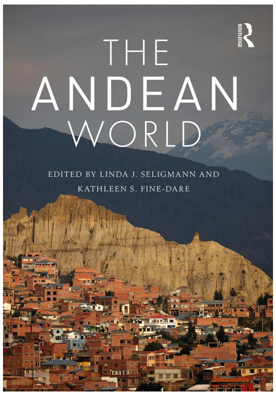

The Andean World

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The domesticated landscapes of the Andes

Publication details
https://www.routledgehandbooks.com/doi/10.4324/9781315621715-3
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Published online on: 28 Nov 2018

CHAPTER TWO

THE DOMESTICATED LANDSCAPES OF THE ANDES

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INTRODUCTION

Agriculture, including the farming of domesticated crops and herding animals (agro-pastoralism), is key to the development of settled life and civilizations. The domestication of plants and animals involving control of their reproduction and survival, selection for higher yields (better taste, color varietals, longer storage, and other traits) and related infrastructure took hundreds of years of experimentation and careful tending by humans. The result was an impressive complex of crops and animals suited to diverse needs and specific environments. Domestication also included the human built environment such as the creation of the domestic sphere and cultural landscapes from nature. The domestication of landscape involved intentional permanent changes to the natural environment to meet human needs, specifically the creation, transformation, and management of important resources. This domestication includes transformation of the environment for crops and economically important wild species of plants and animals, as a result increasing their numbers, quantity, and availability, often in competition with natural biodiversity. The process involved clearing of land; physically reshaping or "terraforming" the surface of the earth for fields, residences, roads, and other human features, and substituting natural biodiversity with agrodiversity.

Early Andean farmers faced an environment that was both challenging and of considerable potential due to its diversity, including deserts to tropical forests, sea level plains to glacial capped mountains. The Andean region is characterized by dynamic geological, climatic, and ecological systems with unpredictable and disruptive events such as droughts and floods caused by the El Niño phenomenon, earthquakes, landslides, and tidal waves, and longer cycles of climate change over time. Despite these risks, Andean peoples learned to thrive in this environment through their labor, ingenuity, and cultural practices, much of these expressed in landscapes of everyday life. Though only a brief survey of the rich complexity and variation of Andean agriculture across time and space, this chapter tries to capture the most remarkable and unique inventions, innovations, and landscape transformations of the pre-Columbian farmer.

DOMESTICATION, CROPS, ANIMALS, AND TOOLS

The processes of domesticating plants and animals; raising food that complemented or replaced hunting, gathering, and fishing; and the adoption of village life took thousands of years in the Andes. As in most societies, Andean farmers produce surpluses rather than a "hand to mouth" existence at a subsistence level for sustaining their social, economic, and political life.

Domestication of plants and animals began long before Andean peoples settled in permanent villages. Many crops (manioc, capsicum pepper, peanut, achira, and coca) were adopted from the tropical forest peoples in Amazonia or from Mesoamerica (maize) while other key crops (potato, quinoa, cañihua, sweet potato, isañu, oca, ulluco, pumpkin squash, lupine, cotton, lima and jack bean, lucuma, avocado, chirimoya, and pacae) were indigenous (Pearsall, 2008). Domesticated animals included llama, alpaca, guinea pig, and dog (Stahl, 2008). Increasing reliance on farming and herding over hunting, gathering, and fishing increased at the same time as the first appearance of public monumental architecture and irrigation around 3500 BCE (Haas and Creamer, 2012), although adoption of domesticates was not uniform in that crops appear late in some valleys. The demands of Andean social life inspired beer brewing (*chicha*), diverse cuisines, and expansion of farming and herding. Freeze-drying techniques and sophisticated storage structures provided a means of accumulating resources for times of need and support of social life (Peñarrieta et al., 2011).

Compared to Andean farmers' rich environmental, climatological, agronomic, and organizational knowledge, the tools they used were perhaps more simple but nonetheless quite effective. Often referred to as "hardware poor" (Donkin, 1979; Denevan, 2001), the primary tools are the *chaquitaqlla* (Q. *chaqui* = foot; *taqlla* = plow), mattock or hoe (A. *liukanas*), clod buster or club (Q. *watana*), and digging or planting stick (Donkin, 1979; Bourliaud et al., 1998), in addition to carrying cloths and baskets for moving earth. The chaquitaqlla is composed of a vertical shaft, a hand hold, and foot peg of wood, a blade (of either a wide flat extension of the vertical shaft, ground stone, chipped stone, copper, or bronze), all tightly bound by a long leather lashing. This tool is commonly used in teams with two men working at right angles to cut and raise sod, often with women turning the sod bock over to bury the surface vegetation to prepare the field for sowing.

