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Resisting uncertainty: transhumant pastoralism and socio-ecological transitions in the Argentine Andes

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Transhumant pastoralism represents a socio-ecological system shaped by mobility, uncertainty, and resilience. Drawing on 5 years of ethnographic research in Malargüe, Argentina—the country's primary region for goat transhumance—this article explores how peasant families sustain their livelihoods and territorial presence amid environmental variability, extractive pressures, and institutional neglect. Engaging with Latin American political ecology, peasant studies, and theories of socio-ecological transitions, the paper reframes transhumance as a contemporary and adaptive livelihood strategy, rather than a remnant of the past. It foregrounds mobile territorialities, subsistence ethics, and vernacular governance as forms of resistance and resilience. In doing so, the article contributes to current debates on resilience, justice, uncertainty, and ecological transitions from below, offering grounded insights for reimagining pastoral policy and socio-ecological governance in the Andean drylands. The findings underscore the need for flexible governance systems that support pastoral mobility and recognize the socio-ecological value of transhumance.

KEYWORDS

political ecology, pastoralism, resilience, uncertainty, socio-ecological transitions

Introduction

Amidst the converging crises of climate change, extractive expansion, and agrarian restructuring, rural societies across Latin America are increasingly governed by uncertainty. Among the most affected—yet persistently overlooked—are transhumant pastoralist communities: peasant and Indigenous groups whose livelihoods depend on the seasonal movement of livestock across ecologically diverse landscapes. Rather than representing a remnant of the past, these mobile systems offer enduring and adaptive forms of ecological governance, grounded in mobility and reciprocity.

In recent years, several geographical inquiries have emerged that incorporate debates on contemporary socio-ecological transformations with a particular focus on current environmental justice claims (Braun, 2015; Benjaminsen, 2021; Perreault et al., 2015; Truffer et al., 2015; Werner, 2019; Hansen and Coenen, 2015). In this sense, geography is a

overarching discipline, bridging the gap between the social and natural sciences (Allen, 2024; Harvey, 2007; Sobirov, 2024). Conversely, several authors have contributed to the revitalisation of the notion of territory as the axis of their reflections in pursuit of nderstanding the current economic and ecological crises in the case of Latin America (Haesbaert, 2011; 2020; Saquet and Cichoski, 2022; Martín, 2020; Morales et al., 2024; Comerci, 2015; 2018; Silveira, 2013; Mançano Fernandes, 2019; Quimbayo Ruiz, 2020).

In Latin America, the question of the territory is inextricably linked to the discourse surrounding the peasantry (Barbetta and Domínguez, 2023; Soto, 2023; Santiago-Vera et al., 2021; van der Ploeg, 2010). This is why studying agrarian life and livelihoods in the current food crisis is increasingly relevant (Borras, 2023; van der Ploeg, 2020; Edelman and Wolford, 2017). Considering the profound implications of the global climate crisis, several hypotheses on potential solutions to the problem have been put forth, which posit the reorganization of future justice along more ecological lines (Huber, 2022; Scheidel et al., 2022; Demos, 2023). Indeed, Latin American and Caribbean Political Ecologies have moved the environmental justice working agenda to other territories of intellectual/activist inquiry and action (Hernández Vidal et al., 2023: 371). At the same time, inquiries into ´uncertaintý have emerged as a sign of the times (Scoones, 2019; Welsh, 2014; Zeiderman et al., 2015; Zinn, 2009; Renn, 2017). There are multiple views and a long tradition of thinking about uncertainty, from the philosophical traditions of skepticism to the quantum view of physics (Ravetz, 2008; Scoones and Nori, 2023; Power, 2004). In addition, over the past 2 decades, a substantial body of research has emerged on the current trajectory of socio-ecological transitions, which has been developed alongside the theoretical and practical inquiries described above (Turnheim et al., 2015; Kern et al., 2019; Wesely et al., 2014; Köhler et al., 2019; Truffer and Coenen, 2012; Smith and Raven, 2012; Geels, 2019; Longhurst, 2015).

