ETHNOBIOLOGY AND CONSERVATION

SHORT REVIEW

Ethnobiology and Conservation, 15:25 (25 November 2026)
doi:10.15451/ec2026-11-15-25-1-13
ISSN 2238-4782 ethnobioconservation.com

A Framework for Reciprocal Management Assessment: Lessons from Agrodiversity Stewardship in NW Patagonia

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ABSTRACT

Historically dominant conservation approaches frequently overlook the reciprocal contributions between humans and non-humans (such as animals, plants, rivers, and mountains), despite their historical role in constructing landscapes and maintaining agricultural systems. Drawing on situated ethnobiological inquiry with family farmers in Northern Patagonia, this short review proposes an assessment model for Reciprocal Management Practices (RMPs). We define RMPs as bidirectional actions that entail a cycle of exchange with the environment, shaping both the landscape and socio-ecological relationships. The model identifies seven attributes through which the reciprocal orientation of farmers' management practices can be recognized: (1) contextualized subsistence knowledge, (2) adaptive systems thinking, (3) socio-environmental monitoring, (4) recognition of non-human agency, (5) risk reduction strategies, (6) a sense of responsibility, and (7) the generation of synergies. These attributes interact holistically: their interplay underpins the reciprocal character of RMPs and distinguishes them from technically similar agroecological practices lacking this relational grounding. We conclude that RMPs are essential for sustaining long-term socio-ecological coexistence. By making the relational and ethical dimensions of reciprocity explicit, our model offers a framework for recognizing and monitoring these practices, thereby serving as a critical lens to foster transitions toward more resilient systems.

Keywords: Biocultural Conservation; Human-non-human relations; Family farmers; Local Ecological Knowledge; Socio-ecological resilience.

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SIGNIFICANCE STATEMENT

Reciprocity has often been treated as a symbolic or ethical principle, but rarely understood as a concrete form of socio-ecological management. Building on a previously proposed typology of Reciprocal Management Practices (RMPs), this manuscript develops an assessment model to identify the socio-ecological attributes that distinguish reciprocal from non-reciprocal agrobiodiversity management practices. Grounded in ethnobiological research with Patagonian family farmers, the framework identifies seven dynamic attributes, including contextualized subsistence knowledge, adaptive systems thinking, socio-environmental monitoring, recognition of non-human agency, risk reduction strategies, sense of responsibility, and the generation of synergies. By integrating empirical testimonies with socio-ecological theory, this paper provides a practical analytical tool to identify, monitor, and strengthen relational forms of stewardship that are often overlooked by historically dominant conservation approaches. The study contributes to biocultural conservation by reframing reciprocity as an active socio-ecological praxis essential for sustaining resilient and coexistent futures.

INTRODUCTION

In an era defined by escalating socio-environmental challenges, reciprocity has gained renewed attention as a fundamental relational framework for guiding socio-ecological transitions (Ojeda et al. 2022). The concept of reciprocity holds a foundational place in social theory and has spawned a vast and diverse literature that cannot be fully captured here. Marcel Mauss's classic theory of the gift conceptualizes human reciprocity as a social obligation driven by mechanisms of exchange, contractual equivalence, and return (Mauss 2002 [1925]). This transactional view, however, has been extensively debated and reconceptualized in contemporary social theory (Game and Metcalfe 2011; Adloff 2016; de Peyrelongue et al. 2017). Moving beyond contractual or purely instrumental frameworks of social exchange, it is vital when thinking about sustainability transitions to adopt a relational perspective and to conceptualize human reciprocity not as a mechanism of conditional payback, but as an ongoing, embodied practice embedded in social life, where ethics, responsibility, and community well-being are inextricably bound (West et al. 2018).

Nevertheless, reciprocity has been examined predominantly in relation to exchanges and obligations among people, while its expression in everyday practices linking people with other beings and components of their environments has received less attention (Tereucán-Angulo et al. 2016; Salazar et al. 2025). Reciprocity is central to many Indigenous relational ontologies, including diverse formulations of *Buen Vivir* in Latin America, in which collective life is constituted through relations among humans, other beings, and territories (Escobar 2017). More-than-human scholarship has likewise challenged the treatment of non-humans as passive elements of the environment by foregrounding non-human agency, multispecies relations, and the co-production of shared worlds (Whatmore 2006; Haraway 2008; Lorimer 2015). Recent comparative work across Indigenous and local knowledge systems further shows that reciprocity is enacted through culturally specific practices that connect ethical commitments with material contributions between people and nature (Teixidor-Toneu et al. 2025). Despite these contributions, the ways in which reciprocity is enacted through everyday landscape management practices remain less explicitly characterized.

