

FRONTIER CONSTELLATIONS: A HISTORY OF LAND-USE REGIMES IN PARAGUAY'S PILCOMAYO RIVER BASIN*

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ABSTRACT. The Paraguayan Chaco is increasingly known for the extreme rates of forest loss caused by the rapid expansion of cattle ranching and crop farming over the last few decades. Knowledge of its twentieth-century land-use history, however, remains limited. In this article, I address that gap by discussing land-use dynamics since the 1900s in the Pilcomayo River basin, a part of the Chaco that borders Argentina and Bolivia, and hosts a great diversity of actors and land uses. Using the concept of land-use regimes, I show that the area, once characterized by what can be called an Indigenous mixed-use regime, transitioned to a land-use regime dominated by livestock herding by Argentine Criollo settlers after the Chaco War (1932--35), and then again to one of large cattle ranches managed by absentee owners towards the end of the twentieth century. No land-use regime ever completely dominated the area, however, and I use this fact as a starting point to then discuss how using the concept of land regimes can help direct attention to the coexistence of regimes in space and to their relationships in a way that helps refine our understanding of land-use transitions. *Keywords: Gran Chaco, regime shift, livelihoods, Indigenous people, Criollos.*

Close to a century ago, between 1932 and 1935, the Chaco made international headlines for a bloody war that pitted Bolivia and Paraguay against one another for its control and left over 80,000 dead (Breithoff 2021, 9). Today, the region is resurfacing as an object of global attention for a different reason: the massive deforestation that has radically transformed its landscapes since the end of the 20th century (Baumann and others 2022; Hansen and others 2013). The realization that Paraguay had among the highest rates of forest conversion to agriculture in the world has led to a surge of conservation and development initiatives in the last couple of decades, such as the Green Chaco project, an initiative backed by the United Nations Development Programme that aims to develop sustainable beef production under the UNDP Green Commodities umbrella. Academic research on land-use change in the Paraguayan Chaco, on the other hand, has been slower to take off. While there are now a wealth of studies on the causes and consequences of land-use change in the wider Gran Chaco region (Baumann and others 2022; Camino and others 2023; le Polain de Waroux and others 2018; Levers and others 2021) and many studies discussing deforestation in the Argentine (Grau, Aide, and Gasparri 2005; Magliocca and others 2022; Piquer-Rodríguez and others 2018), and to a lesser extent the Bolivian Chaco (Killeen and others 2008; Pacheco 2006; Redo, Aide, and Clark 2012), only few have discussed land-use change dynamics in any detail specifically for the Paraguayan Chaco.

The Chaco's particular place within Paraguay may have something to do with that. As discussed by Fabricio Vázquez, the radically different physical geography of the lands lying east and west of the Paraguay River has often led observers to view Paraguay as essentially made up of two countries (Vázquez 2013, 16). To the east, amidst rolling hills blessed with abundant water and fertile lands, lay “useful” Paraguay (Souchaud 2002, 37), which harbored the vast majority of the country's population, product of a long history of *mestizaje* between Spanish and Indigenous people. To the west lay the semiarid Chaco, a vast expanse of dry land that, despite making up 60 percent of the country in area, supported less than 3 percent of its population. Even after Paraguay went to war with Bolivia over it, the Chaco remained a marginal territory in the national consciousness (Vázquez 2013, 16). This divide is reflected in scholarship on land issues in Paraguay, which has had much more to say about the populated east than about the western part of the country. Geographers, historians, and anthropologists working in eastern Paraguay have produced rich studies of, among other things, the history of the soy boom (Correia 2019), its governance (Elgert 2015; Hetherington 2020), and its consequences for forest cover in the

Atlantic forest (Da Ponte and others 2017; Richards 2011; Wesz Junior 2022), and for peasant and Indigenous lives and livelihoods (Cardozo and others 2016; Ezquerro-Cañete 2016); the history of *Brasiguaios* and their role in land-use change in the Atlantic forest frontier (Blanc 2015; Souchaud 2007; 2002); and activism, land titling, and territorial struggles among peasants (Fogel 2023; Hetherington 2009; 2011) and Indigenous people (Ioris 2024; Mondardo 2022; Tusing 2023).

Most of the work pertaining to land use in the Paraguayan Chaco, by contrast, consists of high-level studies covering the whole region, such as Vázquez's human geography of the Paraguayan Chaco (2013) and his more recent work on the rural geography of Paraguay (2023); Jan Kleinpenning's encyclopedic rural history of rural Paraguay (2009), which covers the Chaco; Chengquan Huang and others (2009), Marcellus Caldas and others (2013), and Matthias Baumann and others' (2017) remote sensing studies of land-cover change; James Henderson and others' study of the emergence of soy cultivation (2021); or my own study of the role of transnational investments in frontier expansion (le Polain de Waroux 2019). Research adopting a finer scale of analysis has mostly focused on Indigenous land, lives, and livelihoods without explicitly or extensively discussing land-use change. This is the case for work by Mario Blaser (2010), Lucas Bessire (2014), and Paola Canova (2022), exploring the Yshiro (Blaser) and the Ayoreo's (Bessire and Canova) experience of, and relationships with, modernization and change in the Paraguayan Chaco in the twentieth and twenty-first century. Some research, including Joel Correia's discussion of Indigenous land rights and environmental justice among the Enxet and Sanapaná (2023), and Marcos Glauser's study of transformation in Angaité communities surrounded by deforestation (2019), does engage with spatial dimensions of land-use change. These two studies are, however, both situated in the Humid Chaco (or Bajo Chaco) region, which has a different history from other parts of the Paraguayan Chaco. John Renshaw's ethnography of Indigenous peoples of the Paraguayan Chaco (2002) covers a wider array of locations and groups and provides valuable observations for the study area, but is older and as such does not discuss recent dynamics of agricultural expansion. Overall, the relative scarcity of fine-grained studies of land-use change in the Paraguayan Chaco makes it difficult to build an understanding of the region's land-use history that acknowledges its complex social and ecological dimensions.

In this article, I enlist the notion of land-use regimes to help in that endeavor. This concept was first proposed a decade ago, along with that of land-use regime shifts, as a way to formalize a concern with the unpredictability of land-use change (Müller and others 2014; Ramankutty and Coomes 2016). It has since been adopted in the land-use change literature to describe, analyze, and sometimes attempt to predict, these shifts. Papers that adopt this framing usually focus on the regime shift rather than on the regimes themselves, whether their goal is to establish whether a certain land-use change qualifies as a regime shift (Junquera and Grêt-Regamey 2019), to understand the causes of a regime shift (De Alban and others 2019), or to identify early warning signs that indicate a possible regime shift (Zaehringer and others 2020). They typically spend less time defining what constitutes land-use regimes, which are often implicitly understood as shorthand for a general “state of things,” or for some specific land covers or land uses. So, studies will describe, for example, a regime shift from forest to plantation crops, two land covers (Müller and others 2014) or from livestock herding to game farming, two land uses (Achieng and others 2020), but rarely do they dwell on what features make these land uses and land covers distinct regimes in the first place. Here, I propose that the composition of land-use regimes deserves more attention, and that the concept itself has value of its own, as it provides a useful way to represent land-use dynamics at a medium level of complexity, one that has sufficient granularity to represent interactions between multiple groups of actors in complex landscapes, while still allowing for a general view of long-term land-use change, a consistent goal of land system science (Meyfroidt and others 2018). Indeed, at a time when discussions in land-system science are increasingly shifting from a focus on the dynamics of specific land covers and land uses to an emphasis on land as a complex social-ecological system, a framing of land dynamics in terms of land-use regimes can help focus the study object and structure inquiry.

I adopt Ramankutty and Coomes’s (2016, 3) definition of a land-use regime as a “constellation of enduring land-use dynamics, which may or may not entrain land-cover change,” but I expand on it by proposing six dimensions of such a “constellation” whose descriptions help characterize it: 1) land cover(s): the main land covers defining that constellation, such as forest, farmland, or grassland; 2) land use(s): the main activities conducted on the land, such as livestock herding, timber harvesting, or irrigated farming; 3) agent(s): the main agent of land-use decision-making, for example the community, family, individual, or company, indicating a type

rather than a specific agent or group, though both can be combined (Indigenous community, foreign company); 4) access: the main rules of access to land, including land tenure, but also enforcement and means of access (following Ribot and Peluso 2003), for example open access, commons, or private land; 5) connectedness: the degree and types of connectedness to other systems, particularly through inputs and outputs, for example high connectedness in commercial agriculture through the use of inputs and export of commodities, or low connectedness in small-scale subsistence agriculture; and 6) motive(s): the class of objectives pursued by the agents, such as social reproduction, capital accumulation, biodiversity conservation, and the like. These six dimensions partially overlap with the groups of factors proposed in Pratzer and others (2024) for developing scalable typologies of land systems. They are not meant to be exhaustive, but rather to provide a solid starting point for identifying land-use regimes and a way to highlight contrasts and transitions among them. Because there are many different ways to combine these dimensions into an “enduring constellation,” the definition of any particular regime should be understood as context-specific and dependent on the scale that is contemplated (landscape, national, regional), the precision that is required (is there a need to differentiate between different categories within one main land use class, such as forestry), and the processes of interest (ecological impacts, spread of a particular land use).