This article examines transhumant pastoralism in Malargüe, a mountainous region in central-western Argentina and the country's main area of extensive goat production. Drawing on 5 years of ethnographic research, we explore how peasant families navigate and inhabit uncertainty, organize production and reproduction through altitudinal mobility, and maintain resilient socio-ecological systems under adverse conditions. Our analysis reframes transhumance not merely as a livelihood strategy, but as a vernacular form of commoning and an expression of non-capitalist ecological rationality.

The notion of justice is proposed as a concept for understanding the controversial relationship between grazing and the conservation of practices in marginal rural areas (Wang and Lo, 2022; Caviedes et al., 2023). Situated within the interdisciplinary field of studies on territorial vulnerability and rural resilience (Córdoba et al., 2019; Meza et al., 2020; Mussetta and Hulbert, 2020) and in conversation with Latin American political ecology (Martín, 2020), the article addresses a set of interrelated questions: What forms of economic life persist outside market-centric paradigms? How do mobile pastoralist systems resist enclosure and commodification? And what insights do they offer for thinking about resilience, ecological governance, and socio-ecological transitions from below? We argue that transhumant pastoralism constitutes a living socio-ecological economy: a mode of commoning attuned to variability, organized around principles of sufficiency rather than accumulation, and on ecological knowledge and forms of adaptation (Rodríguez-Díaz et al., 2025). These systems challenge dominant models of sustainability rooted in control, stabilization, and growth, proposing instead a relational and plural ontology of cohabiting with uncertainty (Laborda et al., 2023; Pérez León et al., 2020). This case study from Malargüe, Argentina, also contributes to broader international discussions on rangeland governance and pastoral mobility. As highlighted in the Rangelands Atlas (ILRI, IUCN, UNEP and ILC, 2021) and the Global Agenda for Sustainable Livestock (GASL), mobile, pastoralism plays a critical role in biodiversity conservation, climate resilience, and rural livelihoods across drylands worldwide. Yet, despite these recognized contributions, pastoralist systems often face policy environments that misunderstand or marginalize mobility as inefficient or outdated (Bendini et al., 1993; Easdale et al., 2018) By situating Andean transhumance within these global debates—alongside experiences from the Sahel, the Horn of Africa, and Central Asia—this article underscores the need for context- specific, flexible, and inclusive approaches to rangeland management that support rather than undermine pastoralist ways of life.

Materials and methods

This study is based on 5 years of ethnographic fieldwork (2018–2023) conducted in the department of Malargüe, in the southern region of Mendoza Province, Argentina. As the country's principal area for transhumant goat pastoralism (Soto, 2021; Senasa, 2022). Malargüe provides a critical setting for exploring resilience, mobility, and adaptation in non-equilibrium dryland environments. The research employed a qualitative, inductive approach rooted in political ecology and rural ethnography. Extended stays in rural communities and mountain grazing areas allowed for immersive participation in the seasonal cycles and everyday practices of transhumant families. This ethnographic engagement was essential to understanding the situated knowledge, territorial practices, and socio- ecological strategies of pastoral households (Soto, 2024).

Primary data collection methods included:

Participant observation during summer and winter grazing periods. Thirty- five semi-structured interviews with herders, family members, and local institutional actors. Informal

