Ripples of reciprocity: Navigating trust and communal governance in hydrosocial territories

ABSTRACT

This study examines dynamics of trust, reciprocity, and the effectiveness of communal governance systems within hydrosocial territories, specifically focusing on water associations managed by indigenous Aymara communities in the Bolivian Altiplano. Employing path analysis and experimental economics, we measured the interplay of trust, reciprocity and cooperative behavior among 100 Aymara community members. Our findings suggest that trust is a crucial factor in promoting cooperation, but reciprocity is equally essential in driving cooperation levels and achieving efficient communal governance within hydrosocial territories. However, we found that reciprocity was particularly low in the studied communities. Our results demonstrate that the initial actions of trust were not reciprocated, which discouraged collaboration within the governance system. While the communities displayed prosocial behavior, this lack of reciprocity challenged trust among community members, leading to the ineffective functioning of communal governance of water resources. In general, our findings underscore the vulnerability of communal governance in hydrosocial territories when collaborative action is strongly rooted in negative reciprocal paradigms and increasingly reliant on extrinsic motivations. Addressing the internal causes of inefficient communal governance calls for a nuanced exploration of pathways towards fostering intrinsic motivation and positive reciprocal interactions, necessitating collaborative efforts between communities and policy stakeholders.

KEYWORDS: Bolivia ; Communal Governance ; Hydrosocial ; Reciprocity ; Trust

1. Introduction

The Plurinational state of Bolivia (hereafter referred to in short as Bolivia) is but one of the countries in the Global South that has a rich history of indigenous communities relying on communal water management practices (Boelens, Bustamanta, et al., 2007; McKay, 2023; Rivière, 1994; Verzijl, 2020; Wutich et al., 2017). Said management takes place in hydrosocial territories, in which human society and water are interconnected and mutually shaping; water is not merely a physical element, but is embedded in social, cultural, economic, and political contexts (Boelens et al., 2016; Seemann, 2016; Swyngedouw, 2009). For instance, for the indigenous Aymara living on the Andean Altiplano, water is the blood of the *Achachilas* (tutelary hills) and the milk of the *Pachamama* (mother nature). As a living being, water is to be respected and loved (Apaza Ticona et al., 2021). For the Aymara, the construction and maintenance of irrigation canals are imbued with specific rituals and indigenous labor systems rooted in *ayni* and the *ayllu* structure. *Ayni* constitutes a deeply entrenched practice within Aymara culture, wherein individuals contribute their labor to the endeavors of others, underpinned by the reciprocal expectation of receiving assistance when needed. The institute of the *Ayllu* denotes the organizational framework of Aymara society, comprising communal and cooperative units formed by extended families residing in close proximity, sharing common ancestry, land, and vital resources such as water. Labor invested in these communal lands or the utilization of natural resources is collective in nature and governed by principles of reciprocity, akin to the ethos of *ayni*. Within the *ayllu* framework, individual contributions to the community are reciprocated by communal support in times of need. Both concepts are considered indispensable to the harsh natural environment of the high Andes, emblematic of the Aymara worldview emphasizing the interconnectedness of all facets of existence (Altamirano Enciso & Bueno Mendoza, 2011; Alvizuri, 2009; Paerregaard, 2017; Walshe & Argumedo, 2016; Wutich et al., 2017).

These irrigation practices unfold within a hydrosocial territory, where water holds a significance that surpasses its mere designation as a natural resource. Water embodies a multifaceted entity intertwined with societal norms, values, knowledge, and dimensions of identity and authority (Apaza Ticona et al., 2021; Boelens et al., 2016; Cairns, 2018; Swyngedouw, 2009). However, in recent decades community-based water management practices in these and other hydrosocial territories have been disrupted by the expansion of extractive industries and neoliberal economic policies (de Vos et al., 2006; Dupuits, 2019; García-Mollá et al., 2020; Helgegren et al., 2021), leading to conflict over access to and control over water (Boelens, Bustamante, et al., 2007; García et al., 2019; Gutiérrez et al., 2013; Hailu et al., 2012; Wutich et al., 2016). Additionally, Bolivia is considered one of the most water-stressed countries in Latin America, with water resources often distributed unevenly across different regions and sectors. This has further fueled competition between users and other stakeholders, including rural and urban communities, agriculture, mining, and industry (Boelens, 2011, 2014; Garrick et al., 2022; López et al., 2015). Moreover, the country has recently undergone significant political and social upheaval that further complicates efforts to establish effective local resource governance systems (Dupuits, 2019).

While the above-mentioned external factors pose a significant challenge to the effective governance of communal water systems in hydrosocial territories (Duarte-Abadía & Boelens, 2016; Hailu et al., 2012; Helgegren et al., 2021), it is important to acknowledge that internal challenges within local governance bodies can have a considerable impact as well (Fernández-Llamazares et al., 2016; Helgegren et al., 2020). Expanding upon Elinor Ostrom's seminal work on collective action (Ostrom, 1990), the literature underscores the importance of user participation in fostering the efficient functioning of communal water governance, particularly within the intricate nexus of human society and water (Baldwin et al., 2018; Boelens, 2014; Del Mar Delgado-Serrano & Ramos, 2015; Mustafa et al., 2016; Rocha López et al., 2019;

Rodríguez, 2022). In this vein, Andean communities inhabiting hydrosocial territories have long been engaged in the development of community-driven systems reliant on trust and collaborative endeavors to navigate the challenges posed by the scarcity of water (Boelens, 2011, 2014; Boelens et al., 2016; Hoogesteger, 2013).

Given the consensus that collaboration is essential for effective communal governance (García et al., 2019), communities grappling with insufficient levels of interpersonal trust may struggle in sustaining a collaborative governance system (Authelet et al., 2021; Boone et al., 2010; Rand & Nowak, 2013; Rodríguez, 2022). Furthermore, the presence of reciprocity, as in returning the favor when trusted, and intrinsic motivations for collective action - manifesting as collaboration stemming from inherent satisfaction or ideological convictions rather than external inducements - are considered indispensable for the success of communal governance endeavors(Ben-Ner & Kramer, 2011; Cardenas & Carpenter, 2008; Curran, 2020; Dohmen et al., 2008; Fehr & Falk, 2002; Narloch et al., 2012; Rand & Nowak, 2013; Rodríguez, 2022; Walsh-Dilley, 2013, 2017). In Aymara communities, where the reciprocal labor systems of *ayni* and the *ayllu* are deeply ingrained and propelled by a robust sense of shared identity and collective responsibilities, the significance of trust and reciprocity is further accentuated (Altamirano Enciso & Bueno Mendoza, 2011; Alvizuri, 2009; Curran, 2020; Paerregaard, 2017; Walsh-Dilley, 2013, 2017; Wutich et al., 2017). Hence, uncovering reasons why some of the communal governance systems in place do not function well and are ineffective in managing natural resources requires a better understanding of trust and its expression in reciprocity between community members. Understanding the reciprocal behavior of actors in response to displays of trust or resistance is indispensable to comprehend how they interact with each other in governing communal resources.