This article uses these six dimensions of land-use regimes to tie together a narrative of land-use transitions in the Paraguayan Chaco. It focuses on a territory of about 4,000 km² located on the left bank of the Pilcomayo River in Paraguay and extending from the Bolivian border about 120 km south and east and about 30 km inland (Figure 1), which I hereafter call the “Upper Pilcomayo.” The paper is based primarily on data collected during four visits between 2018 and 2023---totaling two months in the study area---though my understanding of land-use dynamics in the Gran Chaco through fieldwork and interviews with a variety of actors in the wider region over the last decade also informs this work. I selected the Upper Pilcomayo for this study because, having worked on the dynamics of land investments in agricultural commodity frontiers of the Gran Chaco, I was interested in understanding the transformation of smallholder livelihoods brought about by these investments. The Upper Pilcomayo had both smallholders and rapidly expanding commodity frontiers, and it was understudied compared to other parts of the Chaco.

My first visit was facilitated by contacts at a Paraguayan environmental NGO working in the area. In the field, I presented myself as someone wanting to understand and write about the land-use and livelihood history of the area, and how people dealt with the challenges posed by the commodity frontier. As a white man from the Global North with an accent in Spanish that could pass as Argentine, people sometimes assumed I might be either an NGO worker or a land investor. I made sure to always clarify first and foremost that I was neither, and that I did not bring either development projects or funding, nor had any ties with or interest in land investments in the area. During my first visit, I asked the leaders of different Indigenous and Criollo communities whether they thought the questions I was asking were worth pursuing. They agreed that they were and encouraged me to continue---people in the area were generally eager for their history to be told and hoped that greater visibility might enhance their chances of getting support. I continued to check in with participants about this as I conducted oral history interviews, informal interviews, and participant observation in communities and isolated homesteads of the area, as well as informal and semistructured interviews with key informants outside of the study area (mostly government employees, NGO workers, and missionaries active in the area).

All interviews were conducted by me in Spanish, some of them with the presence of a local field assistant. To synthesize information, I coded interview transcripts and field notes for themes using open and axial coding. Repeated visits over the five-year period allowed me to track changes and check in with participants about my understanding of the local context and history. For my last visit, I prepared summarized histories of different localities and discussed them with participants to expose inconsistencies and triangulate information. Finally, I used a variety of documents, including maps, satellite images, books, and government and NGO documents to understand or confirm certain aspects of life in the area. I rely more heavily on secondary sources for the earlier part of the account and for the story of the Indigenous communities, which are somewhat better documented, than for more recent periods and especially the history of the Criollos, for which secondary sources are scarce and that are better covered by oral histories. Where no source is cited, the information comes from oral histories and other interviews.

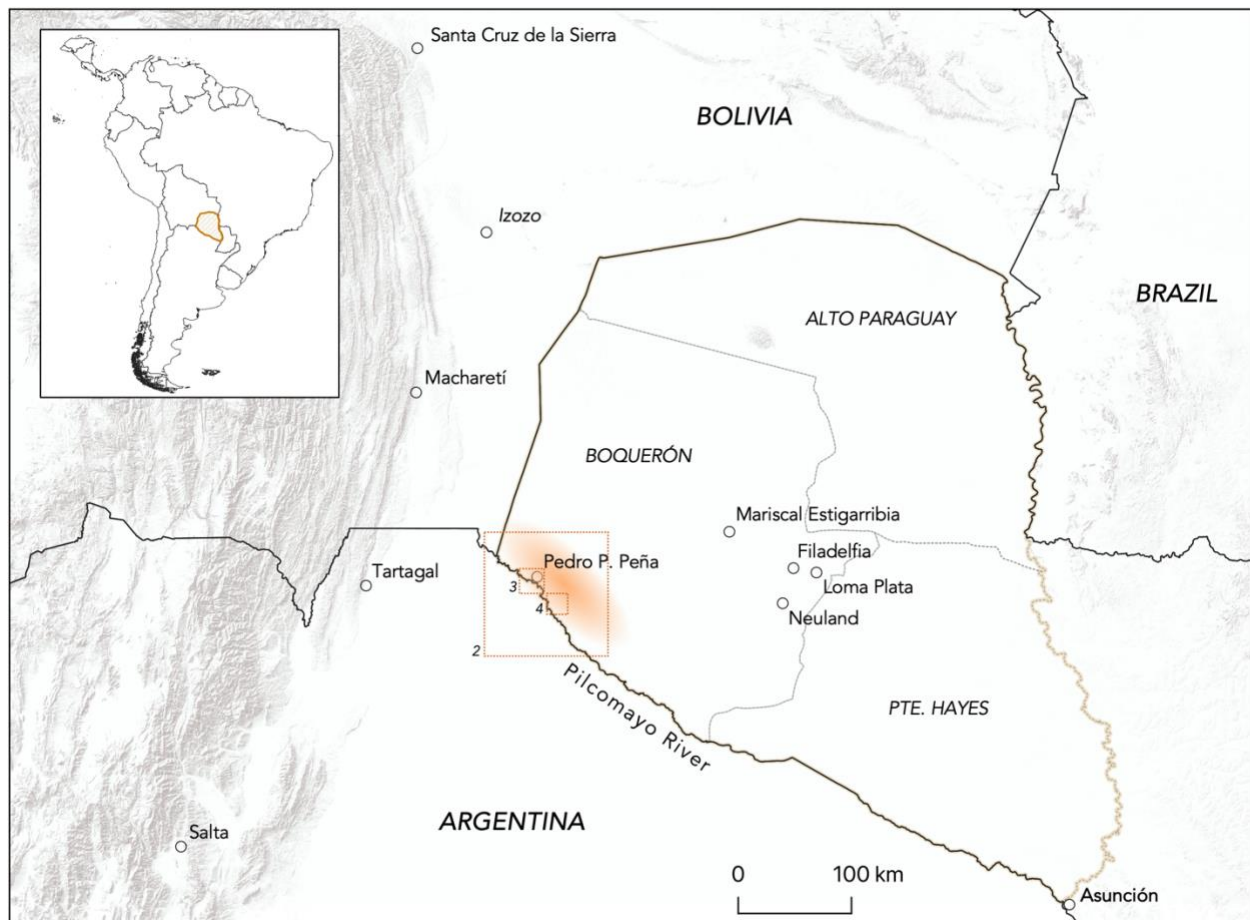


FIG. 1---Study area. The orange area indicates what I call the Upper Pilcomayo in this article, and the dotted squares indicate the footprints of FIGS. 2, 3, and 4 (panels b-d in the latter two).

INDIGENOUS OCCUPATION IN THE EARLY TWENTIETH CENTURY

The Pilcomayo River area long functioned as a refuge for Indigenous people affected by the growing pressures of the colonial world, a place where, until the late nineteenth century, various Indigenous groups managed to maintain a relative socioeconomic and political independence (G. Gordillo and Leguizamón 2002, 22). By the beginning of the twentieth century, following the establishment of the national border between Paraguay and Argentina along the Pilcomayo River in 1878, tribes that had formerly occupied both sides of the Pilcomayo started dividing themselves between the right and left banks (G. Gordillo and Leguizamón 2002, 24, 36, 42). Meanwhile, military raids from Argentina pushed more and more Indigenous people to flee towards the latter, intensifying local conflicts (Fritz 2008, 154; Nordenskiöld 1912, 120). At that point in time, the left bank of the Upper Pilcomayo was populated mainly by two Indigenous groups of the Matacoan linguistic family: the Nivaclé and the Manjui.¹ The Manjui occupied the northwestern part of the area, close to what is today the Bolivia-Paraguay border (Figure 2), while the Nivaclé populated the left bank of the Pilcomayo River downstream from the Manjui, from the location of what would later be the military fort of Guachalla to the southeast (Métraux 1946, 235). Both groups comprised riverine and inland communities, the latter more permanent than the former, which moved frequently according to changes in the riverbed and in natural resource availability (Nordenskiöld 1912, 29–30).