Building on these relational perspectives, Ladio et al. (2026) proposed that reciprocity is enacted through concrete, material practices in and with the territory, and plays a functional role in sustaining socio-ecological relations. This functionality, however, is inseparable from its ethical grounding. Drawing on Dussel's ethics, Arpini (2025) situates such practices within a Universal Material Principle: the ethical obligation for the production, reproduction, and development of life in community. RMPs therefore combine practical effects with relational responsibility and a situated ethics of care. An assessment model cannot by itself ensure that this ethical orientation is maintained; its purpose is to make that orientation explicit so that functional outcomes alone are not taken as evidence of reciprocity. The model should thus be understood as a situated analytical heuristic, not as a standardized protocol for optimizing relational efficiency. Practices detached from responsibilities and obligations toward other participants may retain technical functions, but would not, within this framework, constitute RMPs. In this sense, RMPs challenge development paradigms centered exclusively on maximizing short-term private gain by foregrounding interdependence and the continuity of life in community.

We define RMPs as bidirectional actions that entail a continuous cycle of exchange with the environment, shaping both the physical landscape and the underlying socio-ecological relationships (Ladio et al. 2026). What distinguishes them from technically similar non-reciprocal management practices is the relational orientation guiding them, rather than their technical form or ecological outcomes. Conventional

agriculture, by contrast, relies on intensive, utilitarian, and market-driven models primarily focused on short-term yield maximization (Kremen et al. 2012). Yet, non-reciprocal approaches extend beyond conventional systems; they can also be agroecological and environmentally beneficial. Crucially, however, they lack a sustained relational process of recognizing, responding to, and holding responsibility toward other beings and landscape components (Chan et al. 2016; West et al. 2018).

Over recent decades, conservation thinking and practice have increasingly incorporated community-based, socio-ecological, and biocultural approaches that recognize Indigenous and local knowledge and the interdependence of biological and cultural diversity (Berkes 2004; Mace 2014; Gavin et al. 2015). However, top-down, fortress-style, or purely technocratic approaches and assessments may overlook the relational and multispecies dimensions of local stewardship. Even within more inclusive frameworks, the reciprocal and more-than-human dimensions of everyday management can remain difficult to identify when assessments focus on ecological outcomes without considering the knowledge, values, and relationships through which they are produced. As highlighted by Pereira et al. (2021), uncovering these relational dynamics requires a diverse toolkit of bottom-up, qualitative approaches and deep field engagement to capture the complexity of social-ecological systems. Here, we apply this lens specifically to the biocultural conservation of agrobiodiversity, where production and conservation are intertwined.

Through empirical research with non-Indigenous family farmers in Northern Patagonia (Ladio et al. 2026), we have identified a typology comprising three core categories: Mutualism, Covenant, and Altruistic practices. First, Altruistic practices involve unconditional care driven by holistic gratitude, where farmers foster ecosystem vitality such as protecting water springs or leaving part of the harvest for wildlife, without expecting a direct return. Second, Covenant practices consist of ritualized, symbolic negotiations rooted in mutual responsibility. Typically reserved for high-agency non-humans like specific animals, these actions carry an explicit expectation of a response and are often sealed through spiritual permission-asking rituals. Finally, Mutualism represents practical, daily multispecies collaboration embedded in technical praxis, where farmers identify and activate functional, shared benefits such as utilizing livestock to fertilize soil or planting flowers to attract pollinators without the need for formal or explicit dialogue.

This approach aligns with the identification of seeds of a good Anthropocene: existing initiatives about human-environmental relationships at a local scale that foster harmonious coexistence (Bennett et al. 2016; Kim et al. 2026). The utility of this framework lies in its capacity for visioning plausible futures, by anchoring scenarios in localized realities and existing adaptations. RMPs, therefore, serve as fundamental building blocks for transitions toward more desirable and sustainable socio-ecological futures.

