NOMADIC STUDIES

RESEARCH ARTICLE

The Reappraisal and recovery of camelids in the Argentine Puna

Changes in the multifunctionality of agropastoral systems in the high mountains

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Breeding camelids is the primary livelihood of Indigenous pastoralists in the high-altitude cold desert of the Andes. Puna pastoralists face a nexus of longstanding and emerging challenges alongside new opportunities. Primary among these challenges are the impacts of climate change, which disrupt traditional environmental, animal health, and agricultural knowledge. Socio-economic pressures, including youth out-migration and localized labor shortages, further compound these difficulties. Conversely, new opportunities have emerged from growing demand among discerning consumers for unique, healthy, gourmet pastoral products, as well as the increasing adoption of mobile technology and e-commerce. Despite their vital contribu-

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tions, pastoralists have frequently been blamed for land degradation through overgrazing, while public policies have often treated them as passive recipients of social assistance rather than productive contributors to food systems and local economies. Drawing on grassland ecology data and ethnographic research gathered over more than twenty years of fieldwork in the Puna, this paper examines the pivotal role of Puna pastoralists in Argentina, analyzing current trends, key challenges, and the multifunctional services their systems provide.

Introduction

Pastoral livelihoods rely primarily on livestock production sustained by natural rangelands (FAO, 2021, p. 3). Pastoral systems have evolved predominantly in drylands, environments characterized by low, unpredictable primary productivity and spatially and temporally variable forage and water supplies. Consequently, pastoralists globally navigate this inherent variability by moving herds across diverse grazing territories, maintaining management flexibility, and rapidly adjusting livestock herd size and species composition in response to shifting climatic, economic, and political dynamics (FAO, 2021, p. 6).

Pastoral production systems are widely recognized for supplying an extensive array of goods and services. These include productive goods such as protein (meat, milk, and derivative products), fiber, wool, and artisanal crafts; environmental services such as landscape conservation, maintenance of primary productivity, biodiversity preservation, freshwater conservation, seed dispersal, and carbon sequestration within managed agroecosystems; socio-cultural services including community settlement, identity preservation, traditional knowledge transmission, and social cohesion; and economic development services such as employment generation, value addition, and the establishment of market nodes and trade networks (Ickowicz et al., 2018, p. 3; Ragkos & Nori, 2016, p. 325).

Since pre-colonial times, highland pastoral communities in northwestern Argentina have raised the llama (*Lama glama*), a domestic South American camelid, as a source of protein, textile fiber, and pack transport (Flores Ochoa, 1977, pp. 422–423; Murra, 1964). Following the Spanish conquest of the Americas, sheep and goats were introduced alongside local llama herds in varying proportions, eventually becoming central pillars of the Puna economy. Over centuries, sheep and

goats underwent a distinct process of adaptation and local integration, reinforced by agricultural extension programs that promoted selective breeding and technical innovations aimed at commercial specialization and yield improvement. Consequently, domestic camelids lost their central status in local herds, becoming relegated to small flocks kept primarily for household subsistence.

Concurrently, the vicuña (*Vicugna vicugna*) – the wild Andean camelid renowned for its extraordinarily fine fiber – suffered severe overhunting that pushed the species to the brink of extinction. In response, comprehensive national and international legal protections were instituted starting in the 1960s to safeguard remaining populations (Baldo et al., 2013). This historical trajectory illustrates how sheep and goat pastoralism predominated in the region for over half a century, largely marginalizing South American camelids.

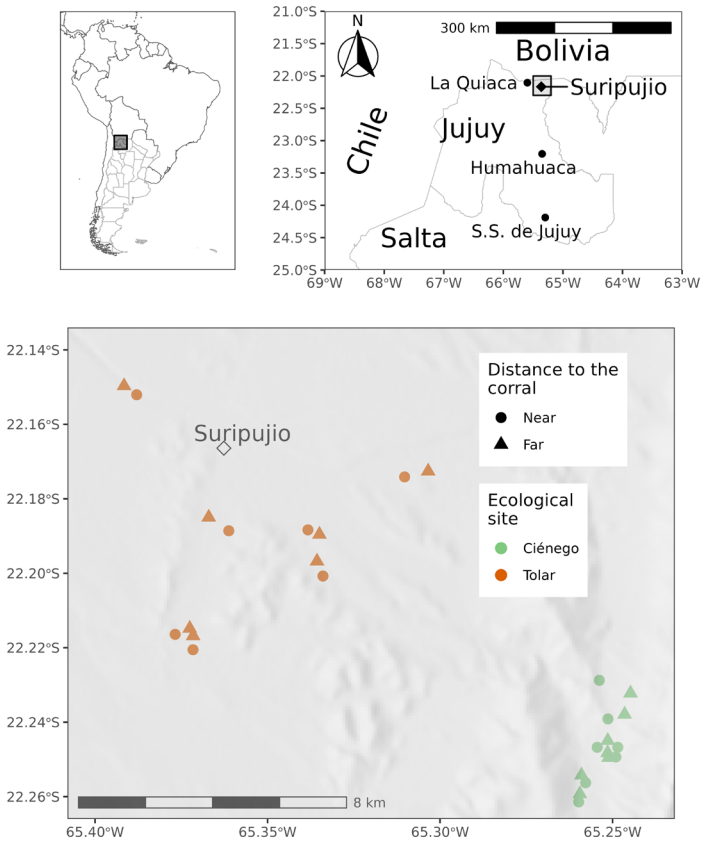


Figure 1: Study site, Jujuy province in the North West of Argentina.

