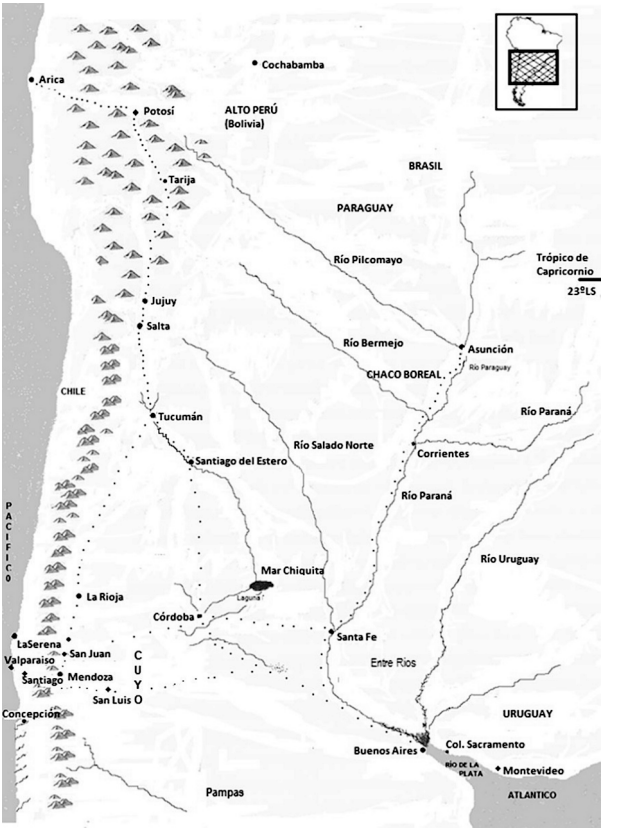
Land Use in the Southern Cone in the Colonial Period

Colonial Spanish America between the 19º and 34º South Latitude

Margarita Gascón

Under the Habsburg regime (sixteenth and seventeenth centuries), the territories of present-day Argentina, Bolivia, Chile, Paraguay, and Uruguay located approximately between the 19° and 34° south latitude (SL) (Fig. 1) were part of the Viceroyalty of Peru. The administrative reorganization of the Bourbons in the eighteenth century brought Cuyo, Upper Peru (now Bolivia) and present-day Paraguay and Uruguay under the jurisdiction of the Viceroyalty of the Río de la Plata, founded in 1776. In the territorial strip between 19° and 34° SL, the populations located around 31° formed the southernmost periphery of Spanish America, since Patagonia remained uninhabited by Europeans, as did most of southern Chile after the Great Araucanian Rebellion at the end of the sixteenth century. There was an unsuccessful attempt to establish populations in the Strait of Magellan around the end of the sixteenth century, but they succumbed to difficult environmental conditions, lack of food, and disease. From the seventeenth century onwards, the frontier with the Indigenous was militarized on the banks of the Biobío River and the main Spanish settlement was Concepción (36°LS). The indigenous domain began south of 35° SL on both slopes of the Andes and in the lands designated as *Trapalanda* or *Magallanica*. Spanish incursions were driven by accounts of the existence of immensely wealthy populations. The legend of the "City of the Caesars," for example, referred to a fabulous kingdom in some southern confine, with abundant gold and silver, governed by whites ("caesars") with docile and helpful natives.

Fig. 1: Study Area, Main Towns, and Colonial Routes



Source: Author's own elaboration.

The reconstruction of the development of land use in this territorial strip follows three interrelated variables: population, strategic natural resources, and location of both populations and resources. Colonial sources have limitations, temporal interruptions, and information gaps, but they allow us to reconstruct land use change related to the Anthropocene as a multiple crisis. The change in land use during the colonial centuries has had consequences that are associated today with the Anthropocene. For this reason, Wendt (2016) considers the colonial period as an early phase or proto-Anthropocene. Voosen (2022) understands the Anthropocene as an "event," which is an informal term used by Earth System Science researchers to express gradual changes that affected the entire planet: from those that have occurred over millions of years to those caused by the impact of an asteroid. The colonial period would

be an event that altered land use throughout the continent, in a decisive way with cumulative consequences.

The structure of the argument considers historical data following three variables that modified land use. It deals with demographic changes, strategic natural resources, and the location of both populations and resources. The population variable involves the sixteenth century and first half of the seventeenth century with the advance of Europeans and the demographic collapse of the indigenous population. The main reason for the collapse – though not the only one – was the introduction of pathogens to which the native peoples lacked immunity. Diseases such as smallpox, measles, typhoid, influenza, pneumonia, and angina, among others, caused an abrupt demographic change. This changed the use of the soil by rearranging access to energy, starting with access to food and the incorporation of germplasm together with domesticated animals.

In addition to the resources needed to sustain human populations, strategic resources such as gold, silver and mercury were added, as well as soils suitable for haciendas producing exportable goods such as sugar or cotton. Thus, the location of populations and resources linked productive spaces with land and sea routes. Finally, the crown had strategic considerations for the defense of its possessions, explaining the location of populations and land use.