Latin-America, and particularly Bolivia, record amongst the lowest levels of general trust globally (Ciudadanía, 2019). Paradoxically, Bolivia showcases robust prosocial manifestations

of community governance. Studies have demonstrated that collaborative endeavors, often rooted in conflict and resistance, have effectively united small-scale water users within hydrosocial territories to collectively confront external pressures (Boelens, 2014; Boelens et al., 2018; Hailu et al., 2012; Manosalvas et al., 2021). Indigenous communities inhabiting the Altiplano have historically migrated to these less productive and more arid lands due to displacement as incoming populations pushed them out of the valleys. Nowadays, they rely heavily on intra-group trust and reciprocity for communal water governance. Their collective identity is intricately linked to local water sources, thereby shaping the hydrosocial landscape (Boelens, 2014).

Yet, such solidarity may paradoxically lead to internal distrust and subsequent inefficiencies in collaboration (Dohmen et al., 2008). Recognizing that high levels of trust and reciprocity are essential prerequisites for cooperation and effective communal governance (Boone et al., 2010), the observed inefficiencies in managing the communal water associations prompt us to question whether the internal tensions experienced by water users stem from the (lack of) reciprocal responses to displays of trust. Thus far, the literature has overlooked the foundational role of reciprocal systems and the motivations driving trust and reciprocity in communal governance. In this paper, we argue that even in the presence of a certain level of trust within a hydrosocial territory, which may lead to an increased valuation of cooperation, effective communal governance can still falter if the society lacks intrinsically motivated and proportionate reciprocity.

Despite the growing attention for the use of experimental economics in the field of agricultural economics (Mesa-Vázquez et al., 2021), and the application of Elinor Ostrom's work in experimental economics (Anderies et al., 2011; Cardenas et al., 2000; Cardenas & Carpenter, 2008; Engle-Warnick & Slonim, 2004; Fabbri, 2018; Gelcich et al., 2013; Kosfeld et al., 2009; Rodriguez-Sickert et al., 2008), we have yet to find any research that applies these experimental

methods in the empirical and quantitative analysis of communal governance systems. Moreover, we observe a gap in the literature concerning the examination of human society's relationship with water within the framework of communal governance, despite its departure from the intricate human-environment complexities elucidated by Ostrom (1990)and Swyngedouw (2009). All this is particularly important as previous studies have shown that the commonly used World Values Survey question on trust[1] is not as an accurate proxy of trust behavior as what is measured in the standard Berg et al. trust game (Banerjee, 2016; Berg et al., 1995; Sapienza et al., 2013). If we want to understand why the communal governance systems are challenged from within, accurate measures of the participants' economic and social behavior are crucial. In light of this, our research aims to examine the challenges towards efficient communal governance experienced in hydrosocial territories due to trust and reciprocity issues, resulting in suboptimal net benefits. Through our analysis, we find that a communal governance system like the one studied is bound to fail or at least function inefficiently if trust is not reciprocated, even if it results in a higher valuation of cooperation. This is particularly pronounced in the Aymara communities, despite their demonstrated capacity for collective action.

To bridge this research gap, we examine the behavior of 100 indigenous Aymara community members residing in the Bolivian Altiplano, who manage water associations within a single hydrosocial territory: the municipalities of Batallas-Pucarani where Aymara water associations govern irrigation and water supply. Employing experimental economics and path analysis within Elinor Ostrom's self-governing model (Ostrom, 1990), we unveil that trust alone proves inadequate in fostering cooperation within communal governance systems. Our first hypothesis posits that while heightened interpersonal trust may amplify individuals' valuation of

[1] "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" – Likert Scale 0-5.

cooperation (Guiso et al., 2010), tangible increases in cooperation manifest solely when trust is reciprocated (Sapienza et al., 2013). However, this reciprocal response does not occur automatically in response to trust-building behavior (Fischbacher et al., 2001). In societies characterized by a historical identity deeply rooted in defensive collective action against external threats (Boelens, 2014), internal communal governance of common resources may face challenges stemming from the prevalence of negative reciprocity, manifested as retaliatory actions against those perceived as adversaries (Berg et al., 1995; Dohmen et al., 2008; Egloff et al., 2013). Given the stronger inverse relation between trust and negative reciprocity (Dohmen et al., 2008), the adverse effects of ineffectiveness within a communal governance system on the behavior of learning and norm-adopting individuals (Ostrom, 1990; Poteete et al., 2009) could potentially outweigh the positive impacts of successful cooperative endeavors. Our second hypothesis posits that this phenomenon could be particularly pronounced within spaces such as the hydrosocial territory under examination in this paper. In self-governing collaborative systems, such as those that shape the Aymara identity, intrinsic motivations play a pivotal role in deterring individuals trusted by their peers from engaging in free-riding behaviors and instead incentivizing reciprocal responses (Berg et al., 1995; Kosfeld et al., 2009; Walsh-Dilley, 2017; Wutich et al., 2017). Nonetheless, an increasing influence of extrinsic motivations may gradually undermine intrinsically driven collaborative systems by partly supplanting the reward mechanism for cooperation, potentially elucidating the diminished stability of communal governance systems in such societies (Authelet et al., 2021; Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Narloch et al., 2012; Slosse et al., 2023).

Our findings suggest that higher levels of trust amongst members of the water association correlate with an increased appreciation for cooperation, but do not necessarily lead to higher levels of cooperation if reciprocity is lacking. Additionally, we underscore the difficulty of overcoming the challenge of distrust and lack of reciprocity in societies with a strong history

of collaboration grounded in resistance. By questioning dynamics of trust, cooperation, reciprocity, and their underlying motivations within communal governance systems, our study offers valuable insights into enhancing the efficiency of such systems and delivering benefits to their users.

2. Background

2.1.Trust and reciprocity in communal governance

In his seminal work, Arrow (1974) has argued for the centrality of trust in the optimization of self-organized cooperative efforts between individuals. A multitude of empirical studies has subsequently demonstrated that Hardin's (1968) "Tradegy of the Commons" can be averted when individuals governing a common good enter into cooperative relationships (Alós-Ferrer & Farolfi, 2019; Baldwin et al., 2018; Walsh-Dilley, 2013, 2017; Zak & Knack, 2010). Despite the standard assumptions of non-cooperation in economic game theory, cooperators can avert the non-cooperative Nash equilibrium if a sufficient level of trust is present among them (Aswani et al., 2013; Ben-Ner & Ellman, 2013; Boone et al., 2010; Finkbeiner et al., 2018; Guiso et al., 2010; Jones & Kalmi, 2009; Rand & Nowak, 2013; Rothstein, 2005). On the other hand, cooperative governance systems may break down if the initial sacrifice of trust by one party is absent or not reciprocated (Alós-Ferrer & Farolfi, 2019; Boone et al., 2010; Dietz et al., 2017; Ostrom, 1990; Ruiz-Mallén et al., 2015; Sebhatu et al., 2020).