This study documents the major transformations experienced by camelid herders in northwestern Argentina, with a specific focus on the high-altitude regions of Jujuy province. We highlight the evolving role of camelid pastoralists during this transition and examine their system's multifunctionality amidst accelerating climate change and shifting local social dynamics.

Methodological Considerations

Drawing on secondary sources covering historical and contemporary pastoral contexts, we analyze empirical data on agricultural production, economics, demographics, local development, climate change, and grassland ecology under grazing pressure in the Puna. Livestock population trends were evaluated using data from successive National Agricultural Censuses (INDEC, 2003, 2008, 2021). Analysis of wild camelids relies on secondary sources, including protective legal frameworks and official vicuña census counts. To contextualize macro-level statistical trends with local pastoralists' perspectives and lived experiences, we conducted semi-structured surveys and in-depth interviews, drawing upon more than twenty-five years of continuous field research in the region.

A Brief History of Camelid Domestication in the Central-South Andes

The Central and South-Central Andes served as primary centers of camelid domestication, underpinning a resilient pastoral economy. Archaeological evidence suggests that camelid domestication in the South-Central Andes developed concurrently with processes in the Central Andes (cf. Olivera, 2018, p. 300). Early hunter-gatherer populations established initial sedentary settlements and began domesticating camelids around the fourth millennium BP in the Puna of Jujuy (Olivera, 2018, p. 301; Yacobaccio, 1994, 2001). Long before the expansion of the Inca Empire, South American camelids formed the foundation of Andean subsistence and transport networks, while fulfilling essential ritual roles and serving as live food reserves during periods of environmental stress (Flores Ochoa, 1977, pp. 422–423; Murra, 1964).

Following the Spanish conquest, massive livestock wealth was extracted primarily to satisfy colonial tax obligations (Flores Ochoa, 1977, p. 22; Murra, 1964). Heavy taxation, combined with intense demand for meat in the silver mining hub of Potosí and the heavy reliance on camelids for pack transport, precipitated a rap-

id decline in native camelid herds. Colonial authorities and landholders progressively replaced llamas with European sheep; by 1650, indigenous camelid stocks had been severely depleted across much of the region (Flores Ochoa, 1977, p. 26; Murra, 1970).

Presently, variations in census methodologies and reporting intervals across Central Andean nations complicate precise population estimates for South American camelids. FAOSTAT reported approximately 8.7 million camelids (llamas, alpacas, vicuñas, and guanacos) across South America in 2022, though this dataset notably omits national counts from Chile and Argentina. According to González Ulibarry (2023), Chile accounts for 177,959 wild and domestic camelids. In Argentina, the 2018 National Agricultural Census recorded 194,787 llamas (INDEC, 2021). Meanwhile, Argentina's wild camelid populations have stabilized over the past decade, with vicuñas estimated at 100,000 head (Arzamendia et al., 2019) and guanacos exceeding 550,000 head (Canevari & Vaccaro, 2007). Combined, these data indicate a total wild and domestic camelid population in Argentina of approximately 844,787 head. Ultimately, these species constitute an indispensable ecological and economic resource base that has sustained Andean cultures across millennia.

Pastoralists in the Puna of Jujuy, Argentina

The Indigenous inhabitants of the Argentine Puna belong to diverse ethnic groups integrated into Qullasuyu (the southern province of the Inca Empire) prior to Spanish colonization. While collectively identified today under the broader designation of 'Kollas', distinct historical communities retain their unique identities, including the Atacama, Paypaya, Omaguaca, Tilcara, Maimará, and Ocloya.

Today, Puna camelid herders reside in remote rural settlements, managing grazing lands allocated by communal assemblies in accordance with customary tenure systems. These land rights frequently take the form of a non-contiguous 'archipelago' of pastures distributed across distinct ecological belts, affording herders access to complementary forage resources and water sources throughout seasonal cycles (Abeledo, 2023; Göbel, 2003; Quiroga Mendiola, 2015b).

Individual herds often combine multiple livestock species belonging to different members of an extended family. Primary herd management typically falls to a single resident family member – most commonly an adult woman – who is compensated through reciprocal exchanges of goods and labor. Traditionally, women,

elders, and children oversee small ruminants (sheep and goats), while men manage larger stock (llamas and cattle). Sheep and goats are corralled nightly in pens, whereas cattle and llamas range freely. Due to llamas' gregarious social behavior of bedding together at night, their communal resting spots form distinctive cleared circular patches (*dormideros* or roosts) within the surrounding native vegetation (Quiroga Mendiola & Cladera, 2018).

