayala." In *El proceso histórico hacia la territorialización del poder*, ed. María Luisa Soux, 69–81. La Paz: IEB.

Medinacelli, Ximena. 2010. *Sariri: Los llameros y la construcción de la sociedad colonial*. La Paz: IEB/IFEA/Plural.

Mora Pacheco, Katherinne Giselle. 2012. "Prácticas agropecuarias coloniales y degradación del suelo en el Valle de Saquencipá, Provincia de Tunja, siglos XVI y XVII." Master's thesis, Universidad Nacional de Colombia.

Murra John. 1975. *Formaciones económicas y políticas del mundo andino*. Lima: IEP.

Petitjean, Martine and Yves Saint-Geours. 1998. "La economía de la cascarilla en el corregimiento de Loja (Segunda mitad del siglo XVIII – Principios del siglo XIX)." In *El Norte en la Historia regional, siglos XVIII-XIX*, ed. Scarlett O'Phelan Godoy and Yves Saint-Geours, 15–41. Lima: IFEA.

Salas de Coloma, Miriam. 1995. "Transformación del paisaje ganadero en el centro-sur-este andino con la llegada del conquistador español, siglos XVI-XVIII." In *Colonización agrícola y ganadera en América, siglos XVI-XVIII: su impacto en la población aborigen*, ed. Laura Escobari de Querejazu, 225–268. Quito: Abya-Yala.

Sánchez Albornoz, Nicolás. 2015. *Historia mínima de la población en América Latina*. Madrid: Turner.

Sánchez Mejía, Hugues Rafael. 2012. "Composición, mercedes de tierras realengas y expansión ganadera en una zona de frontera de la gobernación de Santa Marta: Valledupar (1700–1810)." *Anuario Colombiano de Historia Social y de la Cultura* 39, no. 1: 81–117.

Serrano, Carlos. 2005. "Problemas de contaminación minera y salud en la época colonial." *De re metallica: Revista de la Sociedad Española para la Defensa del Patrimonio Geológico y Minero* 5: 73–85.

Soux, María Luisa. 2012. "El proceso histórico-jurídico hacia la consolidación de la propiedad privada de la tierra." In *El complejo proceso hacia la territorialización del poder*, ed. María Luisa Soux, 29–52. La Paz: IEB.

Spalding Karen. 1970. "Tratos comerciales del Corregidor de Indios y la formación de la hacienda serrana en el Perú." *América Indígena* 30, no. 3: 595–608.

Troll, Carl. 1980. "Las culturas superiores andinas y el medio geográfico." *Allpanchis* 12, no. 15: 3–55.

Urrego Mesa, Alexander. 2014. "La formación del sistema agrario colonial de la Nueva Granada, 1550–1650." Master's thesis, Universitat de Barcelona.

Wachtel, Nathan. 1976. *Los vencidos. Los indios del Perú frente a la conquista española (1530–1570)*. Madrid: Alianza Editorial.

———. 2022. *El regreso de los antepasados. Los indios urus de Bolivia*. La Paz: Biblioteca del Bicentenario de Bolivia.