In "Governing the Commons" (Ostrom, 1990), Elinor Ostrom suggests that the sustainable and successful self-governance of common pool resources such as water requires adherence to a set of design principles to create the local institutions which address problems of provision, credibility and monitoring (Dell'Angelo et al., 2016). While these principles are frequently observed in successful systems, it is important to note that their presence does not necessarily guarantee success, nor is their absence indicative of failure. Rather, these principles can serve

as valuable guidelines, offering insights into effective institutional design for governing common pool resources (Cox et al., 2009). Ostrom distinguishes learning from norm-adopting individuals depending on how they stand vis-à-vis innovation and status quo. Their behavior is influenced by their context which includes the broader context but also the specific situation they are in. Though the precise definitions in the Ostrom framework have been topics of discussion (Araral, 2014; Williams et al., 2023), several studies explain how the learning and norm-adopting individuals engage in cycles of trust-building through positive reciprocal behavior, resulting in increased levels of cooperation and associated benefits (Carlisle & Gruby, 2019; Fehr & Gächter, 2000; Ostrom, 2009b; Poteete et al., 2009) (Figure 1).

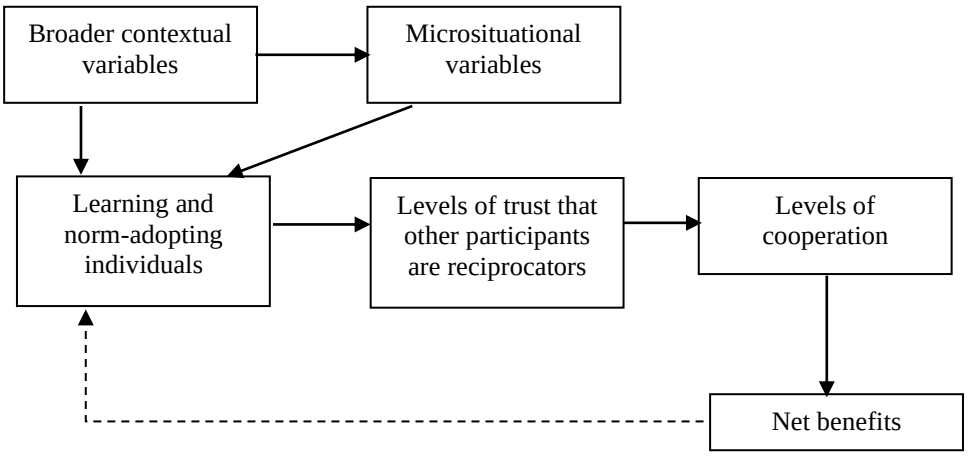


Figure 1. How trust fits within a well-functioning framework of self-governing common pool resources. Based on: Poteete, Janssen, and Ostrom, 2010.

Yet, trust (by itself) is not a homogenous phenomenon. In order to fully comprehend the relationship between "levels of trust" and "levels of cooperation" as depicted in Figure 1, it is important to recognize that trust is a multifaceted phenomenon. First, it encompasses both internal or interpersonal trust, as opposed to external or systemic trust. The former refers to the informal trust placed in individual actors within one's immediate vicinity, such as neighbors or

family, while the latter pertains to trust in unknown individuals and formal institutional entities, such as the police or government (Ciudadanía, 2019; Parra Saiani et al., 2021). In communal governance systems where overlapping authority is shared among separate actors without hierarchical regulation, such as the Aymara water associations (Boelens, 2014; Skelcher, 2005), individuals must place trust not only in formal institutions, but also in the informal institutions at play, in their peers, and in individuals with whom they have personal relationships (Authelet et al., 2021; Ostrom, 2005). In hydrosocial territories, both internal and external trust play pivotal roles in facilitating the efficient communal management of water resources (Ostrom, 2009a; Rodríguez, 2022; Torso et al., 2020). Specifically, within Aymara communities, internal trust is intricately intertwined with indigenous identity and its relationship with water. It encompasses trust in indigenous reciprocal behavior and labor systems such as the *ayllu* structure and *ayni*, closely aligning with Ostrom's conceptualization of trust as depicted in Figure 1 (Alvizuri, 2009; Manosalvas et al., 2021; Ostrom, 2009a; Poteete et al., 2009; Walsh-Dilley, 2017; Wutich et al., 2017). Concurrently, external trust in hydrosocial territories, particularly in government institutions responsible for water infrastructure networks, cannot be disregarded, as the indigenous identity is shaped in response to and resistance against state actorsv(Boelens, 2014; Wilson et al., 2023).

Second, trust influences reciprocity. Reciprocity serves as the initial and conditional form of cooperation that follows trust (Rand & Nowak, 2013). Following an initial trust-building or distrust-inducing move by one party, the affected individuals must decide whether to respond in a reciprocal manner, or ignore the initial action when making its subsequent move (Alós-Ferrer & Farolfi, 2019; Ostrom, 2005). This reciprocity can either be positive or negative in nature (Gervasi et al., 2022). Positive reciprocity refers to the act of returning a favor, while negative reciprocity involves retaliating or punishing one who has wronged you (Fehr & Gächter, 2000). As a manifestation of conditional cooperation (Rand & Nowak, 2013), we

argue that proportional reciprocal behavior is necessary to advance from increased trust to higher levels of cooperation (Figure 1) (Poteete et al., 2009). While trust may initiate and increase the value placed on cooperation(Guiso et al., 2010), it may not necessarily translate to higher levels of cooperation if not reciprocated (Fehr & Gächter, 2000). The ongoing debate on the independence or substitutability of the positive and negative type of reciprocity (Chernyak et al., 2019; Dohmen et al., 2008; Egloff et al., 2013; Shaw et al., 2019; Szolnoki & Perc, 2014) suggests that negative reciprocity may be strongly and inversely correlated with trust, while the relationship between trust and positive reciprocity, while positive, is weaker (Dohmen et al., 2008). Yet, the role of reciprocity in the communal water governance of hydrosocial territories has remained ambiguous until now. On one hand, the reciprocal systems inherent in these spaces have demonstrated a positive impact on the efficient management of water, serving as the very bedrock upon which the communal system is constructed, thereby binding the local identity to water (Apaza Ticona et al., 2021; Rodríguez-de-Francisco & Boelens, 2016; Wutich et al., 2017). On the other hand, hydrosocial territories often serve as a defensive mechanism, mobilizing collective action and indigenous identity through negative reciprocity against external threats to the communal system, such as rejecting top-down government proposals on water management or engaging in large-scale protests against policies facilitating the expansion of extractive industries (Manosalvas et al., 2021; Wutich et al., 2016). This could potentially hinder efficient communal governance if negative and positive reciprocity are indeed substitutes (Dohmen et al., 2008). Furthermore, while the *ayllu* and *ayni* have often been portrayed as egalitarian indigenous practices in literature, they are in reality dynamic cultural processes that also encompass elements of inequality, including attempts to maintain unequal social relations to the detriment of nondominant individuals (*ayni*) and clans (*ayllu*), who are expected to make larger contributions akin to a form of clientelism. *Ayllu* could even be translated literally as “lineage” or “caste” (Alvizuri, 2009;

Córdoba et al., 2021; Paerregaard, 2017; Walsh-Dilley, 2017). The use of group-identity as a basis of resistance could further entrench and exacerbate these inequalities (Manosalvas et al., 2021). In hydrosocial territories where trust is low, not followed up by proportional reciprocal behavior, or where reciprocal systems favor the powerful, achieving effective communal governance may prove challenging. To establish an upward feedback loop grounded in trust and reciprocity (Figure 1), it is imperative to comprehend the intricate interplay between both and their effects on cooperation and other aspects of communal governance further down the line.