Pastoral households typically operate across multiple residences, centered on a primary village home (*domicilio*) where major familial and community events take place (such as livestock branding, weddings, and baptisms). Husbands and school-aged children spend most weekdays in the village to accommodate employment and educational commitments. Concurrently, the household maintains temporary pastoral outposts (*puestos* or *estancias*) across dispersed grazing grounds, where mothers or adult daughters reside to oversee daily herd management (Göbel, 2003; Quiroga Mendiola, 2015b).

Multifunctionality of Camelid Herders in the Puna of Jujuy

Multifunctionality encompasses the full range of environmental, social, and economic services generated by agricultural and livestock systems, encompassing both market goods (such as food and fiber) and non-market public benefits (Ragkos & Nori, 2016). Applied to pastoralism, this framework elucidates the tightly coupled socio-ecological system uniting herders, livestock, natural rangelands, water resources, and shade (Ickowicz et al., 2022). Grounded in this conceptual approach, we categorize pastoral services into four major domains: (1) Productive, (2) Environmental, (3) Socio-cultural, and (4) Local Development (Ickowicz et al., 2018).

In Jujuy, the principal productive services of pastoral systems include meat production for household consumption and local commercial channels (both formal and informal), as well as the conservation of domestic animal genetic resources. Key environmental services comprise sustainable rangeland management, maintenance of net primary productivity, soil protection through vegetative cover (which regulates soil temperature and moisture via shade and windbreak effects), preservation of floristic diversity, and watershed stewardship. Socio-cultural services center on rich cultural heritage and community identity anchored in customary land governance, traditional ceremonies, livestock rituals, culinary practices, ethnobotanical knowledge, indigenous linguistic expressions, climate adaptation strategies, and collective self-organization. Lastly, pastoralism supports local de-

velopment by generating household income and rural employment, building trade networks, and maintaining regional communication channels (Table 1).

Table 1: Multifunctional services provided by camelid pastoralists in the Puna of Jujuy, Argentina: Production services (1), Environmental services (2), Cultural services (3), and Local Development services (4).

Production Services	**References**
Total meat produced (537,100 kg/year); annual contribution to Gross Production Value (USD 2,685,500/year)	Own estimations based on Paz et al. 2011; Echenique et al. 2015; CNA 2018.
Domestic zoogenetic resources, selection criteria, and affectivity	Quiroga Roger 2021
Environmental Services	
Dry shrubby steppe ANPP (400–800 kg DM/ha/yr); Plant cover (10–30–70%); Plant richness (27–30); Diversity (Shannon–Wiener Index = 2)	Quiroga Mendiola et al. 2001; Yufra et al. 2019; Quiroga et al. 2019; Sosa et al. 2022: 38; Quiroga Mendiola and Tálamo 2024.
ANPP Wetlands in high mountains (2,000–3,500 kg DM/ha/yr); Plant cover (80–97%); Plant richness (13–20); Diversity (Shannon–Wiener Index = 2–2.5)	
Socio-cultural Services	
Communal land distribution; Traditional festivals and rituals; Livestock traditional management; Native plant use; Local knowledge and strategies against dryness; Risk and uncertainty management	Göbel 1994, 2003; Abeledo 2014; Quiroga Mendiola 2015b; Bugallo 2010, 2013; Bugallo and Tomasi 2011; Quiroga Mendiola et al. 2018; Tortoni et al. 2021; Ickowicz et al. 2022; Lambaré et al. 2024
Development Services	
Annual family income, employment, market channels	Abeledo 2023; Sabha et al. 2023; Ickowicz et al. 2022

Scenario of Changes: Persistence of Camelid Herders

Llama populations in Argentina are heavily concentrated in three northwestern provinces: Catamarca, Salta, and Jujuy. According to the 2018 National Agricultural Census (INDEC, 2021), the vast majority of the national llama herd (80.03%) is located in Jujuy province on the high Andean plateau.

Following the Spanish conquest, rural livelihoods in the Jujuy Puna became closely tied to introduced small ruminants. For decades, sheep farming constituted the dominant economic activity in terms of herd size, medium of exchange, and social organization – dictating community agreements, seasonal labor schedules, and transhumant mobility patterns across elevation gradients to optimize access to forage, water, and microclimates.

However, agricultural census data from recent decades reveal a steady decline in both the number of sheep-raising Agricultural Establishments (*Explotaciones Agropecuarias* / EAPs) and total sheep stock (Table 2).

Table 2: Sheep Agricultural Establishments and sheep stock in Jujuy province. Source: Authors' elaboration based on INDEC CNA 2002, 2008, 2018.