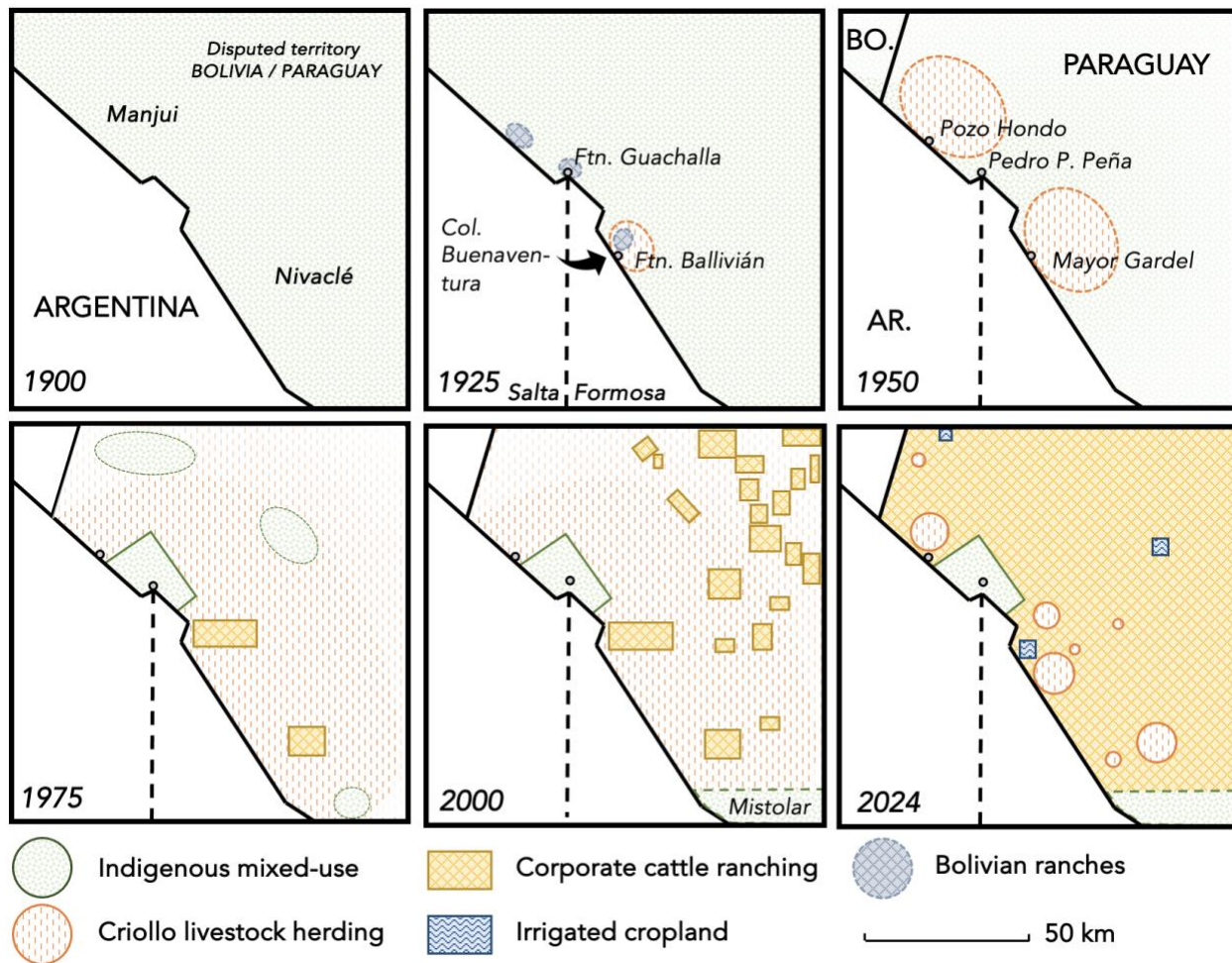


FIG. 2---Schematic representation of territorial changes in the Upper Pilcomayo. Each pattern represents a different land-use regime. Solid lines indicate fixed and enforced boundaries; dashed lines indicate either undefined or non-final boundaries.

Livelihoods among Manjui and Nivaclé centered on a combination of fishing, crop farming, hunting, gathering, livestock herding, and work migration. The fishing season, a time of plenty, only lasted from April to early June, so people had to rely on other sources of foods for the rest of the year (Métraux 1946, 236–37). Manjui and Nivaclé cultivated multiple varieties of maize and beans as well as manioc and squash, in plots scattered across the landscape, often far from each other, although some early observers also noted large maize plantations along the river among the Nivaclé (Belaieff 1941, 25; Chase-Sardi 1972, 254). The Nivaclé reportedly also cultivated watermelon, pumpkin, tobacco, and cotton, and the Manjui sweet potatoes (Métraux 1946, 236–7; Nordenskiöld 1912, 130). Additionally, they gathered forest foods throughout the year, including the fruit of the *algarrobo*, *chañar*, *tusca*, *tuna*, and *tasi*, as well as wild honey (Métraux 1946, 236–37; Nordenskiöld 1912, 48–49). Forest communities relied heavily on hunting, which was less common in river communities. A fair amount of livestock---sheep, goats, cattle, chickens, and horses---could also be found in both groups, but especially among the Nivaclé (Asp 1903, 27; Métraux 1946, 265; Nordenskiöld 1912, 50). By the late nineteenth century, men in these communities had begun working seasonally in the sugarcane fields of Salta and Jujuy in Argentina in order to be able to acquire consumer goods and livestock (G. Gordillo and Leguizamón 2002, 37; Métraux 1946, 236; Susnik 1981, 190).

Property was mostly communal, with only some resources owned by families. For example, the product of fishing was shared with the community, and while livestock was branded and owned by single families, their meat was shared in the community. Land, according to Nordenskiöld, had no formal owners, though once a family cultivated a plot, it was recognized as theirs (1912, 32). Communities seemed, however, to recognize the boundaries of other communities' territories. Nordenskiöld reports, for example, that “[f]ruit trees do not belong to anyone; despite that, Indians do not enter the territory of other tribes to gather their fruit” (1912, 46). In terms of formal land tenure, while most of the Paraguayan Chaco was subdivided into lots after the Triple Alliance War, which opposed Paraguay to Argentina, Brazil, and Uruguay between 1864 and 1870, cadastral maps from the early twentieth century indicate that the Upper Pilcomayo remained unallocated until the Chaco War (Paraguayan Government 1932).

In the absence of clear markers of Paraguayan control over the Pilcomayo, the Bolivian army started establishing forts on the left bank, notably those of Guachalla and Ballivián in 1905

(Figure 2), seeking to eventually reach the Paraguay river (G. Gordillo and Leguizamón 2002, 27). These military incursions were accompanied by the establishment of a number of Bolivian colonists (Astrada 1906, 158; Romero Díaz 1970, 103–4), some of them military who stayed after their service (Fritz 2008, 152). Together, these colonists accumulated sufficiently sizeable herds for the military forts to become “important cattle centers” (Romero Díaz 1970, 255). Nivacé chiefs originally resisted Bolivian incursions but “the Bolivians bought their good will with presents of cloth and provisions” (Renshaw 2002, 236), and as of 1908--9, relationships between the Bolivian governor and local Indigenous tribes were reportedly amicable (Nordenskiöld 1912, 126). Even so, oral histories tell of violent confrontations with Bolivian ranchers and a deep fear of the Bolivian military (Fritz 2008, 152–54; *Hagan Lo Que El Les Diga. 50 Años de Presencia* 1992, 7–8).

While the Bolivians were advancing south and eastward, on the other side of the Pilcomayo, the Argentine government had sanctioned the creation of a new Criollo colony aimed at relieving pressure from the degraded lands of the colony of Rivadavia in Salta province (Barbarán and Arias 2001) and at establishing a civilian presence in Indigenous lands at the margins of the Argentine federation as an alternative to military conquest (Astrada 1906, 11). The term Criollo refers to a rural population that is neither Indigenous nor related to the more recent, mostly European immigration of the late nineteenth and early twentieth centuries, and points to early colonial Spanish as well as *mestizo*, or racially mixed, heritage (Chamosa 2008; Concha Merlo 2022; G. R. Gordillo 2014, 55). While the meaning of the term is somewhat ambiguous and has evolved over time, Criollos in the Chaco have historically been understood as a subaltern class living off small-scale livestock herding in the interior, at the margins of the State (Chamosa 2008; Concha Merlo 2021; 2022). The colony of Buenaventura, established in 1902 on Wichí Indigenous land, was quickly very successful. From an original population of 50 with 3,000 head of cattle, it had already reached about 2,000 inhabitants by 1906, with over 72,000 head of cattle, 14,000 horses, donkeys, and mules, and 34,000 goats and sheep (Astrada 1906, 163). This rapid growth caused land degradation, which in turn pushed Criollos downstream and across the Pilcomayo River into territory controlled by Bolivia, with the authorization of the Bolivian military (G. Gordillo and Leguizamón 2002, 26–27). Criollo settlers, as I will discuss below, operated a very different land-use model from Indigenous people, and their incursions into Indigenous territory were unwelcome. The Manjui and Nivacé

resented the presence of the newcomers whose cattle forced them to cultivate their plots further away from the river, and they frequently raided colonist homesteads to steal cattle or corn (G. Gordillo and Leguizamón 2002, 38; Nordenskiöld 1912, 128–30).

In 1932, as the Bolivian military continued its progression toward the Paraguay River, the tension that had been growing between Paraguay and Bolivia over the control of the Chaco reached a boiling point, and the Chaco War broke out (Breithoff 2021). By November 1934, the forts of Ballivián and Guachalla had fallen to the Paraguayan army (G. Gordillo and Leguizamón 2002, 43). Numerous Manjui and Nivacé men were recruited and armed by both armies, mostly to be used as guides. Several groups were caught between the two armies, and many others fled, either to Argentina or deeper into the forest (*Hagan Lo Que El Les Diga. 50 Años de Presencia* 1992, 4–5; Métraux 1946, 236). This included early Criollos settlers, who had occupied the area under the protection of the Bolivian military and whom the Paraguayan army saw as allied with Bolivia (G. Gordillo and Leguizamón 2002, 47). Some Nivacé also took refuge in the Catholic Mission of San José de Esteros, downstream of Ballivián (Renshaw 2002, 57). Tragically, the casualties of war among the Manjui and Nivacé were compounded by a smallpox epidemic in 1932 and 1933, which decimated their population (Fritz 2008, 154). Métraux estimated in 1946 that the Nivacé population after the war was one third of what it had been in the 1900s (Métraux 1946, 236).