Throughout late prehistory, Andean agriculture was intensive, meaning that farmers cultivated most fields many years in a row with short fallow or rest periods. Rotated camelid herds consumed sparse grass at high altitudes and its energy and nutrients were concentrated in potent dung deposited in corral areas (Winterhalder, Larsen, and Thomas, 1978). The camelid dung (of domesticated llamas and alpacas) was carefully collected into piles to dry and carried to plowed fields as an organic fertilizer for the first year's crop of potatoes. In high altitude above the tree line, camelid dung was burned as fuel for its high heat content and lack of smoke. Although many Andean communities were agropastoral, combining farming of crops and herding of animals, specialization often promoted a symbiosis between full time pastoralists at high altitude and farmers in the warmer valleys below involving trade of crops for camelid meat, wool, skins, and dung. Coastal farmers had access to concentrated bird guano on offshore islands, an abundant and rich fertilizer. Due to its high value, trade for guano extended throughout the southern Andes.

CULTURAL STRATEGIES

The key to the transformation of the Andean environment into a productive agricultural landscape was the use of traditional social institutions for the mobilization and organization of labor rather than development of a complex tool technology and/or use of draft animals. The basic organizational unit of Andean farming and herding communities is the *ayllu*. Although variable in form, the ayllu is made up of groups of related households with a common identity around a *pacarina* or place of origin and links to important past ancestors. Various ayllus are combined into moieties, a form of dual organization of individual communities whereby two paired moieties or "halves" compose a community (Murra, 1979; Weismantel, 2006). Nested ayllus can be also arranged hierarchically to form "macro-ayllus" when needed, such as for defense or war.

As in many regions of the world, the farm or herding family is the basic unit of labor. Traditionally, farm and pasture land was communal property except for family house plots and corrals. The community allotted sufficient land to support each family themselves and assigned fields were periodically rotated throughout the community territory. Community leaders controlled other lands for the support of local *huacas* or shrines and the cults of important ancestors and they drew upon the labor of the community to cultivate the land. The typical Andean community was dispersed in hamlets and small settlements throughout its territory; often, individual households maintained multiple houses to be close to fields, pasture, and other resources in various environmental zones and connected to neighbors for sharing labor and social life. The community's center was often highly visible cemeteries with houses of the dead (*chullpa*) dedicated to important ancestors which legitimatized the right to use land, public plazas for ceremonies, and shrines for local sacred *huacas*, which were recognized and named places or objects of ritual importance for community identity (Salomon, 1995). In some cases, communities held land in distant regions and diverse ecozones to access non-local resources (a model also known as vertical archipelagos and zonal complementarity) (Brush, 1976; Murra, 1979). The long-term occupation of and identity with territory as a community ensured that the improvements to land and infrastructure made over centuries were passed down over generations.

Andean irrigation could range from small local operations to entire lower valley networks covering hundreds of square kilometers and in some cases even crossing drainage basins. Irrigation often required coordination of farmers organized along irrigation canals who were responsible for equitable distribution of water and the building and maintenance of canals, canal intakes, and other infrastructure (Treacy and Denevan, 1994). Farmers using irrigation could lower risk of droughts and farm the vast coastal deserts. The Andean practice of "field scattering" in multiple local environmental zones spread potential risk for farm families (Goland, 1992). Farmers also developed storage techniques for food preservation such as freeze-drying of tubers (*chuño* and *tunt'a*) and meat (*charqui*). Later they developed large, specialized below and above ground silos (*qolqas*) to survive bad years and store surpluses to finance non-subsistence social and political life (Peñarrieta et al., 2011).