To effectively harness these local initiatives as seeds for future scenarios, it is critical to move beyond abstract conceptualizations and provide concrete empirical evidence. Following Nishi et al. (2021), socio-ecological production landscapes and seascapes that currently function harmoniously, where local communities actively conserve biodiversity while sustaining production, represent practical experiments or seeds of plausible futures. The persistence of these locally grounded seeds and their potential to inform broader transformations can be understood in light of Ostrom's (1990; 2009) work on commons governance, which emphasizes locally adapted institutions, collective decision-making, and monitoring as conditions for sustaining shared resources over time. Consequently, the core challenge lies not in inventing entirely new systems from scratch, but rather in identifying, protecting, and scaling up these deeply rooted local practices into global policy agendas to shape desirable futures. For this reason, this paper aims to delineate explicitly what constitutes an RMP and what does not, taking family farmers from Patagonia as a case study. By establishing an assessment model, we offer a functional diagnostic tool to identify and monitor these vital forms of stewardship in family farming systems, ensuring their integration into biocultural conservation strategies.

Towards an Assessment Model

Building on the situated fieldwork of Ladio et al. (2026), Grimaldi and Ladio (2025), and preliminary data from family farmers across Northern Patagonia, including El Manso, Villa Llanquín, Bariloche and its surroundings (including Ñirihuau), and communities of the Andean Comarca (including El Foyel, El Hoyo and Mallín Ahogado), we propose an assessment model designed to characterize the crucial, distinctive elements of RMPs. Within agricultural management, it is easy to fall into a naïve perspective where almost any local practice appears reciprocal; however, by synthesizing empirical evidence with a robust literature analysis, our framework isolates these distinct elements to differentiate RMPs from conventional management practices in farming systems. By conceptualizing reciprocity not as an isolated gesture, but as a system of interconnected elements, this model delineates the specific conceptual dimensions through which intentional

human actions and values are projected onto the landscape, deliberately returning gratitude and honoring the vital contributions of its ecological components.

The seven attributes embodied in Patagonian family farmers' practices

Our assessment framework (Figure 1) characterizes RMPs through seven interrelated attributes expressed in the practices of family farmers. These attributes were identified through qualitative discourse analysis of testimonies collected during long-term ethnobiological fieldwork in Northern Patagonia, including in-depth interviews (92), guided field trips (64), participatory workshops (2), and ongoing collaboration with local communities. Drawing on both published and unpublished data on agricultural, beekeeping, and livestock practices in forest and steppe environments, we reinterpreted these testimonies to elucidate the socio-ecological dimensions that characterize reciprocal management. Table 1 presents selected testimonies illustrating each attribute.

The reciprocal character of family farmers' everyday management practices emerges from the interplay among these attributes rather than from their technical function alone. These attributes are maintained and continually reshaped through multiple pathways of social transmission, supporting the long-term continuity and ongoing renewal of RMPs (e.g., Lozada et al. 2006; Grimaldi et al. 2024; Rico Lenta and Ladio 2026).

(1) Contextualized subsistence knowledge: Reciprocity is grounded in family farmers' material and spiritual knowledge and in their efforts to sustain the ecological basis required for the long-term continuity of their livelihoods and cultures. This attribute combines detailed environmental knowledge with situated relational values (Ladio et al. 2026). RMPs are therefore situated but not place-bound, as reciprocity takes diverse forms and is enacted through culturally specific practices grounded in Indigenous and local knowledge systems (Teixidor-Toneu et al. 2025). Far from being static, situated knowledge and values are continually reshaped by social changes, migrations, and new encounters, allowing repertoires to travel, adapt, and generate hybrid expressions in changing local settings (Agrawal 2005; Pieroni and Vandebroek 2007). Thus, situatedness denotes context-specific, evolving expression, neither implying cultural fixity nor relying on a required length of residence.