Demographic Change

Native population figures for the entire American continent before 1492 are tentative. It is estimated that the collapse of the indigenous population went from about 61 million to 54 million (Nunn and Quian 2010: 165–166) to only about 6 million by 1650. Beyond precise numbers, death from virulent diseases was a common experience of Amerindians (Pietschmann 2002; Elliott 2006; Bailyn 2012). Ironically, this favored the preservation of environments from what would have been an early overexploitation by the economic interests of the newcomers along with the huge increase in population as Europeans joined the natives (Dore 2000: 7). In relation to land use, the collapse of the native population explains the dizzying occupation of fertile lands by the conquistadors. This chapter begins with two examples in different environments. Along the coast and in the valleys of the Peruvian *Sierra*, the sugar or cotton hacienda was easily built (Noejovich et al. 2020). At the same time, in the high altitudes of the Uco-Xaurúa valley in Cuyo, on the route from Buenos Aires to Santiago de Chile, the archaeological record indicates an important pre-Hispanic occupation that, by 1630, had diminished to the point of allowing the appropriation of land suitable for fattening cattle and horses from Paraguay and the pampas destined for the markets on the other side of the Andes. In Uco-Xaurúa, the animals wintered before crossing the mountain range through the Portillo de Piuquenes pass

and, once in Santiago de Chile, the slaughtered cattle were exported as a secondary product (jerky, tallow, and hides) through the port of Valparaíso to Alto Perú and Lima, from where Peruvian sugar and European goods were brought. Tallow for the manufacture of candles constituted the first item of export from Valparaíso to Peru during the entire seventeenth century and amounted to some 30,000 quintals annually (Carrillo de Ojeda 1659: 17); as one head of cattle yields one quintal of tallow, this export volume demonstrates the importance of this interregional network. This exchange circuit had an impact on land use in Cuyo.

In the mid-seventeenth century, the main landowners – by purchase, barter, or donations – in the Cuyo oases were the Jesuits until their expulsion in 1767. They put into circulation wine, cattle, sugar, and yerba mate (*Ilex paraguayensis*) from Paraguay to Chile and Peru through their missions, colleges, and estancias in Santa Fe and Córdoba. The circuit also changed land use in Paraguay, where it encouraged the cultivation of yerba mate, which grew wild in the Sierra de Mbaracayú in Gayra and was harvested in the jungle. While this was the only way to access yerba mate, the consumer market remained limited, but by 1610 the Jesuits were able to manage its cultivation and thus ensured the commercialization of the caminí variety: *caminí* meaning "cultivated" or not harvested from the bush and grown in the wild. Once the plantations were organized within their missions, they maintained their productive and commercial monopoly (Gascón 2007).

The Indigenous demographic catastrophe was compensated by the forced migration of Africans to work in the cotton, cocoa, sugar, tobacco, indigo, and coffee plantations. This had a transformative effect on land use, both geographically and temporally. The hacienda brought clearing, leveling, plowing, drainage, and irrigation, with cumulative consequences that mark the initial moment of the Anthropocene in our continent. In the subtropical region of Argentina, cotton farming began in Santiago del Estero in 1555 with seeds brought from Chile. The cotton hacienda grew because textiles were used to pay Indian tribute (Garavaglia 1986). The dyes came from local plants because the spinners and weavers were Indigenous. Occasionally, indigo from Central America introduced via Lima and Santiago de Chile was used. It was not until the eighteenth century that there was a local venture to produce indigo, with slave labor purchased in Brazil. There were cotton plantations in Paraguay, which was a net exporter to Santa Fe and the Río de la Plata. Cotton, along with wine, sugar, honey and yerba mate, went down the Paraná River to the port of Santa Fe. In the seventeenth century, yerba mate alone accounted for between 20,000 and 25,000 arrobas per year (an arroba is equivalent to 11,340 kilograms). Santa Fe was designated "*puerto preciso*" since 1662 for tax collection purposes, controlling the movement of people and goods, articulating Paraguay, Chile, and the Río de la Plata.

The flow of resources from Paraguay to Chile covered part of the demand of the professional army of the Araucanía stationed on the banks of the Biobío River after

the native rebellion of 1598–1599. With 2,000 places, it counted on allied Araucanian Indians, who could double the number of soldiers (Quiroga 1979: 36). In this early historical moment, the variable of the location of the populations reveals itself as crucial because Spain's decision to station a professional army was due to the defense of the South Sea after the irruption of Francis Drake in 1579 on the Peruvian coasts. The Araucanian revolt at the end of 1598 offered Spain's enemies in Europe the possibility of gaining local allies, so the Junta de Guerra instructed the Paraguayan Jesuits to send military-trained and armed Guarani natives to the Araucanian frontier. In 1608, some 200 Guarani arrived in Chile to whom the priests began to send yerba mate and tobacco from Paraguay every year. Before long, Paraguay was sending cattle and horses to the army, boosting land use with natural pastures along the route (Gascón 2007).

In this context, the evolution of land use in the Argentine pampas is related to location. The main population at the beginning of the seventeenth century was Buenos Aires, which claimed exclusive use of the route opened by Fray Francisco de Vitoria in 1584, linking Brazil with Tucumán and Buenos Aires. As an Atlantic port, it allowed the entry of Africans from Guinea and Angola that served the demanding Alto Peruvian mining industry. Faced with the impossibility of exercising effective control, in 1594, the crown closed this route, but four years later a dispensation allowed Buenos Aires to export flour, jerky, and fat; the license was renewed, cementing a land use aimed at extracting and producing resources for export. The Bourbon opening of the ports with the Free Trade Regulations maintained the use of the Pampean soil for agriculture and livestock with large exportable surplus (Garavaglia and Gelman 1995; Amaral 1998; Moraes 2020).