Ayni is a traditional form of delayed exchange of labor and/or goods between farm families, which is especially important in times when coordinated labor is the most efficient way to plant, harvest, store, and process crops, and to shear animals

(Mayer, 2002). *Minka* is communal labor of multiple farm families organized by a sponsor, commonly a community leader, for construction of public works or farming community lands supporting the infrastructure and cults, often "paid for" by the sponsor through feasting and drinking. *Mit'a* is an advanced form of labor organization used by the Inca and, presumably, other Andean states (D'Altroy, 2003). In the past, Andean peoples paid their taxes to local, regional, and later imperial leaders through labor rather than crops, animals, or valuable objects. This practice involved several weeks or more a year of labor dedicated to public or state works by all adults. Thus, the labor tax was used to produce resources for the state on state-controlled farms, mines, and quarries, and was often used to expand agriculture into new areas through construction of terraces and irrigation networks or to create more efficient transportation such as roads, bridges, waystations, and pasture for llama caravans (D'Altroy, 2003).

FARMING AGROSYSTEMS

Dry fields/permanent fields

Most Andean farming was done in simple fields (*chacra*) watered by rainfall and periodically fertilized. The earliest and simplest fields were relatively unmarked spaces that were infrequently used. To restore and maintain fertility, fields were regularly fallowed, often over longer periods than the years in cultivation. The early fields had little formal built environment that is characteristic of more intensive forms of agriculture, thus remaining largely invisible in the archaeological record. The constant encounter of stone during each year of cultivation and its placement on the edges of fields in year after year of plowing created permanent rock piles and wall features marking past cultivation. Over time, considerable investments in time and energy were taken to maintain and sometimes increase production. With the continuous use of landscapes and growing populations, these mundane fields gradually acquired formal walls and other field boundary markers, canals, aqueducts, level surfaces for terracing, and crop rotation systems (Denevan, 2001). Everyday life in farmed landscapes required movement and circulation among households, fields, pasture, water, and other resources spread across space, resulting in complex networks of paths, trails, roads, ramps, and stairs that were permanently inscribed in the landscape (Erickson, 2000).

Stone-walled corrals of herders at high altitude are used to gather and protect camelids at night. Their dung accumulates in the floors and after many years the corral is taken out of use. The fertile space now can be used to cultivate potatoes, which thrive in the rich soil and within the protection from the elements and thermal heat provided by the walls, thus permitting their cultivation far above the range of most crops where frosts are common.

Raised fields

Raised fields (S. *camellones*, Q. *waru waru*, A. *suka kollus*) are one of the most impressive and well-studied forms of Andean agriculture and have been documented in the highlands, coast, and tropical lowlands (Erickson, 1992; Kolata, 1993; Denevan, 2001; Figure 2.1). Raised fields are generally found in flat areas that are

Figure 2.1 Experimental raised field planted in potatoes in Huatta, Peru in 1982

Photo credit: Kay L. Candler.

prone to shallow seasonal flooding and/or high waterlogging, often located in natural or artificially enhanced wetlands. Sufficient local drainage must be created for crops to survive these conditions; thus farmers created alternating raised earthwork platforms and canals of consistent patterns of groupings, orientations, wavelengths, and sizes. Rectangular flat platforms are made of earth excavated from adjacent canals. The process of construction, in effect, doubles the depth of fertile topsoil, provides local drainage, and creates a dry surface for farming.

The canals trap, capture and store water from rain, runoff, river and lake flooding for use for crops on the platforms through percolation to the root zone or direct application as irrigation. These water-filled canals provided a "green manure" and other nutrients in the form of waterborne sediments from nearby hillslopes and topsoil eroding from the field platforms; decomposing blue-green algae, totora reed, duckweed, and crop debris; and animals such as frogs, fish, snails, insects, and aquatic birds that thrive in this habitat. A complex web of interconnected raised field canals can be opened for drainage of excess water or closed for capture and storage of water, depending on farming needs. Long straight canals radiating from settlements on nearby hills and mounds in the wetlands provide aquatic navigation routes for access to households, raised fields, and open water in the wet season and serve as roads during the dry season. Experiments have shown that standing water in the canals can store solar energy as heat that warms the air and soil of surrounding raised field platforms, providing protection against frequent frosts (Erickson, 1992; Sanchez, Baveye, and Riha, 1994).

Although raised fields cycled in and out of use at various times in prehistory and were finally abandoned with the Spanish Conquest, experimental archaeology and programs to rehabilitate pre-Columbian agriculture have shown that raised fields can be highly productive and efficient, despite the initial high labor costs of their construction. Debates about their role in pre-Columbian lifeways and status as sustainable agriculture have been intense (e.g., Erickson, 2003; Swartley, 2002; Bandy 2005; Baveye, 2012; Renard et al., 2012).