EAP / Stock	CNA 2002	CNA 2008	CNA 2018
Number of EAPs	4,085	3,437	2,807
Number of sheep heads	453,515	373,226	232,204

Similar trends affect goat herds and producers (Table 3).

Table 3: Goat Agricultural Establishments and goat stock in Jujuy province. Source: Authors' elaboration based on INDEC CNA 2002, 2008, 2018.

EAP / Stock	CNA 2002	CNA 2008	CNA 2018
Number of EAPs	2,804	2,269	1,689
Number of goat heads	152,952	138,569	86,054

Conversely, both the number of EAPs engaged in llama husbandry and total llama stocks have expanded steadily over the same period (Table 4):

Table 4: Llama Agricultural Establishments and llama stock in Jujuy province. Source: Authors' elaboration based on INDEC CNA 2002, 2008, 2018.

EAP / Stock	CNA 2002	CNA 2008	CNA 2018
Number of EAPs	2,145	2,375	2,650
Number of llama heads	109,412	142,392	157,420

To account for varying forage intake across species and enable longitudinal comparison, total livestock numbers were converted into Ovine Equivalents (OE). Conversions follow parameters established by Vargas (1980, cited in Quiroga Mendiola 2015a: p. 7) for Bolivian Creole sheep, which closely mirror Puna livestock in body mass and ecological adaptation (averaging 438 kg dry matter intake per year). As illustrated in Figure 2, overall stocking rates across the Jujuy Puna have contracted over time: sheep numbers dropped substantially, goat and cattle populations remained relatively stable, and llama stocks experienced a modest, steady increase.

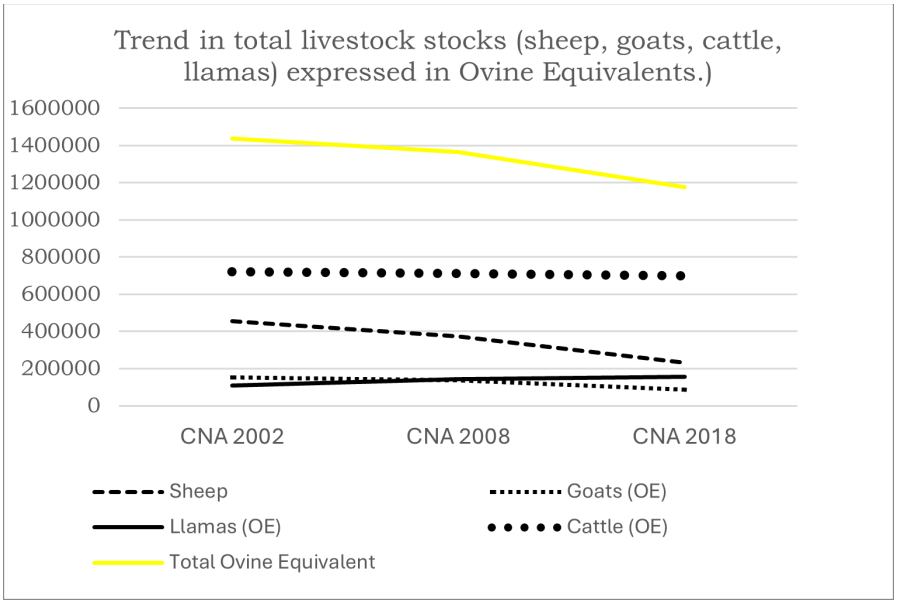


Figure 2: Livestock trends from 2002, 2008 and 2018 National Agricultural Censuses, converted to Ovine Equivalents (1 cattle = 8 sheep; 1 llama = 2 sheep; 1 goat = 1 sheep). Authors' elaboration based on INDEC data and Vargas (1980).

These census data indicate that while the overall number of active farming units remained relatively stable, overall stocking pressure across the landscape eased slightly. Crucially, this shift was accompanied by a clear reallocation of effort toward llama production, reflected in growing numbers of llama-breeding EAPs and expanding llama herds.

Empirical surveys conducted with 22 Puna pastoralists strongly corroborate these macro-statistical trends. Over half of respondents (56%) reported managing larger total herds 15 years ago than today, while 67.7% noted that their mothers maintained significantly larger livestock holdings. Crucially, 70% of herders had reduced or entirely liquidated their sheep flocks, and 90% had downscaled or abandoned goat raising. Conversely, 70% had introduced or expanded llama or cattle holdings. When describing the primary drivers behind herd restructuring, 64% cited deteriorating pasture availability ('forage is scarce now'); 41% pointed to rangeland abandonment resulting from sending children to village schools; and 23% cited temporary or permanent urban labor migration. Compounding factors included youth out-migration (draining family labor reserves), heightened predation by Andean condors (*Vultur gryphus*) and pumas (*Puma concolor*), depressed market prices for wool and meat, and inadequate commercial infrastructure. Furthermore, several respondents highlighted growing safety concerns for women residing alone in increasingly depopulated grazing outposts.