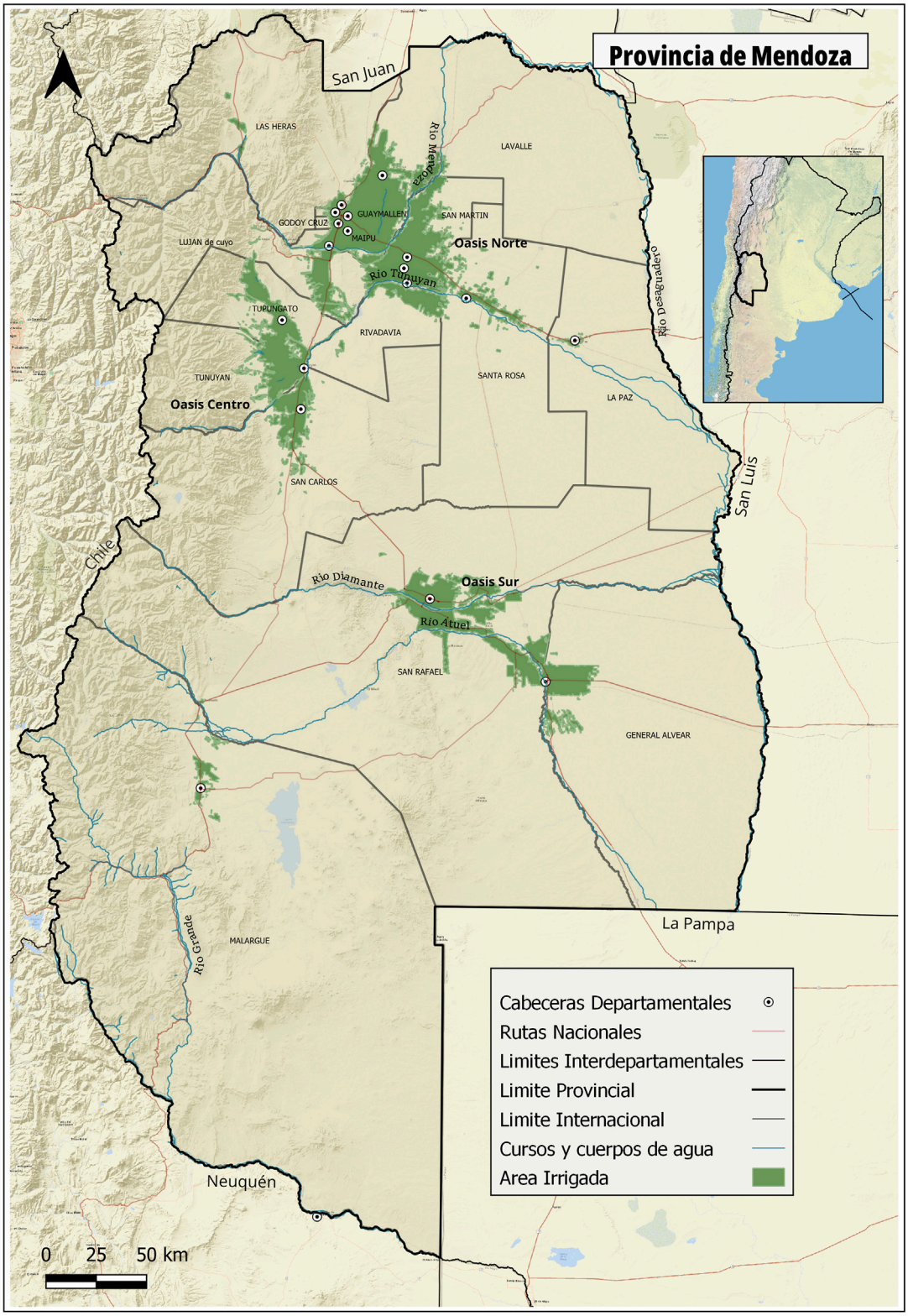

FIGURE 1
Map of the province of Mendoza, Argentina/Source: Prepared by Julian Ramirez Guirao.

conversations and life histories, particularly with elders and women. Collection of field notes, geospatial mapping of herding routes, and documentation of animal management practices. The research focused on the interrelations between mobility, environmental uncertainty, and access to land. Special attention was paid to how pastoralists develop resilience strategies in the absence of state support. This methodological approach prioritized local narratives and embedded knowledge, seeking to understand how transhumant families interpret, inhabit, their territories amid structural marginalization and ecological variability. All research activities adhered to ethical principles including informed consent, the establishment of long-term trust, and sensitivity to community concerns and knowledge ownership.

Results

Political Ecology and Territorial Conflicts Latin American political ecology offers a powerful framework to examine the socio- ecological dynamics of transhumant pastoralism. Rather than viewing pastoralism as marginal or anachronistic, Latin American political ecology recognizes pastoralism as a contemporary mode of life that actively resists dominant development logics, territorial enclosures, and extractive land-use regimes (Alimonda et al., 2017; Delgado Ramos, 2013; Martín, 2020). Territory, within this tradition, is not merely physical space but a relational and contested construct shaped by histories of power, dispossession, and daily practice (Haesbaert, 2011). Transhumant systems allow us to understand space as a political practice.