In summary, and revisiting the six dimensions of land-use regimes discussed in the introduction, the Upper Pilcomayo in the early twentieth century was dominated by an Indigenous land-use regime characterized by multiple overlapping land uses (crop farming, livestock herding, hunting, gathering, fishing) under seminomadic settlement patterns in forest and grasslands (land covers). These activities were managed by Manjui and Nivacé Indigenous people at either the family or community level (agents) but always for the benefit of the community and for the purpose of subsistence and social reproduction (motives), with access to land and resources based on group membership, sharing, and reciprocity among kin. Direct connections to the wider world mostly consisted of labor migrations and limited acquisition of consumer goods with wages from work in the sugarcane plantations (connectivity) (see Table 1 for a summary of the six dimensions). Alongside this dominant regime, the seeds of two other land-use regimes progressed: Bolivian cattle ranches accompanying the establishment of military

forts, and Criollo settlers spilling over from Argentina. The Chaco War upended this dynamic territorial order, and at the end of it, the region was left with the infrastructure of conflict---trenches, forts, and lots of metal scraps (Breithoff 2021)---but few people. This paved the way for a restructuring of the territory along a new “constellation” of actors and land uses.

		Characteristics of dominant land-use regimes					
Land-use regime	Period of dominance	Land cover(s)	Land use(s)	Agent(s)	Access	Motives	Connectivity
Indigenous mixed-use	Until the 1930s	Forest and grasslands, small cropland plots	Semi-nomadic hunting, gathering, fishing, subsistence cultivation	Indigenous community and family	Commons, access based on group membership, sharing and reciprocity among kin	Subsistence and social reproduction	Work migration, purchase of merchandize
Criollo livestock herding	1940s-1990s	Forest and grasslands, small cropland plots	Sedentary livestock herding, hunting; some gathering and subsistence cultivation	Criollo household	Open access, access managed through distance between homesteads	Subsistence and social reproduction	Occasional sale of livestock, hides, metal scraps; purchase of merchandize
Corporate cattle ranching	2000s-present	Planted pastures	Cattle ranching	Private companies of various origins	Private land, access restricted through fences	Capital accumulation	Sale of cattle for export, outside inputs (genetic stock, exotic pastures), workers & management from outside the area, capital from outside & profits exported
Irrigated agriculture	Possibly 2020s	Croplands	Irrigated crop farming	Private companies, mostly foreign	Private land, access restricted through fences	Capital accumulation	Sale of grain for export, chemical inputs, workers, and management from outside the area, capital from outside & profits exported

Table 1--Main land-use regimes of the Upper Pilcomayo.

INDIGENOUS (RE)SETTLEMENTS, MISSIONS, AND TERRITORIAL CONSOLIDATION

The depopulation of the Upper Pilcomayo as a result of the Chaco War opened the way for the resettlement in this area of members a new Indigenous group by the Paraguayan military: the *Guaraní Occidentales* (hereafter Guaraní for short),² a group that had lived in the Andean foothills for centuries and is often thought to descend from Guaraní people who migrated there from the east in the fifteenth and sixteenth centuries and Chané people who had lived there previously, though that thesis is contested (Gustafson 2021; Sala and others 2018). During their westward expansion to the Andean foothills in the war, the Paraguayan army had come in contact with Guaraní communities in and around the Franciscan mission of Macharetí. The Guaraní, who had only recently been subjugated by the Bolivian State and spoke a language very close to the Paraguayan Guaraní spoken by the military, were quick to side with the Paraguayans, and helped guide them through the unfamiliar terrain of the Andean foothills (Fritz 2008, 160; Romero Díaz 1970, 109; Stahl 2007, 55). This put them in a difficult position once Paraguay and Bolivia signed the 1938 truce giving back their territories to Bolivia (Fritz 2008, 161). The Paraguayan government, interested in settling the Chaco with Guaraní-speaking colonists, arranged to relocate them, as well as other Guaraní from the area of Isoso, on the Parapiti River, to different parts of the Paraguayan Chaco (Renshaw 2002, 61), and eventually offered a number of them land in the area of Fortín Guachalla, renamed Pedro P. Peña, where they settled in 1939 (*Hagan Lo Que El Les Diga. 50 Años de Presencia* 1992, 11).

Soon after, the Guaraní requested the formation of a Catholic mission and sent an emissary to Asunción to make their case with the Oblates of Mary Immaculate. Two German priests were sent from the mission of San José de los Esteros to establish a new mission in 1941 (Fritz 1999, 84–85). The Guaraní settled in small *aldeas*, or hamlets of a few families, along the river at regular intervals from the mission (Figure 3, panel a.). Being from a sedentary farming tradition (Stahl 2007, 339), they adopted floodplain farming along the shores of the Pilcomayo River and cultivated corn, squash, and other crops on low riverbanks, taking advantage of the humidity and sediments left behind by the river after the water retreated following the wet season (Romero Díaz 1970, 113). This transition was not without its challenges, and early on, the Guaraní struggled to make sense of this new environment, particularly the unpredictability of the Pilcomayo River. As a result, many left, most of them to work in the sugarcane industry of Salta,

Jujuy, and Tucumán in Argentina, where many Bolivian Guaraní had already been working for some time, (G. Gordillo 2011) and by 1945, the population of this new Guaraní “colony” had declined from close to 4,000 to about 500 (*Hagan Lo Que El Les Diga. 50 Años de Presencia* 1992, 12; Romero Díaz 1970, 109).

The presence of a Catholic mission in Pedro P. Peña came to be a defining factor in the territorial organization of the area. The priests established a school with crop fields and a cattle herd aimed at sustaining both school and mission (Figure 3, panel a.). They set up community plots in several areas close to the mission, organized Indigenous labor around them, and hired *remonteros*, or cowboys, to tend to the cattle, animals originally borrowed from nearby Criollos (Romero Díaz 1970, 193). Years later, the mission would be instrumental in securing a land title for the community, which became known as San Agustín. In 1968, Indigenous community leaders, with the help of the missionaries, initiated a process that would lead to the obtainment of a land title for over 24,000 hectares in 1988 (Figure 3, panel c.). The title, originally held by the vicariate, has now been transferred to the community and specifies areas allocated to the Guaraní, but also to the Nivacle and Manjui, many of whom by the 1970s had settled around the mission.

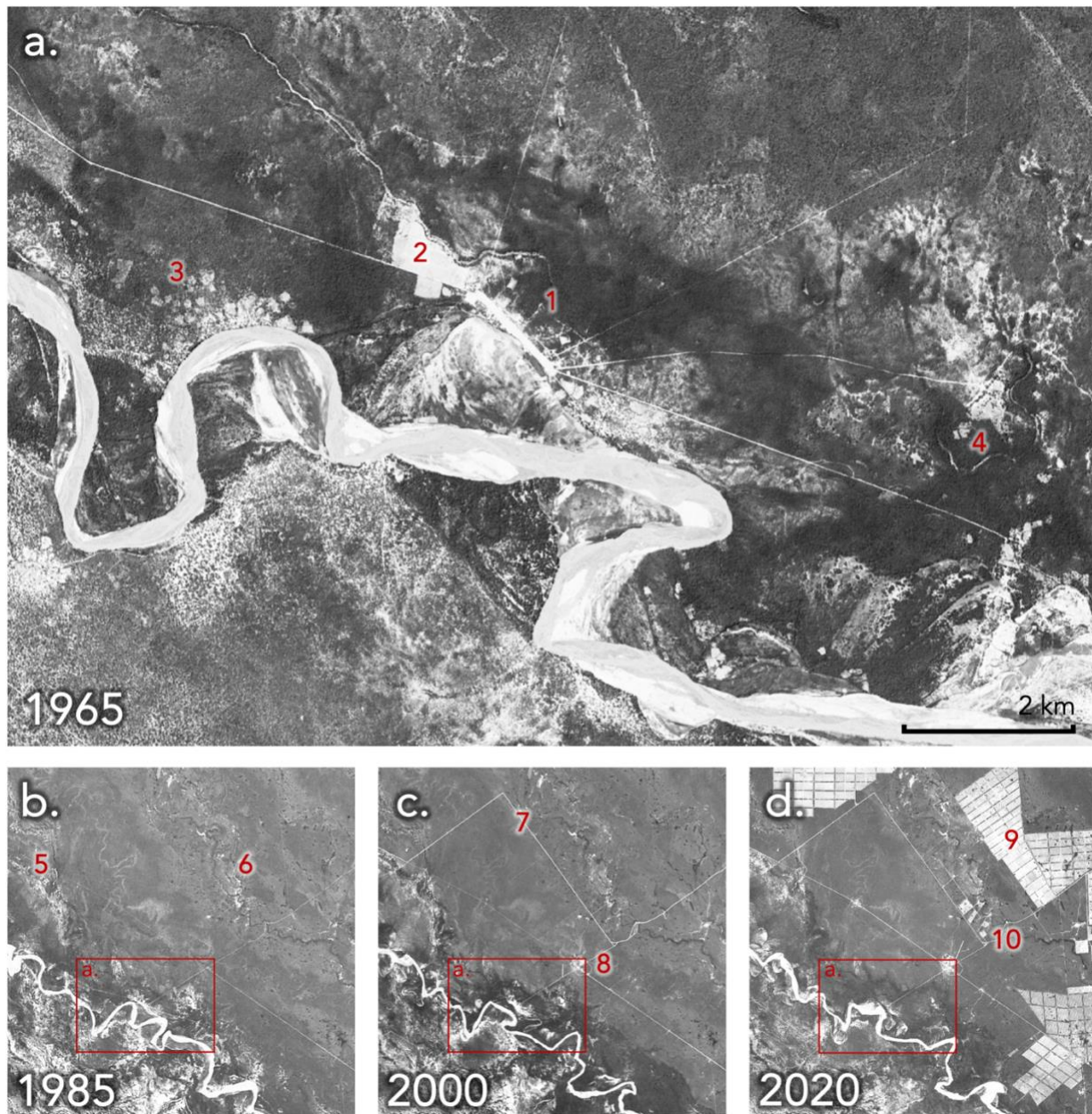


Fig. 3---Evolution of the Indigenous territory around Pedro P. Peña. Panel a. shows the area immediately around the mission of Pedro P. Peña in 1965. The settlement around the mission became an administrative center for the government under the Alfredo Stroessner dictatorship, and a landing strip can be seen at the center of the settlement (1), next to the mission's community fields (2). Around the mission, lighter patches indicate small clearings for subsistence cultivation along the river (3) and further inland (4). Panels b. to d. show a larger area, including that of panel a (shown in red) for the years 1985, 2000, and 2020. In b., lighter patches next to a small lake (5) and around a seasonally dry riverbed (6) indicate Criollo settlements. By 2000, demarcations indicating the boundaries of the Indigenous territory of San Agustín are visible (7), and the community has relocated inland due to intense flooding of the Pilcomayo