> There are only a few of us, the youth, who are dedicated to breeding because the prices of meat, wool and leather are not good… and because of the scarcity of pastures…
>
> We, women, stay mostly with children to bring them to school, plus the daily work… this is the reason there are fewer people dedicated to breeding animals.
>
> People are getting older, and there are fewer of them, plus there is a lack of fodder. We would like more help for livestock farmers in grazing huts, enclosures, or perhaps some help to better fix the huts.
>
> Lack of pastures, many diseases, little water supply for pasture irrigation.

> In the field, it is raining very little; now, more diseases are seen if we do not vaccinate.

As these testimonies illustrate, pastoralists directly link forage and water shortages to heightened vulnerability to animal disease, underscoring the vital importance of veterinary care and vaccination.[1]

Each livestock species occupies a distinct functional niche within multi-species pastoral strategies. Sheep supply wool for textiles, while goats provide household dietary protein. Llamas yield both meat and high-quality fiber; their economic importance has expanded significantly in response to growing consumer demand for lean, healthy meat, alongside opportunities in regional gastronomy and ecotourism. Cattle serve primarily as living financial capital for emergency cash generation, and are consequently pastured closer to major transport corridors, abattoirs, and regional markets.

Climate Change and Pastoralists' Perceptions

Climate change constitutes a major catalyst of regional environmental transformation. According to the Argentine Ministry of Environment and Sustainable Development (2022), northwestern Argentina is experiencing a prolonged winter dry season, leading to acute water scarcity for human and livestock consumption alongside heightened wildfire risks. Concurrently, the frequency of extreme heatwaves and elevated temperatures has increased. Projected impacts include dwindling freshwater reserves, declining rangeland productivity, reduced livestock yields, and disruptions to local tourism – ultimately undermining rural livelihoods and compounding environmental degradation.

Pastoralists' empirical observations closely mirror these scientific projections. Field interviews with 34 local herders reveal a consensus regarding shifts in precipitation and temperature regimes. Most respondents report that rainfall has become increasingly erratic and intense, characterized by brief, torrential storms followed by prolonged dry periods. This altered precipitation regime induces premature vegetation sprouting followed by rapid die-off during subsequent dry spells. When rains eventually return, vegetative regrowth is compromised because plant energy reserves have been exhausted. As a result, forage availability drops and livestock

[1] Pastoralists bring together the concept of veterinary medicines, calcium or vitamin supplements, and vaccination under a single unified term.

health becomes increasingly unstable. Furthermore, herders note that seasonal springs, streams, and waterholes now dry up earlier in the season or have vanished entirely. Winter dry seasons have become protracted, disrupting livestock reproductive cycles, lowering conception rates, and driving up animal mortality. Herders also report wider thermal extremes – marked by earlier autumn frosts, delayed spring frosts, unseasonal heatwaves, and intensified winter freezes.

> It is impossible to ensure vegetal production [because of] sudden frost or drought.
>
> …dry and rainy periods have become more extreme, and temperatures are more severe.

Very few pastoralists perceive positive outcomes from these climatic shifts, with the overwhelming majority viewing them as detrimental to rangeland productivity, water security, and livestock welfare. However, isolated herders observed minor microclimatic shifts, noting:

> Perhaps it is now possible to cultivate certain warm-climate crops that could never grow here before.

Faced with these compounding ecological pressures on pasture and water resources, pastoralists have developed active adaptation strategies:

> We have to purchase supplementary forage for the dry season. We also couse or sell older, unproductive animals. Other measures include searching for new water sources, planting irrigated forage crops, and restoring traditional breeding cycles.
>
> We utilize remote highland pastures as standing fodder reserves, downscale herd sizes, deepen wells, and improve water catchment systems.
>
> We build fenced enclosures to reserve pasture blocks and allow daily grazing grounds time to recover.

Socio-economic Changes

Pastoral households are increasingly relocating to intermediate towns situated within their native regions. This demographic shift was significantly accelerated by the expansion of secondary schooling in rural hubs following the enactment of National Education Law No. 26,206 in 2006, which made secondary education compulsory nationwide (Nóbile, 2016). By granting rural youth local access to secondary education, this policy altered historical rural-to-urban migration pathways, allowing families to avoid sending teenagers to distant provincial capitals (Manzano & Velázquez, 2015).

Residing in intermediate towns enables families to access public schooling, healthcare, electricity, transport, and telecommunications while continuing to operate rural livestock enterprises. Ethnographic field research reveals the emergence of a distinct socio-agrarian actor: the 'absentee herder', who maintains livestock holdings remotely, commuting to rural outposts on weekends via motorcycle, bicycle, or pickup truck. In other cases, livestock owners hire external salaried herders (*puesteros*) to manage daily grazing operations during their absence.