In Kristin Ross's words, they can be thought of as alternative forms of organisation to capitalism and the state, in ecological terms: Networks of solidarity, pleasant collaboration and community consumption and production practices are built that are not subordinate to the logic of growth or privatisation (Ross, 2024). In this context, pastoral mobility is both a livelihood strategy and a political act. It defends and enables the continuation of affective, cultural, and ecological ties to land, while resisting dominant narratives that equate mobility with backwardness or inefficiency, and defend local ways of life. Transhumance in Malargüe provides a compelling empirical case of rural resilience under conditions of uncertainty. Far from being strangers in their own land (Honorable Camara de Diputados Mendoza, 2023) extensive goat herding in this region operates as a dynamic territorial strategy that resists extractive land-use models and developmentalist paradigms. It expresses an alternative spatial logic based on seasonal mobility, intergenerational continuity, and ecological attunement. Malargüe, located in southern Mendoza Province, is Argentina's largest goat-producing region (Senasa, 2022).

Illustrated in Figure 1, Mendoza is situated in the central west of Argentina. In the department of Malargüe, transhumant pastoralism represents an Indigenous heritage maintained over time until the present day. In the upper basin of the Río Grande, the number of productive units nearly doubles from winter to summer, rising from about 90 to 190, due to the seasonal migration of herders and livestock (Ramires, 2013). The territory is characterized by arid, cold conditions, with temperatures ranging from −14°C in winter to 39°C in summer, and significant snow accumulation in mountainous areas. Figure 2 shows its territorial distribution. The central feature of this socio-ecological system is the "veranada" a transhumant movement that capitalizes on high-altitude pastures during the summer months (Dayenoff et al., 2019). Herders describe this practice as a multigenerational livelihood, anchored in tradition yet shaped by environmental change: "My grandparents, who lived here and were goat farmers, were doing the same thing... now it's me, my wife, my baby, my mother, and my grandmother—all in the goat business" (Interview with pastoralist, Malargüe, July 2023). The rhythm of life follows the seasons. Livestock are moved to high-elevation valleys between 1,600 and 2,500 m above sea level, in December and return by April, depending on snowmelt and pasture availability (Figure 3). These movements follow a cyclical and functional logic, shaped by ecological variability (Pérez León et al., 2020).

Multiple patterns of mobility are observed: Short-range (half-day to 2 days) Medium-range (three to 5 days) Long- range (over 5 days) Intra-basin movements to spring pastures. These mobility patterns reflect what Latin American political ecology terms "fluid, non-capitalized territoriality—a spatial practice that resists enclosure and commodification (Hernández Vidal et al., 2023). As another herder noted, "In winter and spring, we stay down here. In summer, we go to the veranada. We travel 6 days up and return in four. That's our rhythm" (Interview with pastoralist, Malargüe, March 2022). This system of altitudinal rotation mirrors the Andean model of the "vertical archipelago," where households access resources across different ecological zones (Guerra, 2005; Scoones, 2024). Transhumant life relies on the coordination of seasonal knowledge, environmental cues, and kin-based labor to ensure the continuity of both herd and household.

Ecology of a peasant productive system

Goat herding in Malargüe is not just shaped by biophysical conditions, but by embedded knowledge systems that respond to climatic unpredictability and socio- political marginalization. This marginalisation is expressed by pastoralist families as follows: "No one comes here, we are not important... the government does not care much about thepuesteros, we live quite isolated..." (Interview, 2022). Families manage herds through a combination of selective breeding, seasonal adaptation, and infrastructure tailored to withstand environmental stressors. Goats are particularly suited to this