Elsewhere, changes in colonial land use show the impact not only of new crops but also of colonial know-how. Moxos in the Bolivian Chiquitanía was known for its cocoa plantation (*Theobroma cacao*) which was exported, along with sugar, to Peruvian markets. Through traders in Lima, Chiquitano cocoa reached Chile and the Río de la Plata. Its processing required care and its export was done in crates made of dry boards, caulked with tar and lined with hairless cowhides. In 1788, twenty years after the expulsion of the Company, a royal official did not mention cocoa as a profitable resource, but rather aimed to increase the yield of the sugar hacienda for export to Cochabamba and the commercial exploitation of palm oil (coconut oil or *motacú*) described as a very efficient fuel for lighting (Santamaría 1986).

Cochabamba's location as a nexus between the Altiplano and the jungle made it an ideal hub from the pre-Columbian era to the time of Spanish conquest. Maintaining this ancestral location allowed Spaniards exchanges of complementary natural resources. The same legend of the discovery of the Potosí ore veins involved Cochabamba as a trading post. Legend has it that the Porco Indians, carrying food to the Altiplano from Cochabamba, when a ram escaped, followed it to a cave where Diego Wallpa, in order to take shelter from the cold of the night, lit a fire that melted

the metal found on the surface (Jiménez de la Espada 1965: 172). Originally called Villa Real de Oropeza, Cochabamba had been founded in 1571 by orders of Viceroy Francisco de Toledo (1515–1582) to feed a Potosí that was becoming a population center with more inhabitants than London at that time. But located at 4,000 meters above sea level, Potosí depended on external supplies, and in 1603, it was already importing 50,000 bushels of corn and more than 90,000 bushels of wheat annually, mostly from Cochabamba (a bushel here is equivalent to 65 kilograms). The figures point to the land use changes that had to be made to reach these production volumes. The number of bushels of corn, on the other hand, testifies that the labor force was Indigenous, mostly dedicated to mining via the *mita* and the *yanaconazgo* labor systems. The collapse of the native population and the reluctance to work in the harsh conditions of Cerro Rico de Potosí, prompted the introduction of African slaves who also served on the haciendas. With the African population came the tropical diseases of malaria and malaria whose spread was, in turn, associated with the environmental conditions derived from the cultivation of sugar cane. Parvovirus and hepatitis B also arrived from Africa. As cumulative effects in the long term, demographic change is associated with the distribution of blood groups and endemic diseases. Thus, today there are entire populations of indigenous Peruvians with Group 0 (71 percent) and there are populations susceptible to a strain of malaria, depending on whether or not they have the Duffy antigen, whose production is related to blood groups (Carmona 2006; McManus, Taravella and Henn 2017).

Potosí had its extractive peak between 1580 and 1620 and declined around 1690 when the viceroyality authorities tried to increase mineral extraction in other deposits such as Lipes and Oruro. At its peak, Potosí produced more than 42 percent of the world's silver, so Viceroy Toledo claimed that, together with the mercury mine of Huancavelica – which allowed the processing of silver through amalgamation or "quicksilver" – both mines were not only the wheels of the viceroyalty's economy but of the entire royal treasury. Potosí had an overwhelming human and environmental cost. Contact with mercury quickly deteriorated the health of the workers and environmental contamination reached its most critical colonial moment in 1626 when the San Idelfonso dam with the pollutants from the quicksilver process collapsed. It killed 4,000 people and carried an estimated 19 tons of mercury into waterways, causing pollution that reached the Río de la Plata through the Pilcomayo River, a tributary of the Paraná River (Gioda et al. 2002). As primary energy (food and firewood) and consumer goods were imported, Potosí impacted land use on a regional scale. By 1630, livestock was supplied from the Argentine pampas and pack animals were imported from Tucumán (Assadourian 1973). At the beginning, the pack animals had been llamas (*Lama glama*). But as they can only tolerate about 25 kilos, they were replaced by mules bred in Tucumán. The populations of Jujuy and Salta orbited around the Alto Peruvian mining industry, according to an eyewitness, since the 100 residents of San Salvador de Jujuy were muleteers (Vázquez de Espinosa 1948: 622).

This caravan traffic had a pre-Hispanic tradition on both sides of the Andes (Rivera 1995; Sanhuenza 1992; Hidalgo 2004, Quesada and Lema 2011; Conti and Sica 2011). In Salta, the mule fair was held between February and March and the Spanish need for corrals and pastureland met with the indigenous activities in the Calchaquí valleys. Spanish wars against various Kakana-speaking tribes during the seventeenth century had varied causes, although the second Calchaquí uprising (1630 and 1647) coincided with the consolidation of the use of the land for pasture. In the eyes of the natives, the booming activity of the Spaniards put them in danger because it made it difficult to access the carob trees (*Prosopis sp*). From its pods a flour is extracted for bread and, in periods of drought, it is the only wild fruit in abundance, which is why the Indigenous called its pods "*frutos de hambre*" (fruits of hunger).