Consequently, novel labor arrangements have emerged alongside transformations in species selection, herd size, and spatial range management. Under these remote management regimes, herders increasingly favor llamas over small ruminants. Llamas range extensively without requiring daily herding or nightly penning, demonstrate exceptional physiological adaptation to high altitude and drought, resist local predators more effectively, and fit flexible male labor schedules.

Such absentee and third-party management arrangements have become particularly prevalent near lithium and mineral mining developments, where expanding off-farm employment draws local labor into industrial mining operations.

Final Remarks

This article has examined the key ecological, social, and economic transformations shaping Puna pastoralism in recent decades. We have highlighted the multifunctional contributions of these integrated production systems, which produce high-quality meat and fiber while adapting to the extreme environmental variability of the high Andean desert. Puna herders maintain a deep cosmological and ecological connection with their land, viewing livestock as relational kin and embedding veg-

etation, pastures, water sources, and mountain landscapes within a framework of mutual care (Blanfort & Lasseur, 2018, p. 91; Quiroga Mendiola et al., 2018).

Andean pastoralists possess a long history of resilience and adaptation in the face of profound socio-political disruptions. Following the Spanish conquest, communities reorganized labor, herd composition, and land-use strategies while seamlessly incorporating Catholic iconographies into traditional ritual calendars (Bugallo, 2010). Supplying pack transport and meat to the silver mining complex at Potosí, highland pastoralists functioned as vital, prosperous agrarian producers (Gil Montero, 2009, p. 42). However, post-independence economic reorientation and political centralization in Buenos Aires progressively marginalized mountain herders. Throughout the nineteenth and twentieth centuries, industrial development in lowland regions drew labor away from the highlands, compelling pastoralists to continually adapt their livelihoods.

The constitutional recognition of Indigenous pre-existence in Argentina's 1994 Constitution, alongside the ratification of ILO Convention 169 and the international Vicuña Convention, brought Andean pastoralism and camelid production back onto the national public policy agenda.

As climate change intensifies environmental uncertainty, policy attention has increasingly focused on camelids as resilient livestock options. Puna herders continue to adapt by revaluing traditional ecological knowledge, revitalizing native camelids ('sheep of the land') (Flores Ochoa, 1977, p. 26; Murra, 1970), and adopting multi-sited living strategies. Pastoral households in the Puna do not abandon their lands; instead, they navigate socio-ecological pressures through multi-sited residence, circular mobility, and diversified economic networks. They persist.

References

Abeledo, S. (2023). *Movilidad y territorio pastores de la puna [Mobility and territory of pastoralists in the Puna]*. Editorial UBA.

Arzamendia, Y., Baldo, J., & Vilá, B. L. (2019). Conservación y manejo de la vicuña en argentina [Conservation and management of the vicuña in Argentina]. *Revista de Biología Neotropical*, *16*, 45–58.

Baldo, J., Arzamendia, Y., & Vilá, B. L. (2013). *Vicuñas en la puna: Conservación y aprovechamiento sustentable [Vicuñas in the Puna: Conservation and sustainable use]*. Editorial UNJu.

Blanfort, V., & Lasseur, J. (2018). Proceedings of the workshop multifunctionality of pastoralism: Linking global and local strategies through shared visions and methods. In *Satellite workshop, International Rangeland Congress*.

Bugallo, L. (2010). La estética de la crianza: Los santos protectores del ganado en la puna de jujuy [The aesthetics of herding: Livestock guardian saints in the Puna of Jujuy]. In M. A. Bovisio & M. Penhos (Eds.), *Arte indígena: Categorías, prácticas, objetos [Indigenous art: Categories, practices, objects]* (pp. 186–205). Encuentro Grupo Editor.

Canevari, M., & Vaccaro, O. (2007). *Guía de mamíferos del sur de américa del sur [Field guide to mammals of Southern South America]*. Editorial El Ateneo.

FAO. (2021). *Making way for pastoralism: Towards better recognition of pastoralist rights in policy-making*. Food and Agriculture Organization of the United Nations.

Flores Ochoa, J. A. (1977). *Pastores de puna: Uchuqmarca y los pastores de la cordillera central [Puna pastoralists: Uchuqmarca and the pastoralists of the central Cordillera]*. Instituto de Estudios Peruanos.

Gil Montero, R. (2009). Mountain pastoralism in the Andes during colonial times. *Nomadic Peoples*, *13*(2), 36–50. https://doi.org/10.3167/np.2009.130203

Göbel, B. (2003). La arquitectura del pastoreo: Uso del espacio y sistema de asentamientos en la puna de atacama (susques) [The architecture of pastoralism: Space use and settlement system in the Atacama Puna (Susques)]. *Estudios Atacameños*, *23*, 53–76.

Golovanevsky, L., Bergesio, L., & Reid Rata, Y. (2015). *Mapa de la dinámica poblacional en jujuy: Cambios y continuidades en el empleo y las condiciones de vida [Population dynamics map in Jujuy: Changes and continuities in employment and living conditions]*.