in the early 1990s (8). By 2020, much of the land surrounding the Indigenous territory has been developed by outside investors for cattle ranching or croplands (9), while some Criollos have started clearing small patches of forest as well on the edge of the territory (10). Sources: The image in panel a. is a declassified high-resolution image from the Corona satellite mission obtained from the USGS EROS archive, and panels b. through d. are Landsat yearly composites extracted from Google Earth.

This process of settlement, in fact, had already started in the 1950s, when the Nivaclé and Manjui began repopulating the territory they had evacuated during the war (*Hagan Lo Que El Les Diga. 50 Años de Presencia* 1992, 4–5; Renshaw 2002, 57). Some Nivaclé had started coming back from Argentina and from the area surrounding the Mission of San José de Esteros further downstream after the war and roaming around the area of Ballivián (now called Mayor Gardel) and Pedro P. Peña. Meanwhile, a group of Manjui who had originally lived inland along an abandoned arm of the Pilcomayo called Cañada Mil started moving between Pedro P. Peña, an area called Mistol Marcado downstream, and the central Chaco (Renshaw 2002, 59). In both cases, the decline in population due to war and epidemics, which left many small groups unable to continue as viable hunter-gatherer bands, and the encroachment of Argentine Criollos and, toward the central Chaco, of Paraguayan ranches, contributed to driving them to larger communities (Renshaw 2002, 104, 223). A desire to access services such as education that were concentrated close to the mission and a feeling of safety associated with the Oblates missions' role in the protection of the Nivaclé in the past may also have favored sedentarization (Fritz 2008, 153). The process of sedentarization took longer for the Manjui than for the Nivaclé, and some Manjui bands were still living nomadically, inland from Pedro P. Peña, up to at least the early 1970s (Chase-Sardi 1972, 247; 1971).

Not all Nivaclé and Manjui settled in riverside communities. Starting in the 1940s, as agriculture began to develop in the area around the Mennonite colonies of Filadelfia and Loma Plata in the central Chaco, many Nivaclé in particular started migrating there in search for work, instead of going to Argentina as they had before (Chase-Sardi 1972, 249). The area known as Mistol Marcado, by 1972, had only 5 Nivaclé families, and eventually even they moved to the Mennonite Colonies (Renshaw 2002, 232). Life in these colonies was very different from what they had known in the Pilcomayo, however, and in 1980, 120 families, facing land constraints and dissatisfaction with their new lives, collectively decided to return to their ancestral territory

(Renshaw 2002, 57). There, they were faced with multiple floods that discouraged many, and about half of these families returned to the central Chaco. The others stayed behind, and after moving to higher land, established the present-day community of Mistolar in the late 1980s. From the moment of their migration back to the Pilcomayo, the Nivaclé benefitted from significant support from the Church of Jesus Christ of Latter-Day Saints, known informally as the Mormon Church, whose missionaries had initially connected with Nivaclé leaders as they were planning the relocation, and today much of the community espouses the Mormon faith. While the Nivaclé managed to get 28,000 hectares of their land protected by a decree in 1988 (Decree 19/88), as of 2024, they were still fighting to obtain a formal title, which made their situation more precarious than that of the communities settled around Pedro P. Peña, and investors had started deforesting parts of their original land claim.

The Indigenous land-use regime, throughout this period, underwent several important changes, particularly through the settlement of a new Indigenous group, the Guaraní, who were sedentary and focused more on crop farming and livestock herding than the Nivaclé and Manjui; the sedentarization of the latter two groups; and the adoption of new livelihoods such as handicraft sale or employment on farms and in the government (many Guaraní became teachers). However, key elements of what I have called the Indigenous mixed-use regime remained the same: multiple overlapping uses of territory including farming, livestock herding, fishing, hunting, and gathering, under a combination of collective and family-based management of resources and kin-based sharing networks, for the purpose of subsistence and social reproduction, and with ties to the wider economy mostly mediated through labor migration and the purchase of food and other merchandise.

THE CRIOLLO SETTLER FRONTIER

In the aftermath of the Chaco War, the northward expansion of Argentine Criollo settlers that had started in the first decades of the century resumed and gathered force, such that Criollo livestock herding gradually became the dominant land-use regime throughout much of the Upper Pilcomayo. Those Criollo families who had retreated to Argentina to escape the war quickly started coming back over the river when it was over, crossing the riverbed with their animals in shallow places during the dry season, in the hope that they would find some of the animals and constructions they had left behind. Others were enticed by the large, open grasslands that then still surrounded the Pilcomayo River (but have mostly disappeared since), contrasting with the overcrowded and degraded lands on the Argentine side. Also attractive were the presence of wild cattle descending from animals abandoned by the Bolivians upon retreating and that had proliferated since then, and the large amounts of weapons, ammunition, and other metal scraps left behind by the war, and which could easily be sold in Argentina (Romero Díaz 1970, 88). By and large, however, people remember that they, or their parents, crossed into Paraguay just because “there was no more room” in Argentina.

Older Criollos recall that they would ask the military in Pedro P. Peña for permission to occupy Paraguayan territory. After a while, the military started imposing a fee (*pastaje*) per animal and per year (Romero Díaz 1970, 155). In January 1946, some seven years after the July 1938 truce was signed, a Paraguayan military stationed in Pedro P. Peña counted 96 non-Indigenous people who had been granted an authorization in that sector, of which 90 were Argentine, and who owned a total of 812 cattle, 165 horses and mules, and 3,900 goats and sheep (Romero Díaz 1970, 255–56). This sector represented only a fraction of the study area, and it is likely that these numbers would have been higher in the sector of Ballivián (renamed Mayor Gardel), which was right across from the main center of the Buenaventura Colony and had already had Criollo settlements before the war.

The Criollo expansion pattern followed the rhythm of the household lifecycle. Isolated homesteads or *puestos ganaderos*³ (livestock outposts) grouped one or a few families and their livestock around a water body, either the river or one of the many ephemeral ponds formed by depressions in the surrounding landscape (Figure 4, panel a.). Newly formed households, when

space ran out in the vicinity of their parents' homesteads, would seek a place with water and fewer people farther in the forest to get established and raise their animals. Because of the relative scarcity of good water points in the Dry Chaco, these places were frequently ones that had been used as seasonal camps by Indigenous groups. They were also sometimes places of significance during the Chaco War, the sites of military outposts and forts, which were conveniently connected by a network of trails left by the Bolivian army.

There were a few ways for a Criollo household to get established in the Upper Pilcomayo. The young family might already have some animals, perhaps from their parents' herd in Argentina, and be able to set up their new homestead directly; they might start by taking care of someone else's livestock in a system called *al partir*, in which they kept half of the offspring of the animals they tended to, allowing them to consolidate their herds until they had enough livestock to be on their own; or, men might start out as paid employees, often as remonteros, or cowboys, and save up to buy animals. In any case, the goal was to operate a livestock herd that could afford one's family a high degree of self-sufficiency and independence.