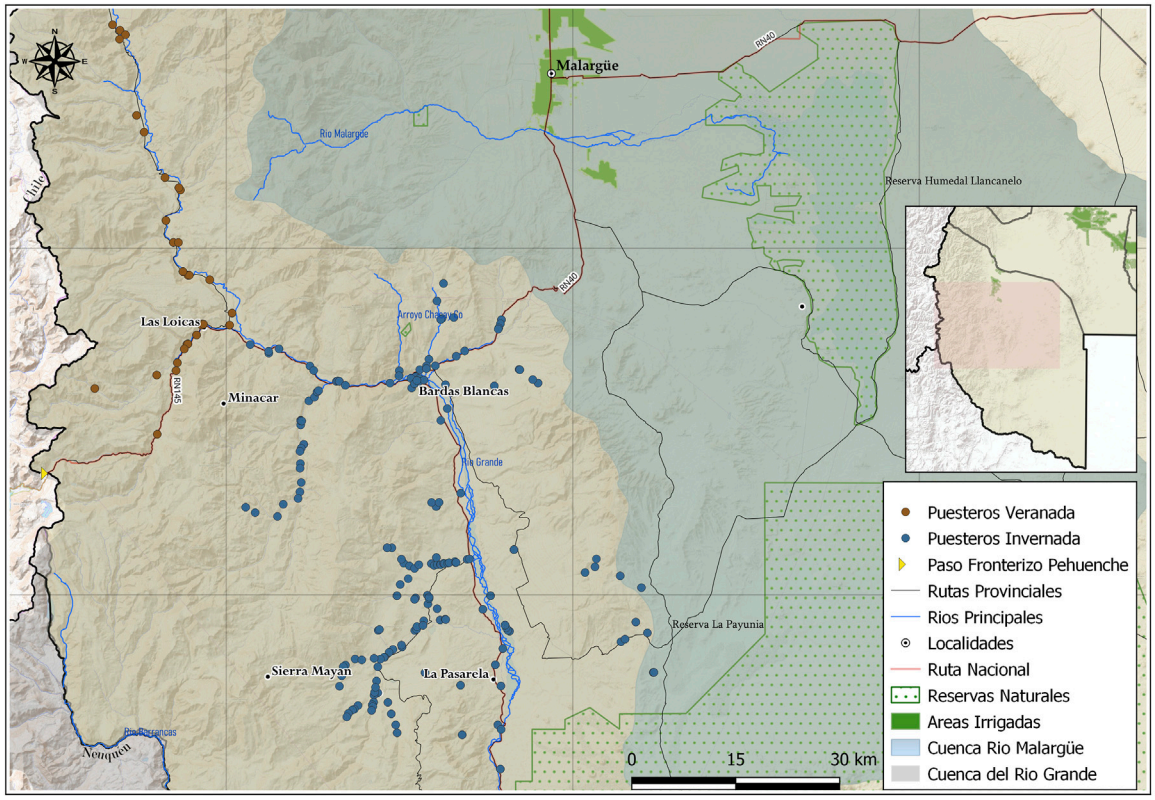

FIGURE 2
Map of transhumance in Malargüe/Source: Prepared by Julian Ramirez Guirao.

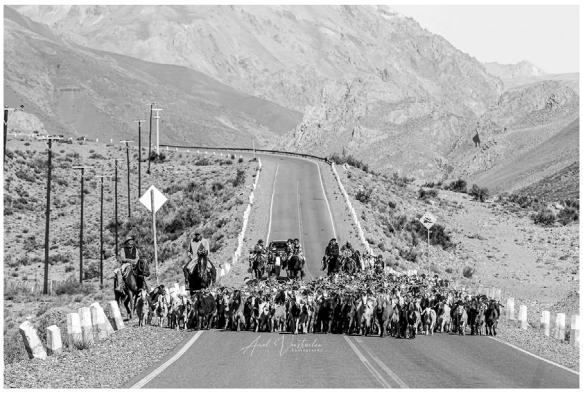

FIGURE 3
Transhumance route/Source: Axel Vanstraelen.

context due to their drought resistance and ability to graze on diverse, sparse vegetation. Despite the marginalisation they mention, their daily practices are forms of profound agroecological productivity and resilience.