González Ulibarry, P. (2023). *Ganadería camélida: Antecedentes y regulaciones [Camelid livestock: Background and regulations]*. Biblioteca del Congreso Nacional de Chile.

Holland, A. (1997). Substitutability: Why strong sustainability is weak and absurdly strong sustainability is not absurd. In J. Foster (Ed.), *Valuing nature? Economics, ethics and environment* (pp. 119–134). Routledge.

Ickowicz, A., Blanfort, V., Forman, S., Hubert, B., Lasseur, J., Marguerat, C., Tourrand, J. F., Velasco Gil, G., & Wedderburn, L. (2018). Why and how address multifunctionality of pastoral farming systems? In V. Blanfort & J. Lasseur (Eds.), *Multifunctionality of pastoralism: Linking global and local strategies through shared visions and methods*. GASL.

Ickowicz, A., Hubert, B., Blanchard, M., Blanfort, V., Cesaro, J., Diaw, A., Lasseur, J., Thanh Huyen, L., Mauricio, R. M., Cangussu, M., Müller, J. P., Quiroga Mendiola, M., Quiroga Roger, J., Vera, T., Ulambayar, T., & Wedderburn, L. (2022). Multifunctionality and diversity of livestock grazing systems for sustainable food systems throughout the world: What can we learn for Europe? *Grass and Forage Science*, 1–13.

INDEC. (2003). *Censo nacional agropecuario 2002 [National agricultural census 2002]*. Instituto Nacional de Estadística y Censos.

INDEC. (2008). *Censo nacional agropecuario 2008 [National agricultural census 2008]*. Instituto Nacional de Estadística y Censos.

INDEC. (2021). *Censo nacional agropecuario 2018: Resultados definitivos [National agricultural census 2018: Definitive results]*. Instituto Nacional de Estadística y Censos.

James, C. P. (2006). *A study of subsistence agriculture in the lower nile delta, 1875–1930* [PhD thesis]. University of Cambridge.

Lambaré, D. A., Urbina, L., Gimenez, L. A. S., Vignale, N. D., & Pochettino, M. L. (2024). Abordaje etnobotánico del complejo vegetal de las 'tolas' en distintos enclaves de jujuy [Ethnobotanical approach to the 'Tolas' plant complex in different enclaves of Jujuy]. *Bonplandia*, *33*(1), 113–131.

Mamani Linares, L., Cayo, F., & Gallo, C. (2014). Características de canal, calidad de carne y composición química de carne de llama: Una revisión [Carcass characteristics, meat quality, and chemical composition of llama meat: A review]. *Revista de Investigaciones Veterinarias Del Perú*, *25*(2), 123–150.

Manzano, F. A., & Velázquez, G. A. (2015). La evolución de las ciudades intermedias en la argentina [The evolution of intermediate cities in Argentina]. *Revista Geo UERJ*, *27*, 258–282.

Martinez-Alier, J., Munda, G., & O'Neill, J. (1998). Weak comparability of values as a foundation for ecological economics. *Ecological Economics*, *26*, 277–286.

Ministerio de Ambiente y Desarrollo Sostenible de la República Argentina. (2022). *Plan nacional de adaptación y mitigación al cambio climático [National climate change adaptation and mitigation plan]*.

Ministerio de Educación de la Nación Argentina. (2023). *Padrón de establecimientos educativos [Registry of educational establishments]*.

Murra, J. V. (1964). Herds and herders in the inca state. *Man*, *64*.

Murra, J. V. (1970). Current research and prospects in Andean ethnohistory. *Latin American Research Review*, *5*(1).

Nóbile, M. (2016). La escuela secundaria obligatoria en argentina: Desafíos pendientes para la integración de todos los jóvenes [Compulsory secondary school in Argentina: Pending challenges for the integration of all youth]. *Última Década*, *24*(44), 109–131.

OECD. (2001). *Multifunctionality: Towards an analytical framework*. Organisation for Economic Co-Operation; Development.

Olivera, D. E. (2018). El proceso de domesticación de camélidos en los andes centro-sur [The camelid domestication process in the south-central Andes]. In H. R. Grau, M. J. Babot, A. E. Izquierdo, & A. Grau (Eds.), *Puna argentina: Naturaleza y cultura [Argentine Puna: Nature and culture]* (pp. 295–315). Fundación Miguel Lillo.

Paz, R., Lamas, H., Echazú, F., Sosa Valdez, F., & Califano, L. (2011). *Diversidad mercantilización y potencial productivo de la puna jujeña (argentina) [Diversity, commercialization, and productive potential of the jujeña Puna (Argentina)]*. Instituto Nacional de Tecnología Agropecuaria.

Quiroga, M. A., Saravia, A. G., Gramajo, G. D., Fuentes, E., Quiroga Mendiola, M., Sánchez, M. E., & De Gracia, J. N. (2019). *Estudio de vegetación de humedal santa rosa de los pastos grandes, provincia de salta [Wetland vegetation study of santa rosa de los pastos grandes, Salta province]*.