Ultimately, the initiation of trust-building and proportional reciprocal actions requires a motivation or multiple motivations to act in a prosocial or deflecting manner. These can either be intrinsic or extrinsic in nature (Ruiz-Mallén et al., 2015). With regard to intrinsic motivations, individuals may be inclined to engage in prosocial behavior not because they anticipate direct rewards or punishment (which are examples of extrinsic motivations), but rather because it leads to social approval and a positive reputation (Ben-Ner & Kramer, 2011; Fehr & Falk, 2002; Narloch et al., 2012; Strang et al., 2016). Therefore, intrinsic motivations for trust and reciprocity are crucial for the proper functioning of communal systems of governance (Cardenas & Carpenter, 2008; Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Narloch et al., 2012; Ostrom, 1990). However, the underlying motivations driving Aymara water management within their hydrosocial territory remain somewhat opaque. In the context of *ayni* and *ayllu*, collective well-being and mutual support are central, intrinsically propelled by a profound sense of shared identity intricately linked to water. Within this framework, reciprocal labor is motivated by the understanding that such labor benefits not only the individual but also the collective (Alvizuri, 2009; Boelens, 2014; Wutich et al., 2017). Nonetheless, these systems and Aymara identities are not static; they adapt in response to external factors. Increasing water scarcity due to climate change may intensify competition,

while greater integration into global capitalist markets may introduce extrinsic financial motivations. Additionally, sustainability initiatives like Payment for Ecosystem Services (PES) offer farmers previously unavailable external rewards for collective action(Córdoba et al., 2021; Hailu et al., 2012; Manosalvas et al., 2021; Walsh-Dilley, 2013, 2017). These external forces can potentially lead to inefficiencies in water management, as the introduction of regulatory systems based on extrinsic motivations may overshadow existing collective practices (Authelet et al., 2021; Bowles & Polanía-Reyes, 2013; Narloch et al., 2012; Slosse et al., 2023). As individuals' preferences for collective action are driven by their personal experiences and socio-economic background, fostering intrinsic motivation is crucial in systems governed by personal relationships requiring a high degree of participation from the involved actors (Figure 1) (Baldwin et al., 2018; Cardenas & Carpenter, 2008; Degli Antoni, 2009; Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Ostrom, 1990, 2009a).

2.2. The hydrosocial territory of the Aymara water associations in Batallas

We investigate communal irrigation systems utilized and overseen by Aymara communities residing in the neighboring municipalities of Batallas and Pucarani, situated in the Bolivian Altiplano near the city of La Pa (Figure 2). This hydrosocial territory is characterized by the presence of mostly natural rivers and two man-made canals, engineered to convey water from the Andean mountain summits to Lake Titicaca. Constructed in the late 1970s under a governmental initiative, these irrigation canals were designed to furnish approximately 45 local Aymara communities in the municipalities with the necessary irrigation water for their agricultural endeavors. To establish democratic water governance within the municipalities, various associations of communities were established (these are indicated by the colored zones in Figure 2). These associations oversee the allocation of water for agricultural purposes among

member communities and facilitate ongoing dialogue to ensure equitable access to adequate and high-quality water resources.

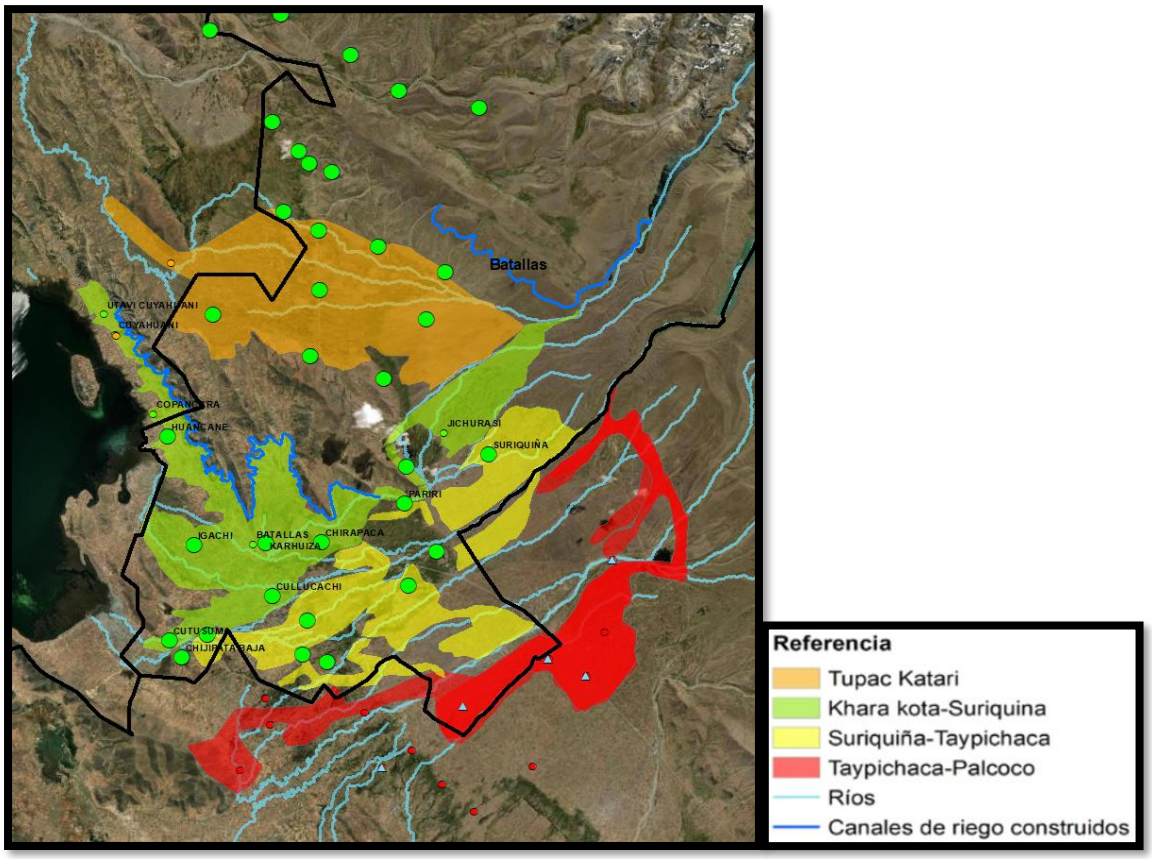


Figure 2. Communal Irrigation Zones Batallas-Pucarani. Colors depict the different associations. Lightblue are the rivers, dark blue the man-made canals.