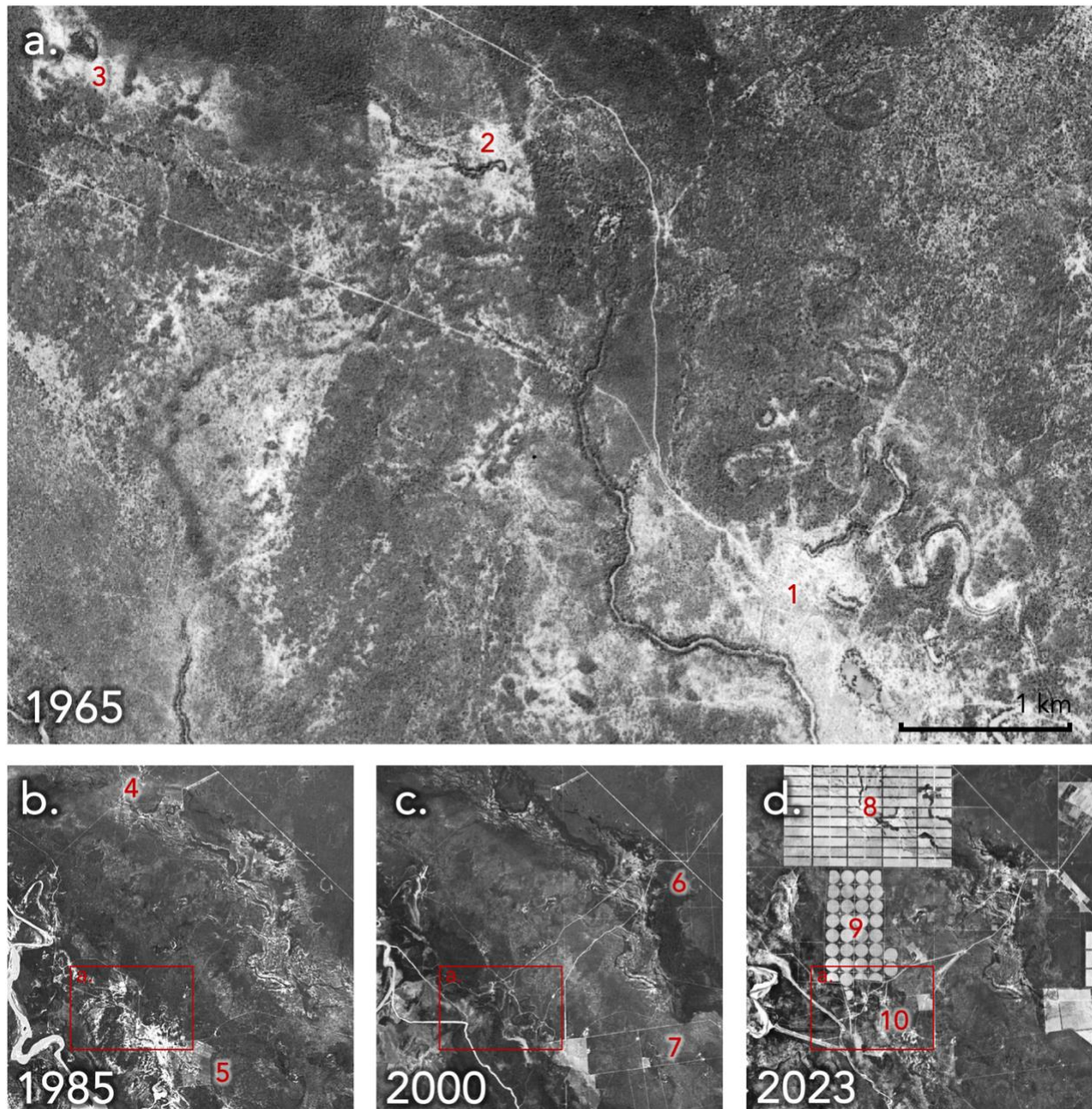


Fig. 4---Evolution of an area called La Dorada, close to former Fortín Ballivián. Panel a. shows a zoomed-in image of the area in 1965, in which clearings are visible around Criollo settlements located next to water bodies (1--3). In panel b., geometric clearings (4 and 5) indicate the location in 1985 of the early cattle ranches discussed in the text. By 2000, some Criollos have formed a new settlement further inland (6) while the demarcations of new cattle ranches in formation are starting to be visible (7). In 2023, one of the old cattle ranches has been fully deforested (8), while Uruguayan investors have cleared land for irrigated agriculture (9). Some Criollo smallholders have claimed land titles in response and started clearing smaller extents of land to put exotic pastures after the ranching model (10). Sources: The image

in panel a. is a declassified high-resolution image from the Corona satellite mission obtained from the USGS EROS archive, images in b. and c. use Landsat yearly composites extracted from Google Earth, and panel d. is a monthly composite from Planet Labs for September 2023.

In the puesto system, spatial separation, rather than physical barriers, was what permitted the division of livestock belonging to different owners (Altrichter and Basurto 2008). Criollo settlers had little regard for formal land tenure and fixed boundaries. Rather, access to land was claimed and maintained through use and presence, and negotiated dynamically, leading to shifting territories whose size reflected the waxing and waning economic power of settler families. This resulted in a spatial pattern of small settlements spread out across the landscape, rarely forming true communities (Figure 4, panel a.).

While Criollo livelihoods were overwhelmingly centered around livestock herding, with a mix of cattle and small livestock (goats, sheep, pigs, and fowl), for the rest, they were similar in some respects to those of Indigenous people in the area. Those families that lived by the river had small, cultivated plots in the floodplain, and those further inland maintained small-scale rainfed plots. People also collected and ate the same forest fruit as the Nivaclé and Manjui. Notably, they also hunted and trapped, both for food and, until the mid-1970s, for hides. These were in high demand, and people recall that the trading posts at Pedro P. Peña and La Dorada further South would buy “everything”: hides of jaguar, puma, fox, boa, alligator, and more. By the 1980s, however, prices for hides had fallen dramatically (Renshaw 2002, 131), likely as a result of Paraguay joining CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) in 1977, as happened in Argentina (Altrichter and Basurto 2008). Finally, for several years after the end of the Chaco War, people scoured the landscape for leftover ammunition, weapons, or any other metal objects left behind by the warring parties, to sell them, mostly in Argentina. Smuggling across borders also extended to other goods, mostly from Bolivia: rubber in the 1940s, and later coca leaves, gasoline, and more recently, cocaine.

Criollos frequently talk about their settlement in new areas using vocabulary that reflects frontier imaginaries, for example talking about the places they settled as “the desert” (*el desierto*), saying that there was “no-one” there, and that they “populated” (*poblamos*) these areas. While this land was historically far from empty, the massive depopulation and displacements caused by war and epidemics of the 1930s may have limited the amount of

opposition that Criollo settlers faced in their postwar expansion, allowing them, perhaps more than elsewhere, to entertain the illusion of an uninhabited frontier. Still, there are multiple accounts of conflicts between Criollos and Indigenous people, especially in the early days of settlement (Renshaw 2002, 242; Romero Díaz 1970, 91), and it is fair to assume that the Criollo expansion contributed significantly to the displacement and sedentarization of surrounding Indigenous people. Yet it would be simplistic to reduce the historical relationship between Criollos and their Indigenous neighbors purely to one of conflict and displacement. Oral histories reveal, for example, that some Criollo families paid *pastaje* to Indigenous neighbors for the right to use the land. In one area, the Catholic priests forcibly removed a Criollo family to make room for a group of Guaraní who needed to move inland to escape the Pilcomayo's frequent floods. Criollos frequently recruited Indigenous people as laborers, for example to clear forest or harvest fields, but the Guaraní also used *al partir* contracts with Criollos to increase their own cattle herds (Renshaw 2002, 113). A few Indigenous families adopted a model of livestock herding in forest *puestos* identical in almost every way to that of the Criollos. Over time, intermarriage became common, especially between Criollo men and Guaraní women. Most Criollo settlements today have some Guaraní women, and both San Agustín and Mistolar are home to a few Criollo or mixed households. Some Criollo families around San Agustín have also started sending their children to be educated in the community's mostly Guaraní school. The two communities are tightly interconnected.

The Upper Pilcomayo, as mentioned earlier, had escaped the massive privatization of Chaco lands after the Triple Alliance War. The creation of the Instituto del Bienestar Rural (IBR) in 1963 under Paraguay's dictator Alfredo Stroessner offered an avenue for settlers to secure land titles in these remaining public lands. To facilitate this process, the IBR set up a temporary office in the town of Pozo Hondo in 1982. However, very few people ended up with a title in their hands. Those who remember that time say that one reason for this was that land titling was costly: settlers had to measure and fence the perimeter of the land they claimed and, in addition to that, buy the land from the government. Even though the price, in retrospect, appears very low today, it was too high for many then, and several of those who started the titling process only made the first payment and effectively never completed the purchase of their plot. Additionally, many simply could not imagine, in that time, that there would ever be a need to own a land title. The idea of land as abundant and open was deeply embedded in Criollo culture, and nobody

anticipated the kind of massive enclosures that would happen in the 2000s. Finally, many people fundamentally distrusted government officials and believed that they were inflating costs of land titling to their benefit. As a result, Criollo settlers overwhelmingly continued to occupy land without formal land titles. Meanwhile, however the Alfredo Stroessner administration was giving away parcels of public land liberally as favors to friends of the regime. Maps of landowners registered with INDERT, the later incarnation of the IBR, still show names associated with the dictatorship that are found in the Paraguayan Truth and Justice commission's list of *tierras malhabidas*, or "ill-gotten lands".⁴ This reallocation of land, combined with the quasi-absence of titling by Criollo settlers, led to a stark disconnect between formal land tenure and the reality of land occupation on the ground that would prove problematic for the Criollos.

After the Chaco War, the Upper Pilcomayo was thus settled by Criollo families operating a new land-use regime characterized by extensive livestock herding in open access forest and grasslands, accompanied by hunting and some amount of crop farming and gathering, and centered on the family unit's subsistence and its reproduction (Table 1). This regime, connected to the wider economy mostly through the sale of animals and hides and the purchasing of merchandise, differed from the Indigenous land-use regime in the centrality of livestock herding and the primacy of the family unit, both in terms of decision-making and of spatial organization. The expansion of this new regime prevented the recovery of the Indigenous mixed-use regime in much of the region after the war, contributing to its confinement as well as to its transformation. The reliance of the Criollos' livestock herding regime on open and abundant land and their unwillingness or inability to secure land titles, on the other hand, created a situation in which the legal owners and occupants of the land were rarely the same. Although that disconnect remained irrelevant to life in the Pilcomayo for much of the late twentieth century, it came to matter once the corporate cattle frontier took off in the Paraguayan Chaco.