Productive cycles follow the ecological calendar. Mating is scheduled for May so that births occur in early spring, aligning lactation with pasture regeneration. Rather than seeking to maximize output, herders emphasize sufficiency-maintaining herd health, avoiding overgrazing, and preserving the reproductive integrity of both animals and landscapes. Communal infrastructure such as watering points and corrals are often built and maintained through cooperative labor. Families observe pasture conditions closely, adjusting herd movement and feeding practices in real time. When drought or snow reduce pasture availability, mobility strategies and informal support networks enable continuity. These practices embody a form of "ecological intelligence" (Goleman, 2009) grounded in agroecological productivity, foresight, and shared experience. In this context, resilience is anticipatory rather than reactive. It is built into the spatial, temporal, and social organization of pastoral life. This peasant ecological governance contrasts sharply with extractive and input-intensive models offering instead a vision of sustainability based on reciprocity, flexibility, and the ethical use of common goods.

Territorial uncertainties, threats, and resilience

This contrast was evident in the opposition of nomadic families to the neo-extractivism of oil extraction through the franking system, promoted by the provincial government (Soto, 2023; Wagner, 2021). To summarize then, transhumant pastoralism in Malargüe unfolds within a context of deep uncertainty-ecological, economic, and political. This uncertainty is not simply a lack of information or a temporary disruption; it is structural and enduring. It arises from climate variability, market volatility, weak institutional support, and the pressures of extractive development. Yet, rather than paralyzing pastoral communities, uncertainty is met with adaptive strategies and territorial resilience. Let us return then to examining this territorial resilience in more detail.

Resilience, as framed by dominant development discourses, is often depoliticized—reduced to technical adaptation or recovery in response to external shocks (Scoones, 2024; Welsh, 2014). However, in transhumant settings, resilience takes on a different meaning. It is a practical implementation of another way of doing politics—more decentralised, collective and creative (Ross, 2024). It reflects a form of territorial persistence: an embodied and collective practice of survival that resists the imposition of external development models. We refer to this as the persistence of transhumant survival practices (Soto, 2024; 2021). Drawing from peasant epistemologies and critical political ecology, this article conceptualizes resilience as a form of infra-political resistance (Scott, 1977; 1990).

Transhumant families engage in subtle, persistent acts of mobility, and resource-sharing that defy dominant territorial logics (Wagner, 2021; Svampa and Viale, 2014; Soto, 2023). Their resilience is not reactive; it is anticipatory and rooted in a worldview that values mobility, reciprocity, and autonomy in agroecological production. This is what a shepherd from Malargüe said: "We produce what we eat with our goats, we use the milk and the skins of the animals. You do not need much to live here. The problem is that we are getting older, and that worries many of us" (Interview, 2022).

This alternative understanding of resilience in agro-ecological production aligns with a territorial ontology of movement. Seasonal mobility is a vernacular governance system based on kinship, ecological knowledge, and customary rights. It challenges state-centric visions of control and modernization, offering instead a politics of cohabitation and sufficiency. Two cases of state-centric modernization that fail to recognize the vernacular governance are illustrative. First the Goat Law No. 26,141, which was initially conceived with the aim of developing family goat production but the majority of whose funds were allocated to address climate and environmental emergencies (Michel and Easdale, 2024). The second state-centric control oriented legislation is Law No. 6,086, which pertains to the promotion and settlement of ranchers in non-irrigated areas. However, in the process the legislation has not effectively addressed the ensuing issue of evictions affecting transhumant families (Soto, 2021).

From the standpoint of Latin American political ecology, territory is inherently dynamic. It is constituted through movement, memory, and affect—not fixed borders or cadastral maps (Haesbaert, 2011; Escobar, 2014). Transhumance, in this light, represents a mobile territoriality that contests hegemonic spatial regimes. Unlike the sedentary and extractivista paradigms that dominate land- use planning, transhumant territorialities operate through fluid seasonal routes, intergenerational transmission of knowledge, and shared access to ecological goods. One needs only to contrast this transhumance with hydrocarbon extractivism. Vaca Muerta, located in the provinces of Neuquén, Mendoza and Río Negro (Wyczykier and Acacio, 2023), is a significant site of metal mega-mining in a mountain range (Wagner, 2021).