Although the irrigation systems have been funded by the government and international cooperation, the impetus for establishing the associations stemmed from collective action and resistance by the Aymara communities against their marginalization within the state and the privatization efforts guided by international financial institutions (Boelens, 2009, 2011; Boelens et al., 2018; Cruz et al., 2022; Dupuits, 2019). Consequently, the Bolivian state has largely assumed an external and relatively passive role in the water management of the Aymara associations. Following successful collective action by the Aymara communities and in alignment with the state's 'Politics of Inclusion', governance of the associations has been vested

in the indigenous communities and the associations themselves (Boelens, Bustamanta, et al., 2007). As previously mentioned, the territory is hydrosocial, with water and human identity intricately intertwined and co-evolving, transcending the concept of water as merely a natural resource(Alvizuri, 2009; Boelens, 2014; Boelens et al., 2016; Seemann, 2016; Swyngedouw, 2009). Consequently, the communal governance of water is imbued with traditional rituals and labor systems such as *ayni* and the *ayllu* (Altamirano Enciso & Bueno Mendoza, 2011; Alvizuri, 2009; Walsh-Dilley, 2017; Walshe & Argumedo, 2016). Annually, the communities elect their representatives in the water associations, amongst which the "water judges" (*Juez de Agua).* In the event of disputes within or between communities, these are settled by the water judges of the respective communities. Rooted in traditional indigenous practices, this system has been formalized and institutionalized through legislation and government support (Aliaga Lordemann, 2021; Boelens, Bustamanta, et al., 2007).

Therefore, the irrigation system in the hydrosocial territory of Batallas-Pucarani operates collectively among different communities and water associations, devoid of any hierarchical structure between them, which is deemed essential for successful communal governance(Baldwin et al., 2018; Poteete et al., 2009; Ruíz & Gentes, 2008; Skelcher, 2005). However, despite the high degree of solidarity among these communities, a historical proficiency in collective action, and the existence of social indigenous arrangements, the water governance system falls short of realizing its full potential. Our research indicates that certain sections of the waterways have dried up, and a significant majority of community members rely on rainwater for their agricultural needs due to the absence of canal water supply. Furthermore, the water judges often encounter difficulties in resolving disputes between communities, and prevailing distrust within and between communities exacerbates conflicts related to overexploitation and mismanagement. These disputes and conflicts frequently originate from geographic inequalities in access to irrigation water, with upstream communities

enjoying greater ease of access compared to those downstream. Ultimately, our survey data suggests that only a small proportion of irrigation system users derive tangible benefits from their membership in the association.

In addition to the lack of net benefits, the inefficient functioning of the communal governance system may be attributed to deficiencies in trust. Studies have revealed that both internal and external trust levels in Latin America, and particularly Bolivia, are generally low in comparison to other regions globally (Ciudadanía, 2019; Neace, 2004; Parra Saiani et al., 2021). Meanwhile, previous studies have underscored the significance of trust and intrinsic motivations in fostering cooperation among individuals who exhibit more pro-social tendencies than pro-self-oriented behaviors(Boelens, Bustamanta, et al., 2007; Boone et al., 2010). However, this intrinsic motivation for internal trust and, more importantly, reciprocity-based conditional cooperation appears to be largely absent. While the Aymara have demonstrated a high capacity for collective action, this is partially fueled by resistance and negative reciprocity. They unite collectively in water issues leveraging their hydrosocial identity, but often in opposition to outsiders (Boelens, 2014; Boelens et al., 2018; Manosalvas et al., 2021).

As trust and negative reciprocity may exhibit a negative correlation (Dohmen et al., 2008), this could undermine rather than bolster trust within and between the communities. Consequently, the prevalence of negative reciprocity within the communities might constrain the extent to which trust can flourish within this society, despite facilitating their high capacity for collective action. Within the Ostrom framework (Figure 1), it becomes evident that in absence of a reciprocal answer the link between trust and cooperation is compromised. To obtain a deeper insight into this challenge, it is imperative to distinguish between the valuation of cooperation and the actual act of cooperation itself, while also examining the role of reciprocity as conditional cooperation within the framework.

To test our hypotheses, we employ a combination of experimental economics and Path Analysis to empirically estimate the Ostrom framework (Figure 1) in the context of the Batallas-Pucarani hydrosocial territory (Figure 2). As established by Henrich *et al.* (Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, et al., 2001), the behavior captured through such experiments allows for a within-group analysis. Furthermore, it is recognized that an individual's institutional environment and personal experiences significantly shape the behavior observed in these experimental setting (Cardenas & Carpenter, 2008; Poteete et al., 2009; G. Wright et al., 2023).

3. Methodology

3.1. Data collection and Experimental setup

In July 2022, data were collected from 100 Aymara community members who were participants in at least one of the four water associations depicted in Figure 2. The Bolivian research team has an agreement with both the formal authorities and the communal assembly from the communities in the research areas which settles the way the research team can interact with community members. Prior to this specific research, one of the researchers sought permission from the communal authorities and, with their consent, informed the potential participants of the research's purpose and schedule.

From those willing to participate, 100 community members were enrolled at random to participate in the experiment. We did not set prior criteria to be included as a participant except for the membership of one of the four water associations, and participation in the experiments was fully voluntary. We cannot ascertain that the sample is free from selection bias as some participants already interested in the topic might be more keen to self-select in the experiment. Additionally, there might be a distance bias as people living in communities far away from the

places where the experiments were held might be less represented. We acknowledge that this may have an impact on the potential generalization of the study results.

Data was collected by two economic experiments or “games”, a pre-survey and a post-survey. The pre-survey covered a broad range of socio-economic questions, while the post-survey delved deeper into the participants' membership in and experience with the water associations. Both the games and surveys were administered by a team of trained enumerators, all of whom were fluent in Spanish, and two fluent in Aymara to assist participants who were not fluent in Spanish.

The pre-survey included questions on the participants' gender, age, education, and household situation, as well as their length of residence in the region and labor activities. The post-survey included questions on trust in others and institutions, the value placed on cooperation in the community, membership in cooperatives and development projects, and perceptions of the success of these endeavors. Additionally, participants were asked about their access to and quality of irrigation water from the water associations and any conflicts they may have experienced.

Two economic experiments were also conducted with all participants before the water association-related questions were asked in the post-survey. As it has been shown that real-life reciprocal contexts impact decisions in such games (Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Rand & Nowak, 2013), we wanted to avoid any bias by bringing their experiences specific to the functioning of the association to the foreground while we are hinting for their intrinsic levels of trust and reciprocity. The instructions for the games were given in Spanish with simultaneous translation into Aymara, accompanied by multiple examples. Participants were informed that they would receive 60 Bolivianos (at the time equivalent to approximately $9 or one daily wage for unskilled labor) for their participation in the study, and that they could potentially earn additional amounts ranging from 0 to 360 Bolivianos depending on the

outcomes of the games. Instructions were repeated individually to ensure that all participants understood the game and had the opportunity to ask questions. Participants who we suspect did not understand the instructions were to be removed from the dataset, yet this was not necessary for our sample.