(2) Adaptive systems thinking: RMP practitioners possess a non-Cartesian worldview, perceiving themselves as integral parts of an interdependent network shared with Nature and other local actors (Berkes et al. 2000; Ladio et al. 2023, 2026). They operate from a position of deep interrelationship rather than domination over the living beings with whom they co-habit their lands (e.g., Tauro et al. 2021). While this resilient and adaptive mindset is widely recognized as a cornerstone of sustainable resource management (Simonsen et al. 2016), we propose it here additionally as a core activator of RMPs, as it enables profound reflection on the lived connections that bind all beings together.

(3) Socio-environmental monitoring: Reciprocity cannot exist without continuous, active tracking of environmental indicators such as fluctuations in seed size, microclimatic variations, or subtle changes in livestock health enacted directly by the farmers themselves. This attribute relies on what Tsing (2015) conceptualizes as Attunement: a sophisticated form of attention and a deep sensitivity toward the presence and expression of non-human needs. Far from being a passive routine, this systematic interpretation of localized ecological signs is a core practice of technical and cultural praxis. By listening to and reading the landscape's continuous responses, the farmers' focused attention becomes an ongoing, adaptive dialogue and a foundational mechanism of reciprocal care (Kimmerer 2013; Castillo et al. 2020; Marchant Santiago et al. 2020).

(4) Recognition of non-human agency: This attribute reframes the landscape from a passive repository of resources into a relational field shaped by human and non-human participants. Family farmers perceive the landscape as an animated network of living subjects, actively interacting and partnering with animals, plants, water, and wind (Skewes and Guerra 2016; Castillo and Ladio 2018; Skewes et al. 2017; Ladio et al. 2026). This recognition does not require the explicit articulation of a particular ontology. It may be expressed directly, when farmers describe or address non-humans as intentional subjects, or implicitly, when they attend to their signals, anticipate their responses, and adjust their practices accordingly. This perspective challenges the universality of the nature-culture divide (Descola 2013) by foregrounding the distributed agency and affective multispecies relationships that define rural livelihoods (Fonck and Jacob 2018) and recognizing that non-human beings may occupy distinct points of view and subject positions (Viveiros de Castro 1998). Instead of dominating or merely preserving a detached Nature, practitioners validate the intentionality of non-human co-habitants, transforming daily agricultural management into an ongoing cycle of mutual affectation and shared territorial stewardship. We do not interpret farmers' accounts as evidence of a coherent or explicitly articulated perspectivist ontology; instead, this perspective helps us recognize how non-human agency becomes

visible in everyday narratives and management decisions.

(5) Risk reduction strategies: In RMPs, family farm management rejects short-term yield maximization in favor of socio-environmental risk reduction (Laborda et al. 2026). While classic literature notes that farmers prioritize minimizing uncertainty over capital accumulation (Scott 1976; Toledo and Barrera-Bassols 2010), this attribute moves further by showing that risk reduction transcends farmer subsistence, operating as a coordinated strategy to sustain the life and well-being of all co-habitants across the shared landscape.

(6) Sense of responsibility: This attribute embodies the symbolic relational value that actively conditions and guides management practices (Arpini 2025). This responsibility arises from the deeply felt rights and obligations inherent in human-land relationships and reframes environmental stewardship into a reciprocal ethical duty, ensuring that everyday agricultural actions are oriented toward sustaining the vitality of all co-habitants (Gauthier et al. 2025; Kaulen et al. 2026).

(7) Generation of synergies: This attribute focuses on fostering a synergistic interplay of beneficial human-non-human interactions while acknowledging unavoidable systemic trade-offs, effectively deromanticizing the concept of care. For example, empirical evidence shows that while family farmers actively tolerate and protect culturally significant edible and medicinal plants (Chamorro and Ladio 2021) and key pollinators (Grimaldi and Ladio 2025), they selectively remove species that negatively compete with crops (Grimaldi et al. 2024). Comparable synergies occur in integrated rice-duck systems, where ducks consume weeds and insects and fertilize rice plants, benefiting both crop and livestock while suppressing other organisms and requiring labor-intensive management (Suh 2014). Together with the trade-offs documented by Locqueville et al. (2025), this example shows that favoring specific biocultural elements inevitably introduces landscape trade-offs where some species benefit at the expense of others, framing reciprocity as a pragmatic, multispecies negotiation rather than a sentimental abstraction.