This knowledge of transhumant work in the maintenance of their goats occurs in contexts of vulnerability faced by local rural producers undergoing major environmental transitions (Mussetta and Barrientos, 2015). These practices destabilize conventional notions of property, zoning, and state authority. As Zibechi (2012) suggests, such forms of territoriality are not simply oppositional—they enact alternative ways of world-making. The movement of herds across altitudinal zones is not chaotic or informal; it is a sophisticated form of socio-ecological governance. Transhumant families manage landscapes through flexibility, reciprocity, and intimate ecological knowledge, resisting state efforts to normalize or regularize their mobility through rigid tenure systems. A specific example in our study area of the latter is the extractivist Malargue Western Mining District project and its threat to local pastoralism (Samson, 2023; Mannino, 2019).

Uncertainty, variability, and vernacular governance

Decades work on non-equilibrium ecologies and uncertainty (Scoones and Stirling, 2020; Stirling, 2010; Krätli, 2015) challenges the assumption that variability is a problem to be solved. In pastoralist settings, uncertainty is not an anomaly but a constitutive feature of the environment. Transhumant practices are grounded in the capacity to live with and off of uncertainty—not to eliminate it. Flexibility, redundancy, and adaptive mobility are not signs of precarity but evidence of socio-ecological intelligence. These are forms of vernacular governance that contrast with the rigidity of state planning and conservation

bureaucracies, for example, the alienation of their lands in favour of "sustainable tourism projects" (Soto and Ramires, 2022). Rather than aiming to restore an idealized equilibrium, transhumant communities embrace change as a normal condition. Their ability to adjust routes, modify grazing rhythms, and negotiate access illustrates a governance system adapted to dynamic landscapes. A notable case has been the territorial negotiations of Iindigenous nomads in the area who opposed the Portezuelo del Viento hydroelectric dam (La, 2017) and recent legal claims for access to land and transhumance trails (Ser y Hacer de Malargüe, 2020).

Despite their contribution to food production and ecological conservation, transhumant systems are often viewed through a deficit lens—as informal, unproductive, or incompatible with modern development As Lanari et al. (2019) note, while Argentina hosts approximately 220,000 family farms, many of which engage in extensive livestock systems, public policies frequently fail to recognize the ecological value and territorial knowledge embedded in such practices. Transhumance, in this sense, becomes a practice of situated autonomy that resists standardization. Herders' reflections illustrate this existential precarity: "We have good years and bad ones... When the land is poor, grazing is harder. Lack of water is a big challenge" (Interview, 2023). Uncertainty is not a disturbance to be managed, but the everyday condition of life and production. This understanding aligns with Stirling's (2010) argument that effective governance under uncertainty must move beyond risk management and embrace plural, flexible responses.

Recognition of these practices calls for a shift in how development and sustainability are conceptualized. Rather than impose fixed solutions, policies must support the autonomy and adaptive capacity of pastoralist systems. As Scoones and Nori (2023) emphasize, pastoral mobility must not be constrained by narrow corridors or administrative timeframes. Effective intervention requires embracing the messiness and complexity of pastoral life. The stakes are high. Without secure access to land and flexible governance frameworks, the viability of transhumant livelihoods is threatened. As one herder put it: "If we do not have land, livestock will disappear from Malargüe. Land is like the roof over our heads. It's fundamental—not just for us, but for our children and grandchildren" (Interview 4).

Transhumance thus emerges as a frontline in the struggle for environmental justice. In this space, a persistent defence of their respective ways of life can be observed. —by continuing to live, move, and care for the land under adverse conditions. In this sense, pastoral mobility constitutes a living socio-ecological infrastructure -flexible, relational, and grounded in uncertainty- that challenges static models of land governance and calls for recognition of pastoralist systems as vital to sustainable futures (Roe, 2020).

Discussion

Transhumance and the future of socio-ecological transitions

The case of transhumance in Malargüe challenges dominant understandings of socio-ecological transition, particularly those based on linear, technocratic, or Northern-driven paradigms. Rather than viewing transition as a managed shift toward pre-defined sustainability goals, this case suggests a more grounded, plural, and contested process rooted in everyday practices, territorial care, and historical continuity.