Trust and reciprocity: Trust Game

First, a standard trust game was deployed to measure the trust or belief that others are reciprocators among a first group of players (referred to as Players 1 or Trustors) and the consequential trustworthiness or reciprocal behavior of a second group of players (referred to as Players 2 or Trustees). Since its conception in 1995 (Berg et al., 1995), trust games have been extensively used to measure trust and reciprocity in a variety of settings (Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; OECD, 2017). In this study, pairs of Trustors and Trustees were randomly assigned without the players knowing their counterparts. Both players were initially endowed with 60 Bolivianos in 12 coins of 5 Bolivianos. It was explained that this money came from a research fund and that it was now theirs to keep and use as they pleased. However, their actions and those of their counterpart in the game could increase or decrease their final payout.

In the first phase, Player 1 could transfer any number of coins of 5 Bolivianos (ranging from 0 to 12) to the unknown Player 2. The amount sent was then tripled by the enumerator, resulting in an additional endowment for Player 2 ranging from 0 to 180 Bolivianos. In the second phase, Player 2 chose what portion of their money (the initial endowment of 60 Bolivianos plus the betrusted amount of 0-180 Bolivianos) they wished to send back to the unknown Player 1. This amount was not changed by the enumerator. The trust game thus presents both players with a dilemma as Player 1 must make an initial move without knowing if Player 2 will fairly compensate the sacrifice made, and Player 2 may wish to play fair but is not rewarded nor

punished if they do not reciprocate (Alós-Ferrer & Farolfi, 2019). As the game is not repeated, and the unknown Player 2 cannot be punished nor rewarded, this type of reciprocity is intrinsically motivated (Falk et al., 1999; Fehr & Gächter, 2000). As such, the trust game generates two categorical variables, namely one for trust and one for reciprocity, which are the number of coins sent to the other player. These categorical measures were rescaled to percentage variables for analysis purposes. Additionally, a percentage variable was constructed to measure the percentage of the endowment betrusted upon them that Player 2 returned as the game behavior of Player 2 depends on the amount sent by Player 1.

Altruism: Dictator Game

Research has shown that while the trust game is an appropriate measure of trust and reciprocity, the behavior exhibited in these games is also guided by altruistic preferences (J. C. Cox, 2004). Consequently altruism, the act of giving to another without getting anything in return, is an important parameter to control for (Kahneman et al., 1986; Zak et al., 2007; Zak & Knack, 2010). For example, a Trustor may choose to send the Trustee the full 60 Bolivianos, not because of the expectation of being rewarded, but due to an altruistic preference to help the unknown peer. In order to control for this, each participant additionally played a standard dictator game (Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, et al., 2001b). The results from the dictator game can be used as a control for altruism in other games such as the trust game (Kahneman et al., 1986). Each participant was again given 60 Bolivianos in 12 coins of 5 Bolivianos and asked to indicate the quantity they wished to transfer to one unknown random participant. This amount would be left untouched and the sender would not be rewarded in any way. It is important to note that, in all cases, the dictator game was played before the trust game and any donations were only received after playing the trust game. This ensured that the results

of the trust game did not influence any altruistic behavior and vice versa. For the empirical analysis, these donations were rescaled to a percentage variable.

3.2. Econometric model

To estimate the relevance and statistical strength of the relationships in the Ostrom framework (Figure 1), we chose to employ Path Analysis. This method, developed in the 1920's by Sewall Wright, estimates causal pathways between exogenous and endogenous variables (S. Wright, 1934). These pathways between variables are positioned within a system of regressions, in which the response variable in one equation can appear as an explanatory variable in another (Lleras, 2005). Path Analysis is a special case of Structural Equation Modelling (SEM) that contains only a structural model and no measurement model estimating assumed latent variables. As a SEM requires a higher complexity and larger sample size as compared to the Path Analysis, we deemed our data more appropriate to the latter method. A Path Analysis does not require one ultimate dependent variable (Stage et al., 2004), making it a useful model to estimate a system of relations as presented in Figure 1. Fitted to our research questions, we arrived at the following Path Diagram (Figure 3).

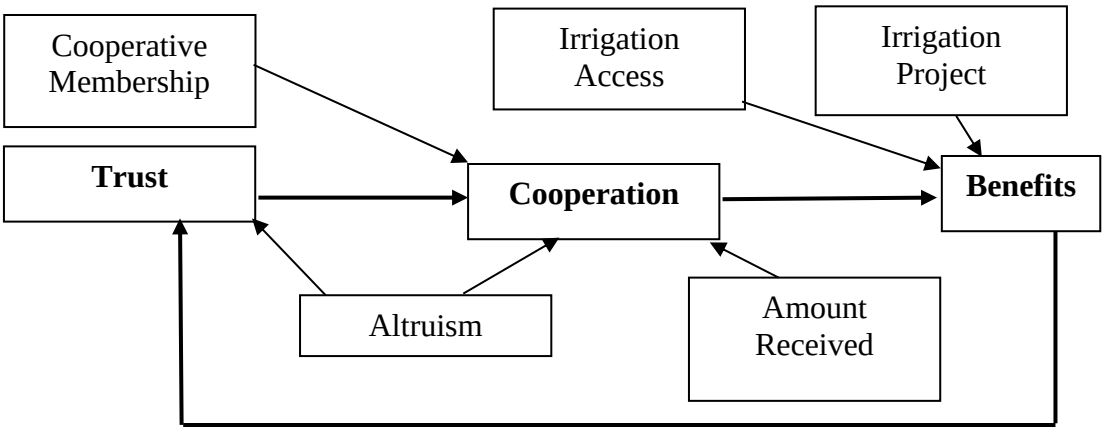


Figure 3. Path Diagram.

As we included the observed game behavior in this Path, we assume the effect of the broader context and microsituational variables (Figure 1) to be included, as experimental economics allows for within-group analysis whilst capturing the effect of the institutional environment on one's behavior as well (Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Poteete et al., 2009).

We estimated the model three times, each time using different variables for the concepts of "Trust" and "Cooperation" in the Path Diagram (Figure 3) as follows:

(1) In the first estimation, we used the game-behavior from participants who were Player 1/Trustor in the trust game (Trustor Trust) to measure trust. Following the game procedure, this fits the description of 'Levels of Trust that other participants are reciprocators'. Cooperation was measured by the self-reported Value of Cooperation on a 1-7 Likert Scale with "1: In this community, it's important to assure your own interests" and "7: Cooperation and working together are important for this community". Altruism, as measured by the dictator game, was added as an exogenous control variable.

(2) In the second estimation, we used data from participants who were the Trustees/Players 2 in the trust game. Cooperation was measured by the behavior in the trust game (Trustee Reciprocity), proxying reciprocity/conditional cooperation. Altruism was added as a control variable. To control for the influence of the amount of money betrusted on the Players 2, the trust game behavior was entered as the percentage of the total possible amount sent back to the Trustor, while the initial amount received was added as an exogenous control (Trust Received). In this case, 'Levels of Trust that other participants are reciprocators' was included as a Trust Level with a self-reported score on a 1-7 Likert Scale with "1: If I help anyone here, I generally cannot expect they will return the favor one day" and "7: Generally, I help others here because I think then they will probably help me one day".