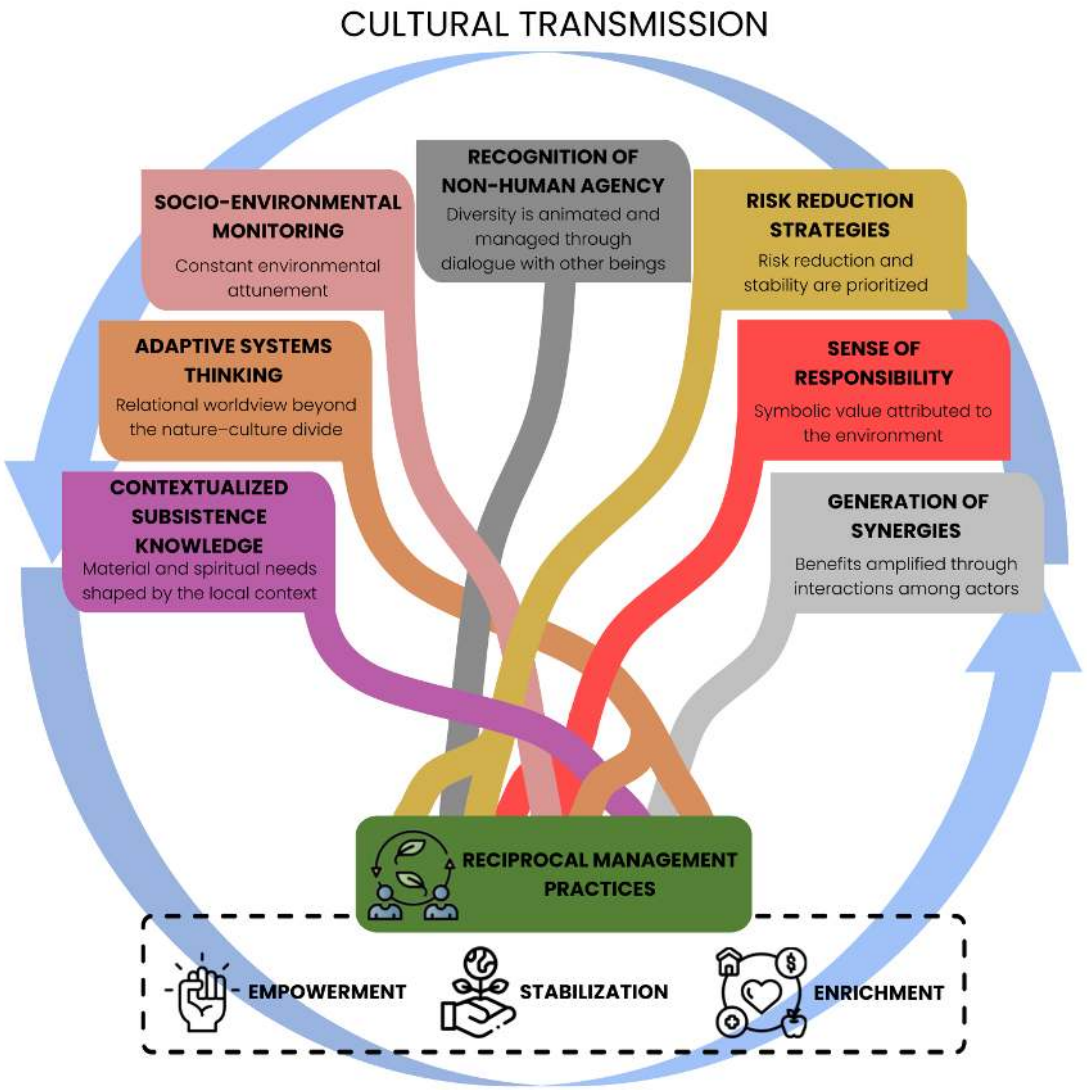

Figure 1. Assessment Framework for Human-Nature Reciprocal Management Practices. The diagram illustrates the seven dynamic, interrelated attributes expressed in family farmer's management practices, the cultural transmission processes that sustain them, and their proposed long-term biocultural outcomes.

Table 1. Selected farmers' testimonies illustrating how Reciprocal Management Practices are expressed through the seven attributes proposed in this framework.