Transhumant pastoralism embodies a form of transition from below. It is not driven by policy design, innovation hubs, or technological fixes, but by embedded strategies of survival and relational knowledge. Seasonal mobility, ecological observation, and kin- based cooperation form the foundation of a resilient way of life that does not seek to, overcome uncertainty but to live with and within it. Their adaptive capacity and the ability of their systems to adjust to potential damage, take advantage of opportunities, or respond to consequences, links this experience to that of farmers in Mexico (Bocco, et al., 2019) and communities affected by climate variability and territorial vulnerability (Rodríguez-Díaz et al., 2025; Oyarzo et al., 2024).

These findings from the Argentine Andes resonate with pastoralist experiences in African and Asian drylands, where uncertainty is similarly understood as a structural condition rather than an exception (Scoones, 2019; Krätli and Schareika, 2010). As in the Sahel, the Horn of Africa, or Mongolia, pastoral communities in Malargüe display a form of "intelligent mobility" (Krätli, 2015) rooted in deep ecological knowledge and adaptive responses to variability. Across these geographies, transhumance operates not as a residual practice but as a contemporary and relational mode of socio-ecological governance which promotes a type of agroecological productivity, sustaining transhumance (Nori, 2019; Köhler-Rollefson, 2023).

Situating the Argentine case within this global framework underscores the relevance of Latin American political ecology in dialogues historically dominated by African or Asian examples, while reinforcing the need for regionally grounded yet translocal understandings of pastoral futures. Supporting such transitions requires more than technical policy instruments. It demands a shift in epistemology and governance: from control to coexistence, from economic productivity to sufficiency, and from regulation to recognition. Transhumant pastoralism reveals that sustainable futures are already being enacted—not through rupture, but through the continuity of practices long marginalized by modernity. In sum, transhumance in Malargüe offers both a critique of dominant transition models and a grounded alternative. Pastoral mobility can be understood not merely as a livelihood strategy, but as a form of living socio-ecological infrastructure.

As Roe (2020) argues, pastoralists should be seen as "reliability professionals" who ensure system functionality under conditions of uncertainty, while pastoral systems themselves function as dynamic infrastructures that sustain ecological balance, food security, and social cohesion. In the case of Malargüe, seasonal mobility, flexible land use, and intergenerational knowledge transmission constitute an infrastructure that is not fixed or material, but relational, adaptive, and co-produced by humans, animals, and landscapes. The findings of this study suggest that effective rangeland governance in transhumant contexts requires a paradigm shift away from fixed models of land tenure, economic productivity, and sedentary planning. Policies that prioritize enclosure, formal or standardized land-use frameworks are often misaligned with the territorial logics and mobility practices of pastoralist communities (Michel and Easdale, 2024; Soto, 2021). Instead, governance frameworks should recognize and support the fluid, seasonal, and collective nature of transhumant land use. This entails ensuring flexible access to pastures, protecting traditional mobility corridors, and incorporating local ecological knowledge into decision-making processes. Community-based monitoring systems, recognition of customary rights, and co-management arrangements with state institutions may offer viable paths forward (Peréz Centeno et al., 2024). Moreover, the undervaluation of transhumant pastoralism in national development agendas must be addressed (Peréz Centeno, 2001; Peréz Centeno, 2007). Public policies should not only safeguard the environmental contributions of these systems—such as biodiversity conservation and climate resilience—but also invest in basic infrastructure, veterinary services, and educational access adapted to mobile livelihoods.

Conclusion

This article has examined transhumant pastoralism in Malargüe as a living system of resilience, mobility, and resistance shaped by socio-ecological uncertainty. Drawing on 5 years of ethnographic fieldwork, it has shown how transhumant families sustain their livelihoods through practices deeply embedded in territorial knowledge, seasonal rhythms, and relational care. Rather than interpreting resilience as a depoliticized capacity to absorb shocks, the study reframed it as a territorial strategy rooted in autonomy, collective memory, and the refusal of imposed development logics. In these marginal Andean landscapes, uncertainty is not an obstacle to be eliminated but a condition to be navigated with skill, cooperation, and ecological foresight. This capacity to inhabit and adapt within fluctuating environments speaks to a form of socio-ecological intelligence that remains undervalued in conventional policy frameworks.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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