(3) In the final estimation, we used data from the full dataset without using any game-behavior variables. In this case, we used the two 1-7 Likert Scales for both trust level and value of cooperation.

In all three models, 'Benefits of water association' was measured as a 0-10 categorical variable, defined by the sum of two 0-5 categorical variables: a self-report on the quantity and quality of irrigation water that the participants had access to. In terms of exogenous variables, the Benefits-equation includes an Irrigation Dummy with a value of 1 if the irrigation systems were in fact delivering water to the participant and dummy variables for membership in the four regional associations. Additionally, for all three measures of cooperation, we also added an exogenous categorical variable counting the number of cooperative producer organizations (Cooperation Category) to which the participants belonged, as we expect this might be an important variable to control for regarding game-behavior.

Overall, this approach allows us to examine the relationships between trust, cooperation, and reciprocity in a comprehensive and nuanced manner, taking into account the different roles and perspectives of the participants in the study.

4. Results

4.1. Descriptive analysis of socio-economic determinants of trust and reciprocity

Table 1 gives the mean-values and standard deviations of the game contributions by trustors and trustees. Remarkable are the low values of reciprocity (Players 2) measured in our experiment, while the results on the behavior of Players 1 in the dictator games and trust games are more in line with other studies worldwide (Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Henrich et al., 2010). The results are a first indication that the challenges faced

by the communal governance system may not solely be attributed to trust issues, but rather to a lack of reciprocity.

Table 2 shows the results of two simple bivariate OLS regressions that measure the association between trust and reciprocity. The independent variable in the first bivariate regression is the amount received by Players 2 from their respective Players 1, while in the second regression it is the altruism shown by Players 2. The dependent variable in both models is their reciprocal behavior in the trust game. The models generate small coefficients for both regressors that are close to zero and statistically insignificant. The R^2 values were also low, indicating that the variables included in the regressions explain very little of the variation in reciprocity. Additionally, we added the bivariate correlations, which are also weak.

Table 1. Descriptive Game Results.

Dictator Game	**Trust Game (Pl 1)**	**Trust Game (Pl 2)**
Altruism	Trustor Trust	Trustee Reciprocity
Mean (% sent) (StDev)	Mean (% sent) (StDev)	Mean (% sent back) (StDev)
0.38 (0.21)	0.50 (0.29)	0.21 (0.17)

Table 2. Bivariate OLS-regressions on Trustee Reciprocity.

	Regression1:	**Regression2:**
	Amount received	**Altruism**
Bivariate OLS-Regressions on	Coeff (StDev)	Coeff (StDev)
Trustee Reciprocity	n=50	n=50
Intercept	0.18	0.15
	(0.05)***	(0.05)***
Trustee Reciprocity	0.00	0.01
	(0.00)	(0.01)

Adjusted R^2	*-0.01*	*0.02*
Bivariate correlation	0.09	0.19

****p < 0.01; **p < 0.05, *p < 0.1.*

Before turning to the Path Analysis models, we first searched for evidence that individual socio-economics characteristics affect trust and reciprocity. We use three regressions to check if age, gender, household composition, education, the economic status of the respondent ("On a scale of 1-5, how do you grade your economic status compared to the one of the people in your community") and land ownership could be associated with trust and/or reciprocity. In the first model on trust (Model 1 in Table 3), the dependent variable is a self-reported 'level of trust that other participants are reciprocators' measured on a 7-point Likert scale. Given its 7-point attributes, the model is estimated as an ordered logit regression. In Models 2 and 3 (Table 3), the dependent variables are the results of the trustor trust and the trustee reciprocity, respectively, captured by the players' behavior in the games. Models 2 and 3 are estimated using censored tobit regressions as the values of the dependent variable range between 0 and 100% (see also Ben-Ner & Kramer (2011); Lotz (2015)). In the last models, altruism as measured in the games was added as a control for the game-behavior (Kahneman et al., 1986).

Table 3. Regressions to capture variance in the trust and reciprocity by individual socio-economic characteristics reflecting levels of learning and norm-adoption

	Model 1	Model 2	Model 3
	n=100	n=50	n=50
Dependent:	**Trust (Scale 1-7)**	**Trustor Trust (game)**	**Trustee Reciprocity (game)**
	Coeff (StDev)	Coeff (StDev)	Coeff (StDev)
Independent:			
Intercept 1		0.49	0.65***

		(0.38)	(0.22)
Intercept 2		-1.43	-1.77
		(0.11)**	(0.12)***
Altruism (%)		0.62	0.09
		(0.18)***	(0.16)
Age (Years)	0.00	-0.00	-0.00
	(0.02)	(0.00)	(0.00)*
Sex (1: Female)	-0.04	-0.04	0.02
	(0.40)	(0.09)	(0.06)
Household head (1: Yes)	0.31	0.24	0.04
	0.40	(0.09)***	(0.07)
Household members	-0.05	-0.03	-0.02
	(0.10)	(0.02)	(0.01)
Education (Years)	-0.00	0.01	-0.01
	(0.04)	(0.01)	(0.01)*
Economic Comparison	-0.02	-0.02	-0.00
(1-5 Likert)	(0.25)	(0.05)	(0.04)
Landownership (1: Yes)	0.56	-0.07	-0.11
	(0.53)	(0.09)	(0.11)

****p < 0.01; **p < 0.05, *p < 0.1.*

A notable result is that altruistic game-behavior is strongly correlated with Trustor Trust (model 2; Players 1), but not with the Trustee Reciprocity (model 3; Players 2). This confirms our intuition from Table 2 that trust levels are not only low, but also accompanied by an absence and/or erratic expression of the reciprocity of the participants. Additionally, we find that when participants are the household head, they show more trustor trust. While the coefficients are small and the significance is weak, we also find that older and more educated participants appear to exhibit less reciprocity. This weak association of socio-economics with trust measures could be attributed to the absence of impact on trust, but also to data limitations (*i.e.*

limited variance amongst the respondents). Moreover, the number of data points was insufficient to allow us to include these extra socio-economic determinants in the Path Analysis model.

4.2. Path analysis

The results of the three path analyses presented in Table 4 suggest a significant positive correlation between the perceived benefits from the water associations and the level of trust in reciprocation among the participants (as depicted in Figure 1 and Figure 3). The use of altruism as a control measure is also supported by the positive correlation between altruism and trust-behavior amongst the Players 1. The positive and significant correlation between the experienced benefits from the water associations and trust shows that indeed good communal governance could result in a higher level of trust within the society. However, it is important to note that while a higher degree of trust in reciprocation leads to a higher valuation of cooperation, it does not appear to be directly linked to increased reciprocal behavior amongst the Players 2. Additionally, the transfer of resources from the Players 1 to Players 2 has a negligible effect on the actions of the Players 2 in the trust game. This confirms our first hypothesis that trust alone is not enough to increase levels of cooperation. Furthermore, the level of reciprocal behavior and the valuation of cooperation amongst the Players 2 are not correlated with the perceived benefits from the water associations. These benefits appear to be primarily determined by the functioning of the irrigation system and, to a lesser extent, by differences between the specific associations (mainly with members of Association 1: Tupac Katari reporting fewer benefits). In general, we find that reciprocity as measured by the game is low.