THE CORPORATE CATTLE FRONTIER

In the early 1970s, taking advantage of the increased accessibility afforded by clearings opened in the forest by oil prospection companies, a couple of investors set up large cattle ranches in the Upper Pilcomayo (Figure 4, panel b.). The first was a notary and writer from Asunción, and the second a man known to be close to the dictator Alfredo Stroessner and whose son would establish another large *estancia* in the area soon after. The father and son set up trading posts complete with landing strips that became the main selling points for hides and livestock in the area as well as crucial suppliers of various commodities for locals, and a platform for contraband and narcotrafficking. This, as well as their connection to the dictatorship (and later to the Colorado government), gave these men great power in the area. One effect of that power was to give Criollos who had lived for decades by the large water ponds now enclosed in these properties no choice but to relocate outside the boundaries of their *estancias*, which, while the Criollos resented it, was still possible at the time because land remained abundant. Indeed, these men's properties, which collectively amounted to several tens of thousands of hectares, had a characteristic that had not been seen yet in this area: clear and enforced boundaries marked by forest clearings (*picadas*) and fences, as well as exotic pasture varieties planted on deforested land. While their objective was not only or even mainly the production of beef, they introduced a model of private enclosures that made them the precursors of a cattle ranching regime that would later come to dominate the region.

Although a couple more such ranches were established in the area in the following decades, it is in the 2000s, as the booming commodity frontier that had taken off in the rest of the Paraguayan Chaco (le Polain de Waroux and others 2018) started reaching the Pilcomayo, that land that had been held speculatively by absentee landowners started changing hands more quickly (Figure 4, panel c). New investors suddenly started showing up in numbers in the Upper Pilcomayo with the intention of clearing the land for cattle ranching. The logic of this new frontier was one of capital accumulation through beef production, mostly for export markets, combined with land speculation. The owners of these ranches, most of which ranged between 5,000 and 15,000 hectares, did not necessarily have ties to agriculture, and for many, the main interest was in the appreciation of land that comes with its transformation from forest to pasture and, sometimes, croplands. Among the main landowners in the area, in addition to a couple of

major national agribusiness companies, were: a former Paraguayan president; a couple of former ministers; several Paraguayan businessmen, including the CEOs of major construction and public works companies; a high-profile Brazilian financier and money launderer; a group of French investors; the governor of a province in eastern Paraguay; the CEO of the Paraguayan representative of car maker Toyota; a Mennonite car dealership owner and prominent local politician; and several consortia of Uruguayan investors.

This new land-use regime relied on the production of a simplified landscape consisting of geometric plots in which forest was cleared and replaced by exotic pastures such as *Gatton panic* (*Megathyrsus maximus*), separated by thin woodland buffers, and with a forest reserve, a portion of the land of 25 percent that owners must keep under forest, usually located on the most marginal land. These ranches were tended by a minimal number of personnel, usually from eastern Paraguay, under the direction of administrators from Filadelfia, Asunción, or abroad. Ranchers dug deep wells to access the Yrendá aquifer, a large groundwater reserve spanning much of the western end of the Paraguayan Chaco, which provided water for their cattle. Most operations focused on fattening, as opposed to breeding, a more complex system. The cattle ranching regime therefore exhibited a degree of homogeneity and simplification of the landscape not seen before, imposing on the complex landscape of the Upper Pilcomayo a semiregular grid that contrasted with the fluid territorialities of previous regimes.

The establishment of these ranches necessitated the replacement of the Criollo livestock herding regime, either through its outright elimination or, at a minimum, through its displacement and its confinement. This happened in a variety of ways. Because long-term occupants of public lands had a right to that land following Paraguayan law and many Criollos could in theory demonstrate they had occupied the land before it was allocated to outside investors, purported landowners frequently negotiated with Criollo households to buy them out, usually taking advantage of asymmetries in knowledge of land markets and literacy to secure their signature at a low price. Criollos sometimes refused or went to court to defend their right to land, but this process was expensive, the lawyers often corrupt, and even if they won a first time, when other landowners showed up later, many eventually caved in. Some ranchers allowed families to remain on, or use, a portion of, their land, often their forest reserve, even though it was supposed to be used only for conservation. Many, however, chose to intimidate Criollo

families into leaving or to outright evict them, sometimes at gunpoint. Stories of threats of violence, killing of trespassing animals, and destruction of property abound, like they do in other parts of the Chaco (del Giorgio, Robinson, and le Polain de Waroux 2022), and while there were some attempts at resistance, these were rare, perilous, and given the enormous power differential, achieved relatively little.

As a result, Criollo families, by and large, were relegated to the margins of the cattle frontier, when they did not leave the area altogether, moving to Argentina or to the towns of the central Chaco. Those who stayed started fencing their land and requesting land titles from the government in the hope of fending off outside investors, sometimes successfully, but more often not. This implied a transition from a system of extensive grazing under forest cover with no formal limits to one based on rigid property boundaries and much smaller land areas, which necessitated investments in intensification, leading many to remove the forest cover and plant pastures on part of their land. Similar issues were faced by Indigenous people in communities without land titles, such as Mistolar, but in those like San Agustín that had secured a land title, issues of space were less salient or came from endogenous demographic growth---although an apparent attempt, in 2022, by private investors to grab land in the territory of San Agustín showed that even their land tenure security could not be taken for granted.

For Criollo and Indigenous people in the Upper Pilcomayo, this new land-use regime was a largely faceless, disincarnated one. Whereas people had known the owners of the first estancias established in the 1970s personally, in the 2000s and 2010s it was more and more common for them to have little idea about who owned the land they were settled on or next to---in many cases, they met the ranch administrators at best and were left in the dark about the owners. The fact that multiple people frequently appeared simultaneously claiming to be the owners of a given piece of land added to the confusion. There were, however, some connections between the new ranches and their Criollo and Indigenous neighbors. Beside conflict and displacement, the main interactions between this new land-use regime and the older ones were through labor and the purchase of animals. Some Indigenous and Criollo people were hired at the moment of clearing land to fell trees and erect fences. Fewer worked on these farms once they were in operation. Better positions were typically reserved for employees from eastern Paraguay, wages were quite low for hard labor, and employers could not always be counted on to pay even those

low wages---some people told stories of working for weeks and not being paid at all. Still, Indigenous people needing the income did often work on these farms, notably some farms operating irrigated agriculture, which required labor year-round. Few Criollos did the same. Among Criollos, those who were able to maintain a reasonably good cattle herd and breed the kinds of cows that large ranches wanted could sell their calves to these ranches. Compared to earlier days when cattle had to be brought on foot to the trading posts in Guachalla or to the central Chaco, most people recognize that this was an improvement. In some cases where families maintained good relations with ranchers or their administrators, they also benefited from some favors, such as the occasional use of machines, for example to clear a pasture, the borrowing of a truck to bring water to the *puesto* in dire times, or the use of the farm's internet connection. Some owners also authorized Criollo smallholders to enter the properties to gather honey or firewood, or even, in rare cases, looked the other way as Criollos let their animals graze on part of their properties.

The 2000s and 2010s thus saw the irruption in the Upper Pilcomayo of a new land-use regime centered on large-scale cattle ranching on exotic pastures in large fenced and deforested properties of restricted access, managed as private companies for the purpose of generating capital for their investors, in a system closely tied to national and global markets and whose beginning (investment) and end (profits) were outside the region (Table 1). While there were precursors of this regime starting in the 1970s, it is only in the 2000s that its rapid expansion enacted the privatization of land that had been happening on paper since the years of the dictatorship, with the effect of relegating Criollo livestock herding to the margins and of threatening Indigenous livelihoods.



Fig. 5--Images of the different land-use regimes: a. Community agricultural plot in the Indigenous territory of San Agustín; b. cattle roaming in the forest under the Criollo land-use regime; c. cattle on a recently deforested pasture; d. clearings for irrigated agriculture next to a former Criollo settlement. Copyright by author (a-c) and Planet Labs (d).

THE EMERGENCE OF IRRIGATED AGRICULTURE

For a few years, there have been signs in the Upper Pilcomayo of a shift to what might be considered yet another land-use regime, one centered on irrigation (Figure 4, panel d.). Cropland farming is generally more profitable than cattle ranching where it is feasible in the Chaco, and some investors have been trying to demonstrate the feasibility of rainfed agriculture in the Dry Chaco of Paraguay since the beginning of the boom in the 2000s. These attempts, however, have been concentrated in areas closer to infrastructure, and the Upper Pilcomayo area, until recently, remained both too remote and too dry for crop farming to take hold. The outlook started changing in the late 2010s and early 2020s, however. As an increasing number of companies successfully retrieved sweet water from the Yrendá aquifer for their cattle ranches, some investors decided to take advantage of that unregulated water source and set up irrigation infrastructure. Throughout the region, the higher price for cropland gives land developers a strong incentive to push crop cultivation even in areas where its economic value is questionable, in the hope that they will find buyers who believe in the agricultural potential of the area (le Polain de Waroux and others 2018). This hope was bolstered by the near-term prospect of the completion of the bioceanic highway, an asphalted road linking the area of Pozo Hondo to the Mennonite colonies of the central Chaco and to the Paraguay river at the Brazilian border (Chambers 2023), which promised to significantly lower transportation costs and reduce travel times.