Another long-lasting impact was the spread of now endemic diseases such as *fascioliasis* (named as *saguaype* by the Guarani, meaning "flat worm"), an herbivore parasite (Mera and Sierra et al. 2007). Another is sheep mange (*carache*) that in 1549 arrived in Santiago de Chile (founded in 1541) from Peru. The town council of Santiago had all the animals killed to prevent the spread of the disease, since it was known that in 1541 scabies in Peru had affected both cattle and natives. In addition, scabies had jumped the species barrier (spillover). It spread to the four American camelids: the llama and the alpaca, which are domestic, and the vicuña and the guanaco, which are wild. The dangerous anthrax was first recorded in 1590 in cattle in Buenos Aires (Noseda 2001).

Another impact was on resources whose management was contained in the field of indigenous knowledge. An example of this was that the Indigenous were the best carpenters in Tucumán during the colonial era, for they knew as much about wood as about native trees. This knowledge was appreciated because in Tucumán they repaired the wagons that were only good for a couple of round trips between Jujuy and Buenos Aires. In Tucumán they used lapacho wood (*Handroanthus impetiginosus*) which grows on the eastern slopes of the Aconquija sierras. The chronicler Fray Diego de Ocaña (1565–1608) recorded that its wood was the dominant resource for carpentry of both carts and furniture, although the wealthier preferred cedar furniture. Activities related to carpentry help Indians to pay their tribute dues, since the individuals entrusted with this job not only worked in the carpentry shops but were also in charge of felling and transporting the wood from the native forests to the city. Although deforestation progressed slowly because it took place in the months without rain (winter) and the export of hardwoods was a luxury that few could afford, in a century and a half more than 2,000 hectares of the Aconquija foothills were affected (Noli 2001: 12). Likewise, goods for ship repair were exported from Tucumán to Buenos Aires, such as tar for caulking, iron, and cabuya (*Fourcroya andina* and *F. occidentalis*), which is a plant that produces good fibers for braiding ropes and sails (Gentile 2009).

The Jesuits of Tucumán adapted the use of the land, investing in haciendas to produce wheat and sugar, maintain the breeding and fattening of cattle, textile mills, carpentry, and cheese making. They had capital, enjoyed tax exemptions, and cooperated among their various regional possessions (Andrien 2020: 78). The most important property in Tucumán was Tafí del Valle purchased in 1670. The expulsion of 1767 freed more than 400,000 hectares of the best pastureland for civilians, where the breeding of cows and goats was maintained for the production of a type of cheese called *tafinisto*.

Changes in Land Use from an Indigenous Perspective

The Indigenous contributed with labor when they could not do so in goods, incorporating environments and adapting land use to internal and external requirements. For example, in arid areas of Chile's Norte Chico (La Serena-Coquimbo), where water is scarce, Indian tribute was authorized on mining labor instead of agricultural products. Also, further north, in Tarapacá, mining work was dominant from the first *encomienda* given to Lucas Martínez Vegazo, with more than 1,500 tributary Indians. Half a century later, the viceroy promoted viticulture and the export of wine to the Alto Peruvian markets in order to generate income and allow the indigenous tribute to be paid in goods. As viticulture is appropriate for an arid region, most production was concentrated in irrigated pockets such as Pica, which produced up to 375,000 liters of wine annually (Urbina 2007).

For the natives, sheep and goats were a common form of payment for their services. Sheep had the advantage of providing wool, which natives could then use to pay their due tribute with textiles. Sheep grazing modified land use with long-lasting impacts, to start with, it in some way explains the relocation of the four native camelid species. In the paleontological and archaeological record, Andean camelids have been widespread since the end of the Pleistocene and were prized for their meat and milk, wool and hides, and their tendons and bones were used to make tools. Even today they are a source of energy as their dried droppings are used for cooking. Unlike the sheep introduced by Europeans and whose environmental impacts have been assessed as predominantly negative (Hunter 2009; Melville 1994; Weber 2005), American camelids do not erode grazing fields, are less selective in the consumption of natural grasses, and the cleft lip of the upper jaw together with a dental buckle allows them to cut grasses rather than uproot them. In addition, the anatomical arrangement of its four limbs and its toes with pads on the soles cause less soil erosion. The Incas protected the vicuña because of the quality of its fibers. Being a wild animal, it must be hunted for shearing and the indigenous people had a procedure – *chaku* – still in use today in the Andean communities authorized to shear vicuñas. During the colonial period, there were slaughters of up to 80,000 vicuñas

per year in Peru and northern Chile. In 1776, a quantity equivalent to the production of 20,000 animals in hides was exported through the port of Buenos Aires. According to a report of export figures for an average year, between 1792 and 1796, 18,402 pounds of vicuña wool was shipped to Spain against some 5,000 pounds combined for alpaca and sheep wool (Bliss 1952). One estimate indicates that, between 1663 and 1853, the equivalent of 1,572,000 vicuñas must have been killed to obtain the wool that left Buenos Aires for European markets (Laker et al. 2006).