Terraces

The most visible transformation of landscape for agricultural production was the establishment of dry and irrigated terracing (Q. *andenes*, A. *pata pata*) on steep slopes throughout the Andes (Donkin, 1979; Figure 2.2). Terracing probably began with simple earth berms protected by vegetation running along slope contours (lynchettes) and later developed into formal stone faced retaining walls and fill to level them. Most Andean terraces continue in use today, although they tend to be poorly maintained and many have been modified or destroyed through mechanized agriculture. Formal terracing involves the excavation of a wall foundation ditch along the contours of a hillslope, construction of a sturdy stone retaining wall, and the cutting into the slope for earth fill to level a platform for crops behind each wall. In general, at the same level of a terrace wall top and platform surface, the base of an adjacent terrace wall upslope is constructed, creating a continuous stair-like

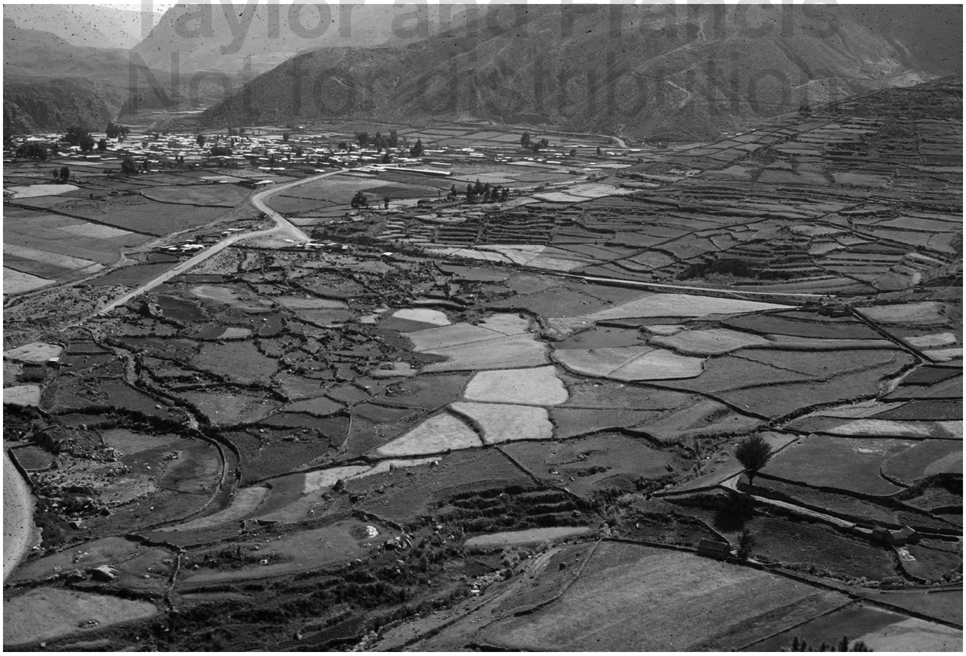

Figure 2.2 Terraced landscapes of the Colca Valley, Peru in 1985

Photo credit: Clark L. Erickson.

arrangement from valley floor to ridge top in many valleys—a monumental landscape of everyday life. Pre-Columbian terraces are estimated to cover large areas of the Andean highlands (Donkin, 1979; Denevan, 2001).

Terraces can range from simple isolated earth faced platforms to complex networks of well-built stone-faced architecture covering mountain sides. The simplest are lynchettes, where a row of dense vegetation (such as maguey or grass) is planted along a slope contour and erosion gradually and passively fills and builds up behind the living wall to create a flattened planting surface. The most complex examples are bench terraces, carefully engineered massive retaining walls supporting stone buildings and fields of important Inca sites such as Machu Picchu, Chinchero, Ollantaytambo, Moray, and Cuzco. Bench terraces often had carefully layered soil fills of graded rock and earth, from coarse on the bottom to fine on the top, which permitted internal drainage and prevented waterlogging, collapse, and landslides (Treacy and Denevan, 1994; Donkin, 1979). Most terrace walls were constructed of local fieldstones collected onsite during surface clearing and construction, often rolled or slid downslope from above. Farmers often incorporated projecting stones in walls that served as stairs to allow movement vertically up and down field systems; wall niches for storage or refuge for workers during storms; irrigation canals to distribute water; water drops or slides from one field to the next; and stones of contrasting colors to create simple patterns.