While it is only at a very early stage of development, a land-use regime organized around irrigated agriculture, if it gains momentum, would have important implications for other actors in the Upper Pilcomayo. People are concerned about the use of agrochemicals in crop farming and their spread to nearby communities, especially if fields are fumigated by airplanes. Stories of communities sprayed with pesticides in eastern Paraguay (Ezquerro-Cañete 2016) are taken as a cautionary tale. While croplands do provide occasional work to locals and more crop farming might mean more employment, this kind of work is hard and often exploitative, with pays below or just at the national minimum wage and exposure to harmful chemicals, and so it hardly constitutes a promising prospect for development. What is perhaps more hopeful is the fact that Criollo and Indigenous communities are progressively also becoming equipped with deep wells that allow them to extract groundwater themselves, fundamentally altering the possibilities of life

and livelihoods for them. In addition to securing a drinking water supply, these wells open new opportunities for intensifying livestock herding and for small-scale irrigation, which might provide a way for land-scarce communities, both Indigenous and Criollo, to continue making a living off the land.

A CONTINUOUS UNFOLDING OF LAND-USE REGIMES

The Paraguayan Chaco is increasingly discussed as a deforestation frontier---a place of fast and radical transformation from forested land to commercial agriculture. While this framing is a helpful starting point, the dichotomous nature inherent to the concept of frontier can obscure the diversity of processes and actors at play, particularly when looking at land-use change over the long term. The concept of land-use regimes, as I have attempted to demonstrate here, provides a useful heuristic to describe and analyze long-term land-use change in a way that allows for some degree of generalization, yet does not rely on overly simplistic representations of space and agents. The six dimensions proposed (land cover(s), land use(s), agent(s), access, connectedness, and motive(s)) enable a characterization of regimes that draws attention to their specific features to highlight differences between them. Using this framing, the Upper Pilcomayo, since the beginning of the twentieth century, can be seen as having gone through a succession of moments in which different land-use regimes dominated the landscape---first an Indigenous, mixed-use regime, then a Criollo livestock herding regime, and finally a corporate cattle ranching regime, with the possibility of a new irrigated agriculture regime in development (Figure 5 & Table 1). These changes in land-use regimes were sufficiently dramatic, sudden, and irreversible, to warrant the label of “regime shifts.” The emergence of each of these regimes in the study area can of course be discussed in terms of different frontiers: Criollo settlement, for example, shares characteristics with similar processes elsewhere discussed as smallholder (or “populist”) frontiers (Pacheco 2005), and the expansion of cattle ranching is a perfect example of an agricultural commodity frontier (le Polain de Waroux and others 2018). Yet characterizing these processes as transitions in land-use regimes affords some insights that are less obvious in a frontier framing.

In particular, the use of a land-use regime framing in this land-use history of the Upper Pilcomayo helps to highlight the coexistence of land-use regimes in space and the existence of relationships between them. Most studies of land-use regime shifts describe a shift from one state to another across a whole landscape---rarely is the possibility of coexistence in these land-use regimes, or their mutual influence, explicitly acknowledged. Yet, in the periods discussed above, the landscape of the Upper Pilcomayo was never entirely dominated by one regime. During the period of dominance of what I called the Indigenous mixed-used regime, before the Chaco War, Criollo settlers were starting to occupy pockets of space across the river from the Buenaventura

Colony, while Bolivian ranchers were advancing along military forts. After the war, while the Criollo livestock herding regime dominated, Indigenous territorial consolidation allowed the Nivacle and Manjui, along with the Guaraní, to continue maintaining an Indigenous mixed-use regime in more bounded spaces, albeit, of course, with some changes. Similarly, both the Indigenous and the Criollo regimes, or versions of them, continued to exist, to some extent, under the corporate cattle ranching regime.

Greater attention to the coexistence of land-use regimes can also help nuance depictions of land-use transitions. The literature has tended to conflate disparate phenomena under the label of regime shifts, such as the birth of a land-use regime (for example, the emergence of the soy complex described in Ramankutty and Coomes (2016)), its endogenous transformation (for example, the adoption of a new commodity crop by smallholders as in Junquera and Grêt-Regamey (2019) or the transformation of pastoral systems at the farm level in Li and others (2017)), or its elimination and replacement by another land-use regime (for example, the replacement of smallholder shifting cultivation by oil palm plantations in Zaehring and others (2020)). By paying attention to the coexistence, spatial configuration, and relationships of land-use regimes, we see that transitions between regimes in the Upper Pilcomayo took a variety of pathways. Sometimes, they occurred through the replacement of a regime by another, either through the former's complete elimination from certain regions of space (the Indigenous regime during the Chaco War or the eviction of Criollos in the corporate cattle ranching regime), or through its displacement to other parts of the landscape (the displacement of Criollos to unclaimed lands in the early stages of the ranching regime). Sometimes, transitions occurred instead through transformation, either endogenously (the emergence of an irrigated agriculture regime within the structure of the cattle frontier) or by contagion (the gradual transformation of the Criollo livestock herding regime towards one dominated by private property with forest clearing during the period of domination of the cattle frontier).

Likewise, paying attention to the configuration of land-use regimes can inform us about potential future transitions. Minority land-use regimes coexisting with dominant ones in a landscape might be the "seeds" of new dominant regimes, like the Criollo livestock system before the war, or the early cattle ranches of the 1970s. These "seed regimes" may or may not come to dominate the landscape: for example, Bolivian ranches that had been expanding before

the Chaco War never did become dominant, though they might have if Bolivia had won the war. Or land-uses that appear to be in a minority at a particular time might be remnants or legacies of a previously dominant regime that continues to persist, perhaps in a transformed form, like the Criollo livestock herding regime in the twenty-first century. The recognition of the coexistence of different regimes in space therefore opens up new perspectives and raises new questions about how these regimes relate to one another and how these relationships influence their evolution and the configuration of the landscape over time in ways that the classical, ecologically-informed view of regimes, most often represented by the ball-and-curve diagram of multiple equilibria, cannot (Müller and others 2014).

What future transitions can we expect, then, in the Upper Pilcomayo? The region is reaching what, from the point of view of frontier theory, could be called a late frontier stage. As I have attempted to show, however, the closure of the cattle frontier is but one moment in a history of waxing and waning land-use constellations that will continue unfolding into the future. Based on recent trends, one can infer a few developments for the near future. The cattle ranching regime will probably continue to expand into the last bits of forest in the area, except for titled Indigenous territories and some titled Criollo properties. It is also likely that, as land becomes scarcer and groundwater more available, the Criollo livestock herding regime will continue to be transformed into something resembling small-scale iterations of the corporate cattle regime. Irrigated crops will likely continue to expand into cattle ranching enough to constitute a regime of their own, although how much of the landscape they will conquer is impossible to tell. Beyond this, things are highly uncertain. The Upper Pilcomayo's history has shown that contingencies matter: consider what would have happened had the Chaco War not been fought. Just like the seeds of new regimes such as irrigated agriculture may flourish, "legacy" regimes may expand again if those that are dominant falter---for example, if a new disease decimates cattle, or if there is a global disruption of the beef trade. New, different regimes may take hold, such as regimes based on forest conservation or mining. At the time of writing, the people of San Agustín had just received payments for environmental services for the first time in exchange for maintaining forest cover in part of their territory. Meanwhile, a Canadian company was negotiating lithium-mining concessions in the Paraguayan Chaco, with claims that appeared to overlap with the territory of Mistolar. Such initiatives may peter out the way that petroleum exploration did in the 20th century, or they may take off and fundamentally change the region. Whatever changes occur

in the future, however, they will likely continue to be complex and involve the coexistence and interaction in the Chaco landscapes of multiple systems operating based on different logics.

NOTES

1. I use the denominations commonly used by people themselves today, which also correspond to those used by the Paraguayan Government. The Nivaclé are also referred to as Ashluslay or Chulupí in older texts, among other names (Chase-Sardi 1972, 245). The Manjui are part of a group called Chorote or Choroti, which also comprises the Eklenjui, the name Manjui or Eklenjui designating whether the group originally inhabited the left or the right bank of the Pilcomayo, respectively (Chase-Sardi 1972, 247). Chase-Sardi also noted the presence a few Tapieté groups along the Bolivian border (Chase-Sardi 1972, 281), and there were still some people who identified as Tapieté in the area of Pozo Hondo at the time of writing.
2. The Guaraní Occidentales are also called Chiriguano or Guaraní (Chase-Sardi 1972, 265), and are distinct from the majority Guaraní speakers of Paraguay and from other groups like the Guaraní Ñandeva.
3. While the word *puesto* may have originally (in the eighteenth century) referred to a division of labor within a larger *estancia* in which a Criollo herder took care of the *estanciero*'s cattle at a location with water on the land of the *estancia*, the term today is commonly used to designate an isolated Criollo livestock herder's homestead (Zorzoli 2022, 56–57).
4. For a list of these lands, see <https://elsurti.com/oligarquia/especial/los-invasores-vip-del-paraguay>

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