The transfer of European livestock to native societies continued its transformative course and having multiple impacts in the long term. In the short term and throughout the continent, the symbiosis between the Indian and the horse was decisive. In an anecdote told by the major chronicler of the Indies, Antonio de Herrera y Tordesillas (1549–1626), his faithful Indian servant told him that the three most important contributions of Spain to native society were chickens because they provided good food daily, candles because they prolonged daylight at night, and horses because they made it possible to travel long distances quickly and comfortably. Similarly, when the explorer Count de La Perouse arrived in southern Chile in 1786, he concluded that the horse had transformed the Indian into a formidable warrior, like "the old Asian Tartars", nomadic, dressing with their skins, consuming their milk and meat, and with their ancestral practices modified forever (1798: 25).

It was not only the horse that had transformed the societies of the Araucanía. The allied Indians had been receiving sheep and goats as payment for their labor for the Spaniards and were raised alongside dogs and farm animals. All of this activity modified land use, although it is difficult to conclude on a single assessment of the impact on the environments. For example, by the end of the eighteenth century in Chiloé, sheep excrement had contributed to fertilizing the soil and this benefit had been so tangible in improving agricultural production that the indigenous people rarely killed a sheep or a goat for consumption (González de Agüeros 1788). But, at the same time, this behavior, which protected the sheep for its wool and manure, had neglected the traditional camelid, and since the eighteenth century, the existence of llamas in Chiloé has not been recorded. In northwestern Argentina, competition for pastures with introduced livestock caused native Andean camelids to migrate to the Puna (Mata de López 2005: 49). On another island – Juan Fernández at 33° – the Spaniards introduced dogs to hunt the goats that they themselves had previously introduced. This was in an attempt to deprive the pirates crossing the Strait of Magellan from finding food there. In the end, the goats evaded the dogs, taking refuge in the steeper places, so that both the population of goats and the population of maroon dogs increased (Juan and Ulloa 1748). Similarly, in the seventeenth century, rabbits were introduced into southern Chile to provide meat and fur, but two centuries later they were a pest that had displaced the native fox (Gallini 2020: 191).

In southern Buenos Aires, the expansion of sheep explains transformations in land use by the natives, since sheep had allowed for beneficial commercial deals

by the eighteenth century. The Hispanic-Creole bought textiles, ostrich feathers, leather, wood carvings, and tools for saddles from the natives (Mandrini 2006). As payment was made with wine and spirits, it has been decried as a trade that caused more problems than benefits (Sánchez Labrador 1936: 40, 164, 165, 175, 177). The town council of Buenos Aires in its session of September 7, 1747 had rejected a request to excommunicate those who paid the Pampas Indians with alcoholic beverages. According to the ecclesiastical chapter, wine was "harmful to the bodies," but the civilians replied that it was not harmful as was the case with the novo-Hispanic pulque, that if it was not sold the Pampas still stole it from the caravans and, finally, that if this was a valid argument, then those who sold wine to those who got drunk in *pulperías* should also be excommunicated; that is, a varied population that included whites, blacks, and mulattos (Archivo General de la Nación 1931: 292–297). At the same time, but in the opposite direction, a governor in Chile considered that it was necessary to stop buying ponchos and textiles from the Indians but sell them a lot of wine and spirits in order to take away their cattle, leave them without resources and complete the task of subjugating them (Alioto and Gimenez 2010). Finally, and as a caveat with respect to the information in the sources, documents from the second half of the eighteenth century indicate that the Indians of southern Mendoza exchanged goods (textiles, salt, tar, and gypsum) for food and not for alcoholic beverages (Gascón and Ots 2020). This same behavior was recorded for the Indians of Valdivia in 1766, who bought indigo, apples, pears, corn, barley, wheat, cattle, and sheep (León 1991: 105).

The size of the sheep herds of natives was proportional to the role their weavings had acquired as a passport, along with salt, to trade with the Spanish-Creole. This was the case for the Pehuenche, meaning "people of the pehuén" or "of the seed of the Araucaria-tree." They were collectors of Araucaria seeds for their food, supplemented by guanaco hunting. In 1774, the Pehuenche had an estimated 2,000 sheep around Campanario Hill, and by 1780, an estimated 1,114 sheep were reported in contrast to about 100 horses, 200 goats, and 17 dairy cows. Seven years later, an expedition to that area took more than 3,000 sheep from them. By this same date, these natives had obtained, through selection and crossbreeding with goats, a strong and long-haired sheep similar to the "pampas sheep," which was a hybrid achieved by natives of southern Buenos Aires and was highly valued in the nineteenth century to improve merino wool (Cattáneo 2008: 196). This pastoral process changed land use with the occupation of niches with pastures in different places and at different altitudes.