Quiroga Mendiola, M. (2015a). 'Donde no se puede sembrar.' la triple espacialidad pastoril en suripujio, puna de jujuy, argentina ['Where one cannot sow': The triple pastoral spatiality in suripujio, Jujuy Puna, Argentina]. In A. Benedetti & J. Tomasi (Eds.), *Espacialidades altoandinas: Nuevos aportes desde la argentina [High Andean spatialities: New contributions from Argentina]: I* (pp. 227–256). Editorial de la Facultad de Filosofía y Letras de la UBA.

Quiroga Mendiola, M. (2015b). Shepherds of puna: Sustainable management of natural grasslands in highland jujuy, argentina. In E. Martínez Carretero (Ed.), *Restauración ecológica en la diagonal árida de la argentina [Ecological restoration in the arid diagonal of Argentina]* (pp. 159–178).

Quiroga Mendiola, M., Briones, V., De Gracia, J., & Sánchez, M. E. (2010). *Conservación y pastoralismo: Experiencias de investigación participativa en el parque nacional los cardones, valles calchaquíes, argentina [Conservation and pastoralism: Participatory research experiences in los cardones national park, calchaquí valleys, Argentina]*. Editorial UNSa.

Quiroga Mendiola, M., & Cladera, J. L. (2018). Ganadería en la puna argentina [Livestock farming in the Argentine Puna]. In H. R. Grau, M. J. Babot, A. E.

Izquierdo, & A. Grau (Eds.), *Puna argentina: Naturaleza y cultura [Argentine Puna: Nature and culture]* (pp. 387–402). Fundación Miguel Lillo.

Quiroga Mendiola, M., Da Silva Wilches, A. C., Gutiérrez, M. A., Ramallo, D., Arapa, N. G., Tolaba, J. A., Ragno, R., & Acuña, E. (2001). *Estimación de la condición de los pastizales naturales en yavi y alrededores, provincia de jujuy, noroeste de argentina [Estimation of natural rangeland condition in yavi and surrounding areas, Jujuy province, northwestern Argentina]*.

Quiroga Mendiola, M., Saravia, A. G., & Longoni, A. (2018). Andean mutual breeding, multifunctional services and pastoral strategies against drought in the Argentine Puna grasslands. In V. Blanfort & J. Lasseur (Eds.), *Multifunctionality of pastoralism: Linking global and local strategies through shared visions and methods* (pp. 90–97). GASL.

Quiroga Roger, J. A. (2021). *Caracterización del recurso genético local caprino de la quebrada de humahuaca, provincia de jujuy [Characterization of the local goat genetic resource of quebrada de humahuaca, Jujuy province]* [Master's thesis]. Universidad Nacional de Tucumán.

Ragkos, A., & Nori, M. (2016). The multifunctional pastoral systems in the mediterranean EU and impact on the workforce. *Options Méditerranées, A*, (114), 325–328.

Rengifo Vázquez, G. (2003). *La enseñanza es estar contento: Educación y afirmación cultural andina [Teaching is being happy: Education and Andean cultural affirmation]*. PRATEC.

Rolston III, H. (1989). *Philosophy gone wild* (2nd ed.). Prometheus Books.

Secretaría de Agroindustria. (2016). *Carne de llama: Nutrición y educación alimentaria [Llama meat: Nutrition and food education]* (Ficha N°48). Ministerio de Producción y Trabajo de la República Argentina.

Sosa, H., Amaya, N., & Gonnet, J. (2022). *Manual de buenas prácticas de manejo del pastoreo y los humedales en salinas grandes, argentina [Manual of good management practices for grazing and wetlands in salinas grandes, Argentina]*. Wetlands International.

Tortoni, G. L., Arias Toledo, B., & Vignale, N. D. (2021). The Andean medicinal flora in the traditional preparations of the community of Ocumazo (Pueblo omaguaca), Jujuy, Argentina. *Boletín de La Sociedad Argentina de Botánica*, *56*, 403–417.

Toulmin, C. (2013). How africa can solve its food crisis by growing more crops sustainably. *The Guardian*.

Vargas, H. (1980). *Capacidad de carga animal para la época invernal [Animal carrying capacity for the winter season]* (No. EE7). INFOL.

Yacobaccio, H. D. (1994). Biomasa animal y consumo en la puna de jujuy [Animal biomass and consumption in the Puna of Jujuy]. *Arqueología*, *4*, 45–71.

Yacobaccio, H. D. (2001). La domesticación de camélidos en los andes centrales [Camelid domestication in the central Andes]. *Relaciones de La Sociedad Argentina de Antropología*, *26*, 101–127.

Yufra, A. V., Quiroga Mendiola, M., & Quiroga, M. A. (2019). *Composición florística de la vegetación del perilago en la laguna de pozuelos, jujuy [Floristic composition of perilake vegetation in laguna de pozuelos, Jujuy]*.