Although terracing is a recognized strategy of soil conservation, Andean farmers note that the purpose of terracing is to create flat surfaces to distribute irrigation water, runoff, and/or rainfall evenly and effectively (Treacy and Denevan, 1994). Water was often brought from distant glacial sources through irrigation canals winding around mountain slopes to be distributed where needed. The addition of irrigation increased crop production, reduced risks of drought, and allowed multiple crops per year. By terracing, farmers also took advantage of warmer slopes above low-lying areas where freezing air from frosts drains and accumulates at high altitude (Grace, 1983; Earls, 1989).

Although considerable cooperative community labor is necessary to construct well-built terraces, once constructed the fields can produce for decades with about the same labor input as a dry, rainfed field. Despite abandonment, no soil amendments, and lack of maintenance over the past 500 years, terrace soils maintain considerable fertility and many are still in use (Sandor and Eash, 1991; 1995; Goodman-Elgar, 2008; Nanavati et al., 2016).

Sunken gardens

Qochas (S. *chacras hundidas, pozas, ojos de agua*; Q. *q'ochas* or *kochas*; A. *q'otanas, cotaña, cota*) are shallow artificial "sunken" gardens or heavily modified natural ponds, lakes, and sinkholes that are used to manage water and other resources (totora, algae, organic matter, small fish) for agriculture (Figure 2.3). The best studied are the qochas of Lake Titicaca (Flores-Ochoa and Paz 1983; Albarracín, 1996; Craig et al., 2011). Some scholars argue that the sustained use of qochas in the Ramis River basin is possible due to a thick impermeable clay layer that created a perched or high-water table (Craig et al., 2011). While this geological insight explains the high density of these features in this location, the thousands of similar features throughout

Figure 2.3 Sunken garden prepared for potatoes (foreground) and sunken garden in fallow with water (background) near Nicasio, Peru in 1985

Photo credit: Clark L. Erickson.

the region demonstrate widespread use of the technique in a variety of contexts. Qochas have been dated to the Early Intermediate Period (200 BCE–600 CE) and continue in use today. Most show evidence of having been excavated in low-lying areas to reach the water table and capture rainfall. The management strategy is impressive. When they are not farmed, the water bodies accumulate organic matter in the form of aquatic plants and sediments over a period of years. Totora reeds used for thatch and reed boats can be cultivated and small fish raised. The qochas are then drained and the now dry and fertile surfaces planted with potatoes and other crops over a series of years. Qochas managed by a family or ayllu are often interconnected by complex networks of canals that regulate water levels.

Another form of sunken gardens characteristic of the coastal valleys are *mahamaes* (Q. *wachaques*), which are located on the coast of Peru (Denevan, 2001; Lane, 2014). In the wide deltas in the lower course of these rivers, most river water has been tapped for irrigation far upstream. Farmers found that they could dig through the desert to recapture irrigation water lost to seepage and access ground water, often meters below the surface to create fields with excavated fill forming rectangular grids of low berms.

Filtration galleries

Throughout the highlands and southern desert coast of Peru, a sophisticated means of obtaining water from deep aquifers for irrigation using underground aqueducts was developed. Filtration galleries or *puquios* are either an open trench or a horizonal gallery/tunnel that serve as canals to capture and direct underground water to the surface for irrigation (Barnes and Fleming, 1991; Schreiber and Lancho, 2003; Lane, 2017).

Trench puquios are dug down to the water table with the floor of the trench slightly sloped to direct flow towards irrigation canals and fields in the river floodplains, often over long distances. To prevent erosion, the open walls of the trench are lined with stone (Schreiber and Lancho, 2003). Where the soil is compact and stable, a gallery puquio—a long horizontal tunnel excavated through the earth to the water table—is constructed. In unstable soil, trench puquios are made and the walls are then stoned lined, roofed with wood beams, and covered with a deep layer of soil to create a narrow tunnel or filled-trench gallery. In both types, the size of the tunnel can vary from a crawl to walk space. A series of stone-lined vertical shafts from the ground surface to the tunnel provide light and access for periodic maintenance. Puquios often combine both trench and gallery structures throughout their course and many are still in use.