Land Use for Food and Commerce

The colonists' consumption implied permanent productive changes because European racist ideologies explained the physical differences between human groups based on the types of diets. So, they intended to continue with their food traditions and preserve themselves from any unwanted physical or mental transformation (Earle 2010). Likewise, an exportable surplus was required for trade. As a result, colonial agriculture and livestock farming forever changed land use in close relation to the globalization of both consumption and diets. The "Columbian Exchange" (Crosby 1972) introduced alfalfa, wheat, barley, chickpeas, lentils, lettuce, onions, cabbage, apricots, figs, lemons, oranges, bananas, cherries, melons, watermelons, pears, apples, quinces, peaches and pomegranates, among others into America. Family orchards provided food, although fruit trees could be more valuable for their firewood, as was the case in Buenos Aires where peach trees were planted for that purpose. But where climatic conditions permitted, the orchards with their fruit trees generated food and provided income to other markets by drying fruits and vegetables in the sun (Lacoste et al. 2011). Along with dried fruits, beans, chickpeas, and lentils had secured markets as the basic ingredients of soups and stews for land and sea travel.

European crops spread when soil and climatic conditions permitted, although there were exceptions. Olive trees and vines were planted in all the colonies because of the Mediterranean culinary tradition and because, together with wheat for flour, wine, and oil were central to the rites of Catholic worship. There were other considerations, as in wine, which had medicinal use and was a safer beverage for human consumption during travel than the water that could be found in the lagoons along the caravan routes. This explains the cultivation of vines in unsuitable areas such as Paraguay; and in fact, it was wine and not yerba mate that opened the trade route along the Paraná to Santa Fe, where vineyards were also planted shortly after its foundation. Unluckily, ants and aphids wiped out the vines prompting settlers to source from Paraguay (Gascón 2017: 453). In the minutes of the town council of Cordoba in 1601, the price of Paraguayan wine is recorded as higher than that of wine from Cuyo (Archivo Municipal de Cordoba 1882: 326) and a will from Buenos Aires noted both olive trees and vines in the orchards of the early seventeenth century (Lima 2019).

Native communities accepted vegetables for human consumption without replacing what they continued to obtain from hunting and gathering. In the case of cereals, there was complementary relationship between the wheat crop (*Triticum spp.*) and corn *(Zea mays)* because wheat has better resistance to cold and is a winter-spring crop, while corn has a summer-autumn cycle. Therefore, if the corn crop fails due to natural disasters or agricultural pests, there is still the possibility to find sustenance from wheat. In temperate zones, wheat was harvested between December

and January, and corn could be sown immediately, which, together with squash and beans, were harvested after April and up to June. In the Araucanía, this complementary relationship even accompanied the war strategy of the Indigenous rebels. In 1610, a royal official reported that the rebellious Indians were growing some corn near the trails where the Spanish soldiers would pass during the summer campaign, but the placement was only to tempt them to destroy that crop and return to the barracks believing that they had caused serious damage. However, the truth was that the crops that fed the Indians were at higher elevations suitable for wheat and far from the eyes of the Spaniards. Lentils, despite their versatility, were not cultivated because the Araucanians believed them to be the germs of smallpox, which they called "the Spanish disease." In 1561, they accused the governor of having brought the disease to exterminate them and, in 1611, there was a rebellion when a bag of lentils brought by the governor for consumption broke and exposed its contents. Rumors quickly spread among the Indians that the official's intention was to spread smallpox to kill them (Gascón 2007).

The Spaniards, for their part, appreciated the potential of a few native foods, principally the potato (*Solanum tuberosum*) when, in Potosí, the *chuño* – dehydrated potato – proved to be the staple food of *mitayos* who preserved it in good condition for long periods before stewing it (McNeill 1999: 70). Potatoes from the Altiplano have accompanied the squash (or "zapallo" from the Quechua *zapallu*), peanuts (*Arachis hypogaea*) native to Bolivia and northwestern Argentina, and the Peruvian tomato (*Solanum lycopersicum*). Cinchona (*Cinchona officinalis*) was considered the most important medicinal plant overseas during the eighteenth century. Among the tropical fruits, pineapple (*Ananas comosus*) has been known since Columbus' second voyage and, because of its resemblance to the cone of the pine tree, was called "piña," the word *ananá* is Guarani and means "big fruit."

One of the most extensive and long-lasting transformations in land use in much of the Americas and the Caribbean was due to the introduction of sugarcane. In our area, the poles were Peru and Paraguay, where after the expulsion of the Compañía, production was maintained sparsely in some of the northern towns (Wilde 2001). Promoted by the Bourbon reforms to activate the economy, in 1790 the importation of Cuban sugar was authorized through the ports of Montevideo and Buenos Aires. As payment, Buenos Aires exported some 70,000 quintals (a quintal was equivalent to approximately 100 kilograms.) of tasajo (salted meat) to Cuba, compared to the little more than 2,000 quintals destined for all the peninsular ports (Silva 2020: 29). Tucumán began to produce sugar for export and in Córdoba, from 1790 onwards, Cuban sugar replaced Peruvian sugar and led to an increase in the export of tasajo to Cuba, as had been the case a decade earlier. This new commercial circuit with the Caribbean modified the use of the soil since the production of tasajo required cattle and salt: both resources abundant in native territories or close to them. It is understood that Bourbon officials strove to maintain good relations with the Indians (Lev-

aggi 2002; Roulet 2004; Rustán 2013; Pérez Zavala et al. 2017). In 1790, for example, a treaty with the Pampas guaranteed tranquility on the route to the Salinas Grandes, located 600 km south of the port and under the jurisdiction of the *cabildo* (colonial municipal administration). Since 1716, the cabildo supervised the caravans and the natives offered their services for salt extraction and loading. They also traded textiles, feathers, and furs (Vollweiler 2018).