Attribute	Key operational concept	Small farmer testimony
Contextualized subsistence knowledge	Site-specific ecological and cultural-spiritual knowledge rooted in local landscapes to sustain livelihoods.	"We used to eat *michay* [*Berberis darwinii*], *molle* [*Schinus molle*], all that when we were kids. I still eat *michay* sometimes. We never really lose those habits" (CT, Villa Llanquín) "I was born and raised here, and I've always seen fruit trees and crops; the insects have always been the same. There have been dry years and wet years, just as there have been snowy years and hot years" (PM, Villa Llanquín) "And our land is at an elevation of 900 meters [meters above sea level]. When a frost hits as early as February, the bees kill the drones, they drive them out. That's why we can harvest a little bit [of honey] before Christmas and leave what's left of the bloom; after that, they fend for themselves, we harvest very little" (SH, El Foyel)
Adaptive systems thinking	A perspective based on the resilience principles, driving active, ongoing adaptation within complex human-nature systems.	"You have to keep looking for ways around things, seeing year by year what happens and what can be done in the greenhouse" (CS, El Manso) "You have to innovate, you know? When water is scarce, you have to innovate. Necessity pushes you. I'm going to grow a few seedlings and see what happens, just to find out. Then, day by day, you keep trying things, trying things, and gradually finding better ways to do them" (GL, El Manso) "This is the experimental greenhouse because we test things. We invent according to what is necessary" (MM, El Manso)
Socio-environmental monitoring	Continuous tracking of localized ecological signs enacted through active attunement to non-human needs.	"If you see that there is a lot of snow during winter, you sow later. And if it is a dry winter with little snow, then you sow earlier and reduce the risk related to water" (CS, El Manso) "I have to go check the spring to see if it is blocked. When cleaning it, you should not touch the spots where the water comes out. You have to remove the sand as carefully as possible" (AM, Villa Llanquín) "And you have to map out the flowering season; I rely heavily on reading the hive entrances. Sometimes when I go check on the hives, I watch 10 bees: How many out of those 10 are bringing in pollen, and how many are coming back empty? How many different pollen colors are they bringing in? Three colors?... If 5 out of 10 come in with pollen, that's perfect" (DM, Ñirihuau)

Continued...

Attribute	Key operational concept	Small farmer testimony
Recognition of non-human agency	Viewing inhabitants of the landscape as active, intentional subjects rather than passive resources.	"I talk to the cows. They do not pay much attention to me, but they already know. In the mornings they are moody, really moody. When one wakes up in a bad mood, we can tell, so we milk her last" (OS, El Manso) "We've had the ducks for three years now. Sometimes I throw them a handful of corn and tell them, Come on, bring your eggs and lay them here"' (OS, El Manso) "When I go to check on [the hive] and hear the buzzing [state of alertness], well. I tell them, I'm not doing anything to you, let's see, girls, excuse me, will you let me?"' (MU, Bariloche)
Risk reduction strategies	Prioritizing long-term socio-cultural resilience and stability over short-term yield maximization.	"We always try to keep a manageable number [of animals] so we can take proper care of them. Otherwise, things become too difficult" (PF, Villa Llanquín) "It's a piece of advice that usually goes unsaid: Only make your garden as big as you can manage.' Otherwise, it will cause you a lot of stress and problems later on" (GL, El Manso) "The last harvest at my apiary is a very valuable honey, but I don't do that anymore. My stance is that we, as producers, aren't just producers; we have to care for them [the bees], ensure there's zero mortality. When more than 5% of the hives die, that seems like a lot to me. So I sacrifice that major harvest and leave it for them [as a food reserve to help them get through Patagonian long winter]" (TE, Mallín Ahogado)
Sense of responsibility	An ethical, relational duty rooted in human-land obligations that guides everyday management of the territory.	"And that is the water that comes from the spring. We take care of the water" (IL, Villa Llanquín) "So we built the campsite partly to control fire risk, so people would not light fires just anywhere. Nowadays there are people everywhere" (LS, Villa Llanquín) "Well, yeah, now that we're completely hooked, we're trying to find the *mangangá* [*Bombus dahlbomii*, native bumblebee] to see it, to bring it here, to attract it. We're going to buy flowers at the nursery to attract the *mangangá*. We never see it, we only saw it once. Now we're trying to set up a garden focused on getting native bumblebees to come, to see if we can pull it off. Because we already know they're around here" (MA, El Hoyo)

Continued...