Scholars debate whether the puquios are indigenous or introduced by Europeans. Similarities between gallery puquios and the widespread *qanāts* of north Africa and the Middle East and early historical documents mentioning the technique are used to argue for late introduction (Barnes and Fleming, 1991). Association with Nasca Period sites (400–500 CE), artistic representations, and the long history of desert occupation by farmers in the region have been used to claim pre-Columbian origins in the Nasca and Ica valleys (Schreiber and Lancho, 2003).

Canal irrigation

In addition to experiencing frequent drought, much of the Andean region is arid or has irregular rainfall, making agriculture risky. In a manner similar to other indigenous solutions practiced worldwide, Andean farmers developed irrigation to move water from locations where it was abundant to dry areas that were to be farmed. The process often involved complex hydraulic engineering and coordination over large valleys. Although used in the highlands to extend growing seasons and mitigate risks, the most impressive irrigation systems were established in the north coastal valleys where arid conditions predominate but good soils are present (Denevan, 2001; Lane, 2009).

In laying out contour canals over long distances, farmers had to be aware that if the water moved too fast, the sides of the canal could be eroded and breached; if flow was too slow, sediments built up and filled the canals. Construction through trial and error or possibly the creation of simple surveying devices using open containers of water established optimal grade levels for the volume of water necessary (Ortloff, 1988). High volume canals are often associated with other engineering works including aqueducts crossing ravines and valleys, stone retaining walls on steep slopes, water drops, and channel "friction" structures to dissipate some of the force of rapid and high flow (Ortloff, 1988). The most ambitious projects were three vast intervalley irrigation networks where long canals crossed adjacent river basins to increase crop production on the coast (Ortloff and Moseley, 2009).

The Andean region is dynamic and irrigation farmers had to constantly mitigate droughts, floods, and landscape changes. Tectonic uplift caused by the meeting of two continental plates which form the Andes mountains raises the ground surface 1.8 cm/year. Over time, the accumulated impact of this phenomenon is significant as rivers adjust by eroding deeper in the channels, thus increasing the distance upstream to where river water can be diverted into irrigation canals for fields in the desert along the rivers (Moseley, 1983). Over time, the locations for maximum capture of river water migrates to the base of the Andes where higher water velocity and landslides make the establishment of canal intakes impossible, resulting in reductions of irrigated areas.

Dams and reservoirs

Some Andean irrigation systems require collection and storage of water far upstream for use at various times of the year in fields below. Pre-Columbian dams and reservoirs of stone and earth with complex inlets, outlets, and other hydraulic engineering have been documented for many highland regions, and many are still in use tapping runoff and glacial melt (Salomon, 1998; Lane, 2009). Check dams are simple barriers of earth and stone built across ravines and narrow valleys in dry areas to capture and retain infrequent runoff water and rich topsoil eroded from above for cultivation and conservation of resources.

Channelized rivers and other flood control engineering

During El Niño years when periodic and abrupt changes in ocean temperature and currents disrupt global climate, heavy rains cause flooding. When previous major earthquakes have loosened soil structure, these events cause massive erosion and landslides of mud and rock, which in turn lay down thick sediments in fields and canals in the coastal valleys (Ortloff and Moseley, 2009; Sandweiss et al., 2009). The earth berms of the mahamae of the same area have been proposed as flood control structures to protect the sunken gardens from similar fate (Knapp, 1982). By the Initial Period (1800 BCE), massive earthen flood barriers and diversions were constructed in Lurín Valley to protect temples and fields from the periodic waves of water and soil from the mountains (Burger, 2003).

The most impressive hydraulic feat was the channelization of the Vilcanota/Urubamba rivers near Cusco (Farrington, 1983). According to colonial documents, the Inca empire mobilized 40,000 workers who worked for many years to straighten and contain the meandering river by temporarily rerouting water for the construction of a massive stone-walled channel of tens of kilometers to serve as the new course. While this massive undertaking provided flood control and additional farmland, the primary goals may have been to straighten the river for aesthetic effect and to show political power.