In Chile, progress had been made towards differential and complementary land use. While in Rancagua Quillota, Aconcagua, and Melipilla cereals were planted for local consumption and export to Peru, cattle grazed mostly in the Maule region (Archivo Nacional de Chile n.d.: f. 99). Both for local consumption and for export, beef, pork, and fish required salt imported from Peru. The demand for salt was high because it was also used as a mordant in dyes and for cheese making. Santiago harvested salt in the coastal lagoon of Rapel which, in the native language, means "black clay". And, indeed, it was a dark salt and unattractive for use in food (Lizárraga 1602: 269). Imported salt from Peru was expensive, so the option was sea salt (Ramón and Larraín 1982) or imports from Argentina. Since the seventeenth century, the Indians had been taking salt from Neuquén across the Andes to Chillán (36°SL) to supply themselves with cereals, in a symmetrical exchange since a bag of salt was equivalent to a bag of wheat (Rosales 1877: 325). Some traders from Santiago avoided intermediaries and crossed the mountain range themselves in search of salt from the south of Mendoza, generating conflicts with the natives who counted on this salt as the main resource for their exchanges. Therefore, when the colonial authorities failed to stop those who crossed the Andes to enter the salt flats, it was the Pehuenche themselves who organized the defense of this resource. The most important episode occurred in 1769 and is known as the Pehuenche rebellion, because it hastened the arguments in favor of the foundation of the fort of San Carlos (Xaurúa), which was ordered the following year (1770). The rebellion involved the natives seizing some 500 mules coming from Chile to harvest salt from southern Mendoza to prevent the theft of their precious resource (Gascón and Ots 2020).

Location, Resources, and Imperial Strategy

Since Philip II, foundations were to be made where conditions of sustainability such as healthy air and soil; fertility for food production; and sufficient pasture, water, and firewood were met (Centro de Estudios Políticos y Constitucionales 1998: 14–15). This explains why the descriptions sent to the crown presented positive information on the locations. One finds this in the founding act of Santa Fe in 1573 where it notes that the site had "water, firewood, pastures, fisheries, hunting, land, and estancias for neighbors," but the difficulties were so evident that in 1650 it was moved some 80 kilometers to the south (Areces 2021). Decisive in both occupation and land use were

practical considerations such as extractive activities, the presence of natives or imperial defense. Mining, as this chapter has noted, was the activity with the greatest impact on land use in the first centuries of colonialism and what determined human settlement in a place with such difficult environmental conditions as Potosí, where resources for food and daily life were scarce. By consuming large amounts of water and energy, mining in Upper Peru modified the surrounding tropical and subtropical zones, because firewood and charcoal were extracted from the Chiquitano country to maintain the smelters as the availability of altiplanic shrub species with caloric power, such as yareta (*Azorella compacta)*, ichu (*Stipa ichu*) and jarilla (*Adesmia atacamensis*), collected by natives as mita was surpassed (Zagalsky 2014).

Likewise, the forests along the shipping routes were affected by extractive practices. In the Valdivian forest eco-region (40°- 43°SL), species such as the hazel (*Gevuina avellana*) and the Patagonian larch (*Fitzroya cupressoides*) were locally harvested timber and were the main export item from Chiloé to Peru for civil constructions and for the Guayaquil shipyards (Urbina 2011). The crown considered the Patagonian larch to be a strategic input because they are large, rot-resistant trees, which were used to repair ships once they had crossed the Strait of Magellan. There are records of logging in 1567 to harvest the hardwood of the luma (*Amomyrtus luma)* in the palisades of the forts of the Araucanía. Firewood and timber for mining, construction, and agricultural and livestock production reduced the xerophytic forests of carob and chañar (*Geoffroea decoricans*) in Chile (Iglesias Zúñiga 2005), in Mendoza (Prieto 1989) and in Córdoba, where there were lawsuits in the eighteenth century to guarantee community access to the forests from which firewood could still be extracted (Tell 2008). In Buenos Aires, the scarcity of trees is present in the very term "pampa," which in Quechua means "plain or flat land without trees." Its 40 million hectares are grasslands and only the ombú (*Phytolacca dioica)*, because of its size and appearance, looks like a tree, but it is not a tree and therefore does not produce wood. Since 1590, the Buenos Aires town council took measures to regulate the extraction of trees for firewood and timber from the Paraná River delta. It prohibited the cutting of willows, demanded that wagons arriving from other places bring their own loads of firewood and controlled how much firewood the ships took out before leaving the port of Buenos Aires. The low construction quality of the properties made of straw, cane, and raw clay is explained by the limitations of fuel to feed the kilns for firing ceramics (Gascón 2011: 86–87).