Attribute	Key operational concept	Small farmer testimony
Generation of synergies	Fostering beneficial human-non-human interactions while pragmatically managing unavoidable systemic trade-offs.	"I plant little flowers so the bugs come. For the raspberries, the squash, the cucumbers" (PN, Villa Llanquín) "The ladybugs lay their eggs on the wormwood, and the larvae eat the aphids. I don't have an aphid problem, but I have ladybugs; it's amazing. I pick them up and spread them around everywhere; we put them out so there won't be any aphids" (FT, Villa Llanquín) "I'm out there multiplying aromatic herbs like crazy because, with the varroa issue, surrounding the hives with aromatics also helps... it supposedly has some effect against varroa [the primary sanitary problem] due to the aromas and essential oils they have... and I've got oregano, winter savory, two types of thyme, several salvias, all sorts of things" (NM, El Hoyo)

Legend: The testimonies presented in this table were collected through long-term ethnobiological fieldwork (interviews, guided field trips, workshops) with family farmers in Northern Patagonia, Argentina, encompassing published and unpublished data on forest and steppe management practices.

System dynamics and feedbacks

While further empirical studies are explicitly needed to test the scalar dimensions of this framework, we propose that the systemic enactment of RMPs gives rise to three core, long-term biocultural outcomes (Figure 1). Enrichment refers to the simultaneous increase of both local biodiversity and local ecological knowledge *sensu* Berkes (2018) and Toledo and Barrera-Bassols (2010); Empowerment involves the enhancement of community autonomy (Escobar 2017); and Stabilization refers to the reinforcement of long-term social-ecological resilience (Gunderson and Holling 2002) (Figure 1). This loop is vitalized by cultural transmission mechanisms, such as oral storytelling, ritual labor, and intergenerational education, keeping the practices contextually alive and innovative (Figure 1). Conversely, if one or more attributes are de-activated, the reciprocal character of management may weaken. This can occur when local knowledge transmission is disrupted, attention to ecological signals and non-human needs declines, or decisions become increasingly driven by short-term yields and market pressures. Under these conditions, management may shift toward more instrumental and potentially extractive dynamics. However, this trajectory is not necessarily irreversible: cultural transmission, social learning, collective organization, and supportive local institutions can strengthen or reactivate weakened attributes (Marchant Santiago et al. 2020). The framework therefore presents reciprocity as a continuum across different management configurations.

CONCLUSION

Reciprocal Management Practices are essential for sustaining long-term socio-ecological coexistence. By making the relational and ethical dimensions of reciprocity explicit, our model offers a strategic roadmap to identify necessary interventions by revealing which human and relational components must be strengthened, thereby fostering transitions toward more resilient systems as genuine seeds of transformative change.

ACKNOWLEDGMENTS

Sincere thanks are due to the farmers of Bariloche, Villa Llanquín, El Manso, and the Andean Comarca for their invaluable generosity and kind engagement with this project. We also acknowledge CONICET for funding the doctoral fellowships of Catalina Rico Lenta, Pablo Grimaldi, and Fernando Céspedes. We are also grateful to the editor and reviewers for their thoughtful and constructive comments, which helped strengthen and enrich the manuscript.

DATA AVAILABILITY

Data will be made available on request.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Ana H. Ladio serves as an editor of this journal but was not involved in the peer review of, or the editorial decision on, this manuscript.

CONTRIBUTION STATEMENT

Conceived the original conceptualization of the work: AHL Carried out the fieldwork: CRL, PAG, FNC
Wrote the first draft of the manuscript: AHL
Interpreted the results: AHL
Wrote, reviewed, and edited the final version of the manuscript: AHL, CRL, PAG, FNC

DISCLOSURE OF AI USE

During the preparation of this work, the authors used Gemini to improve the clarity of the English language in this manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Received: 29 May 2026
Accepted: 11 November 2026
Published: 25 November 2026

Editor: Guillaume Odonne