Artificial pasture

Bofedales (S. *bofedal*, A. *oqho*) are large, high altitude spring-fed wetlands or bogs traditionally used for grazing of camelids. In Andean ethnography and historical documents, bofedales can be classified into three types: natural spring-fed wetlands, artificial wetlands created through irrigation, and enhanced natural wetlands through

Table 2.1 Guide to Andean agriculture landscapes on Google Earth

Type	*Location*	*Longitude/latitude*
Raised fields (*waru waru, suka kollu*)	Huatta	15°37'29.39"S; 69°59'15.83"W
Terraces	Pomata	16°17'42.49"S; 69°19'21.01"W
Canal irrigation	Casma	9°29'2.44"S; 78°22'5.35"W
Sunken gardens (*qochas*)	Corpa	15°11'4.83"S; 70°14'41.37"W
Sunken gardens (mahamaes)	Chilca	12°31'17.02"S; 76°45'12.80"W
Irrigated pasture (*bofedales, oqho*)	Nunoa	14°34'12.16"S; 70°31'45.77"W
Filtration Galleries (*pukios*)	Cantayo	14°49'35.71"S; 74°54'37.28"W

addition of canals (Palacios, 1977; Erickson, 2000; Maldonado, 2014–2015). Bofedales often involve the construction of long canals tapping water from distant springs and a network of dendritic secondary canals to distribute water over a few hectares to many square kilometers. A bofedal under artificial irrigation provides forage year-round, thus solving the problem of seasonal availability for camelid caravans carrying cargo to camps and waystations along trails and roads. Large herds of alpacas, the most valuable of the camelids for their wool and meat but with more finicky diet, thrive on the artificial pasture of bofedales. Irrigated bofedales take years to establish and are easily degraded through overuse or neglect; thus, they require considerable maintenance and protection (Palacios, 1977).

The Inca state established additional large bofedales along the *Qhapaq Ñan* or royal road, a network of over 30,000 linear km. Combined with corrals, storage, and lodging in waystations or *tambos*, bofedales met the needs of large traveling llama caravans transporting resources throughout the empire (Hyslop, 1984; Arkush and Marcone, 2017).

PEOPLE AND THEIR LAND

When traveling through the Andes, visitors soon come to appreciate how pre-Columbian farmers and their communities over time transformed a highly diverse environment into a highly productive cultural landscape that eventually sustained millions of people and civilizations. While obviously created for practical reasons through human agency, the Andean landscape also holds allure due to the rich geometric patterning of agricultural fields and farm infrastructure, often distributed continuously from valley bottom to mountain top, creating a stunning visual pattern of diverse colors as crops mature and a vibrant example of everyday life at harvest time of farmers where still farmed. Even where abandoned and in ruins, the permanent landscape features of terraces, raised fields, qochas, irrigated fields, and other features built long ago remain impressive and can be appreciated as landscape art, memory, and community pride. The finest works of civilizations are often considered "monumental": aesthetically pleasing, valuable cultural heritage, highly patterned, and beyond practical function often involving enormous amounts of labor, energy, materials, and engineering (Burger and Rosenswig, 2012). One could consider Andean terracing, raised fields, and irrigation in which entire environments were converted into vast productive cultural landscapes as monumental in terms of labor, engineering, patterning, and aesthetics (Erickson, 2013). To the many generations of farmers who created and inhabited these farmed spaces, the landscape represented community, territory, ancestors, sacred places, memory, legitimacy to occupy and use, and at times, political power.

Traditional Andean agriculture is considered by most scholars to have been sustainable and appropriate within its temporal and spatial context. Sustainability in this case implies that society lives off the "interest" without drawing upon or exploiting the "capital" of available agricultural resources. Andean farmers were continuously adding additional resources and potential for surplus production through their labor and engineering over generations. Archaeologists have shown that Andean agriculture supported large and dense urban and rural populations over considerable periods of time on landscapes that are often considered marginal for modern agriculture. Some scholars argue that the contemporary world has much to learn from these time-tested technologies and practices (Kendall, 1985; Erickson, 2003; Renard et al., 2012).

Why have many of these landscapes, farming practices, and crops documented for the pre-Columbian past disappeared or been abandoned? In some cases, climate change may have been a factor (Ortloff and Moseley, 2009), but Andean societies have always faced this adversity and developed strategies of survival and resilience (Erickson, 1999). The most significant reason was massive demographic collapse due to the introduction of Old World diseases, civil wars, and population relocations after Spanish conquest of the Andes. Introduction of foreign crops, animals, and political economies; inequality and colonialism; harsh native labor exploitation; unequal land distribution and land appropriation; and urban migration over time have transformed how contemporary Andean peoples use and maintain landscapes (Newson, 1993). Despite these dramatic changes, threats, and risks, many Andean farming communities continue to thrive by relying on time-tested elements of traditional labor organization, farming techniques, crops, and animals, however modified.

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