The demand for firewood and timber increased when the population of Buenos Aires reached 40,000 in the second half of the eighteenth century. The inhabitants of the port required goods supplied by the surrounding horticulturalists and by small and medium-sized livestock producers and farmers (Gelman 2012). Interest arose in the virgin areas of the Boreal Chaco and the Bermejo River, where valuable resources, from timber to pearls, were supposed to be found. And within this same territorial expansion, lands were occupied in Entre Ríos and Uruguay (Djenderedjian 2003) and

Santa Fe reinforced its frontier with the natives of the Chaco (Suarez and Tornay 2003: 548). Some of these local trends were amalgamated with the interests of the crown which, in response to the foundation in 1680 of the Portuguese Colonia de Sacramento across from Buenos Aires to introduce contraband, had founded the fort of San Felipe de Montevideo between 1724 and 1730. Its inhabitants were given land for their livelihood to the point that the export of tasajo to the Cuban sugar haciendas became the main change in land use in the eighteenth century.

Both the Araucanía and the Río de la Plata were strategic areas in the imperial defensive scheme in the south of Spanish America. When Buenos Aires was abandoned after its first foundation in 1536, its inhabitants moved up the Paraná and founded Asunción del Paraguay in 1537. Certainly, these Spaniards were closer to Potosí and close to the route that Alejo García had used in 1524 to go from the Atlantic coast at Santa Catalina Island (27°LS) to the foothills of Alto Perú. It was a pre-Columbian route called *Peabiro,* and that Ulrico Schmidl (1510–1580) knew because he participated in the foundations of Buenos Aires and Asunción. He himself would use it in 1554 to embark and return to Germany (Lütge 2017: 50). However, by depopulating the entrance to the Río de la Plata and establishing a population nucleus in Asunción that cut off the *Peabiro*, the crown opened up a new front of insecurity; something that was clearly seen in 1578 when Francis Drake was able to spend a couple of weeks in what was left of Buenos Aires, preparing to continue south and head for the Pacific. As this chapter has stated, in 1579 he comfortably plundered the mighty galleon *Nuestra Señora de la Concepción* before it entered Panama with its rich cargo, mostly of gold and silver. Just one year later, in 1580, the fort of Buenos Aires was founded for the second time. Beyond the consideration of promoting the exchange between populations in the Paraná axis and thus "opening doors up to the land" (Barriera 2013), it is certain that there was an imperial component in terms of the need to protect the Hispanic-American south end. In 1580 an expedition from Spain arrived in the recently refounded Buenos Aires with the final objective of fortifying the Strait of Magellan. General Alonso de Sotomayor disembarked in Buenos Aires, determined to reach Santiago de Chile by land. Sotomayor opened the imperial route that linked Buenos Aires with Santiago de Chile, following a military objective that avoided the most dangerous stretch of navigation from Spain to the Pacific, which was to cross the Strait of Magellan. In this route with military and defensive aims, Buenos Aires remained as a strategic port for the disembarkation of aid, while Córdoba and Mendoza were to provide the supply for the troops (Gascón 2007).

The Bourbons, for their part, strengthened the Río de la Plata to continue with the care of Uruguay and the pampas (Néspolo 2012, Fradkin 2014). In Bourbon Cordoba, the southern border with the Indians was strengthened from the second half of the eighteenth century because it was the route used by the caravans. The governor intendant, Marqués de Sobremonte (1745–1827), decided that its protection would be articulated with that provided by the fort of San Carlos in Xaurúa and that

it would be financed with some of the taxes paid by all the people of Cordoba (Punta 2001). Thus, the location of the populations due to the demands of the imperial defense organized the use of the land, even if it was ultimately limited to the environmental conditions, as has been pointed out. A final example of optimization and a complementary relationship is the Jesuit estancia La Toma in Catamarca in northwestern Argentina. Although promising, the priests discarded cotton production in order to prioritize the use of water in the cultivation of corn, which they complemented with vineyards for brandy, because corn needs irrigation in winter, when the grape vines do not (De la Fuente 1988).

Conclusion

The colonial centuries started processes that today are incorporated into the debates on the very concept of the Anthropocene. The colonial period was an initial time of land use changes whose consequences reach into the present. For this reason, Wendt considers the colonial as a proto-Anthropocene while Voosen has proposed investigating the Anthropocene as an event. Colonialism as an event changed land use throughout the continent and in a decisive way.

Indeed, the colonial event on the American continent modified the demographic base, introducing crops and animals, reorienting commercial exchanges and favoring the placement of new populations. These spawned profound changes in populations, flora and fauna, with previously unknown diseases affecting humans and animals and a reorientation of the flow of trade in goods at the regional and international levels. The Anthropocene cannot consider, therefore, only the antecedents for Europe such as the Industrial Revolution. What has happened in the Americas since the sixteenth century shows decisive changes in land use that initiated processes whose consequences are still present. In other words, the colonial period was a profound and irreversible alteration of the demographic base, perhaps equivalent to the arrival of the first settlers at the end of the Pleistocene and the beginning of the Holocene.

If one follows the stratigraphic record, after the sixteenth century we find irreversible changes in the fossil record of our continent. The pollen of new plants and the bones of new animals introduced from Europe appear together with fossil evidence of a native fauna of camelids displaced by the irruption of competitors. One can find urban organizations without continuity with those carried out until then by the natives at the end of the Pleistocene as well as also new materials and minerals such as mercury for mining. Therefore, understanding the Anthropocene as a multiple crisis implies relating colonial land use, as one sees for the territorial strip between 19° and 34° SL, with irreversible and cumulative changes in the long term in

reference to population, resources, and location of both population and resources, following certain environmental and imperial requirements and limitations.

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