This might confirm our second hypothesis as well; the specific type of reciprocity that is measured by the game is one that is intrinsically motivated. There is no repeated play, and

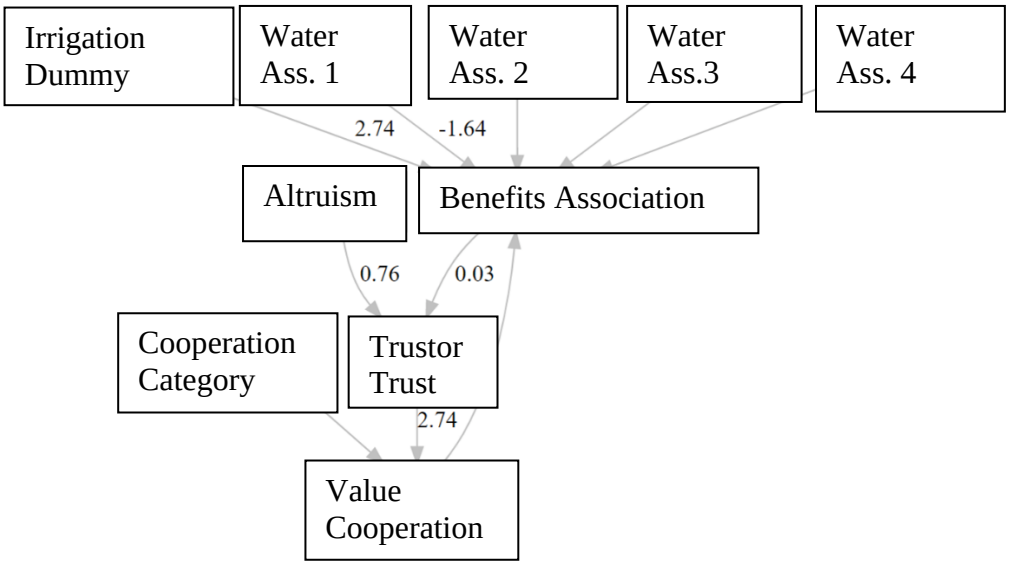
possibility to reward or punish the unknown counterplayer (Falk et al., 1999). This is all the more striking, as in their hydrosocial territory the Aymara link their group identity and it's relation to water with deeply entrenched cultural systems of reciprocal labor (Alvizuri, 2009; Boelens, 2014). Nonetheless, efficient communal governance based on intrinsic motivations could be challenged by the stronger negative reciprocal behavior against outsiders that is entrenched in the Aymara hydrosocial identity (Boelens, 2014; Dohmen et al., 2008; Rand & Nowak, 2013). Furthermore, existing intrinsically motivated systems might be eroding due to the increasing influence of extrinsic reward-systems (Authelet et al., 2021; Walsh-Dilley, 2017). Additional to Table 4, Figures 4, 5, and 6 present the path diagrams in a graphical way. For the significant paths ($p < 0.1$), the coefficients have been added.

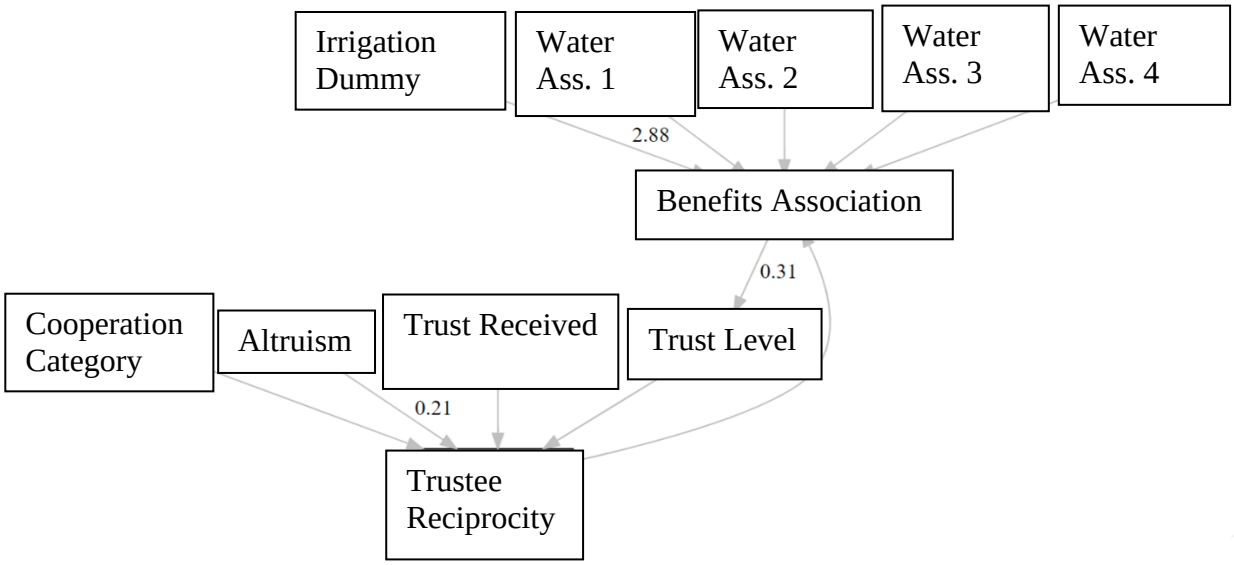
Table 4. Results from the Path Analysis

	Players1		**Players2**		**All**
	Coeff		Coeff		Coeff
	(StDev)		(StDev)		(StDev)
	n = 50		**n = 50**		**n = 100**
Trustor Trust		**Trust Level**		**Trust Level**	
(%)		**(1-7)**		**(1-7)**	
Benefits of water	0.03	Benefits of water	0.31	Benefits of water	0.24
association (0-10)	(0.02)*	association (0-10)	(0.14)**	association (0-10)	(0.10)**
Altruism	0.76				
(%)	(0.16)***				
Value of		**Trustee Reciprocity**		**Value of**	
Cooperation		**(%)**		**Cooperation**	
				(1-7)	
Trustor Trust	2.74	Trust Level	0.01	Trust Level	0.32
(%)	(1.07)**	(1-7)	(0.01)	(1-7)	(0.10)***

Coop Category	0.03	Coop Category	-0.03	Coop Category	0.23
(0-4)	(0.30)	(0-4)	(0.03)	(0-4)	(0.24)
		Altruism	0.21		
		(%)	(0.13)*		
		Trust Received	-0.00		
		(0-180 Bs)	(0.00)		
Benefits of water association (0-10)		**Benefits of water association (0-10)**		**Benefits of water association (0-10)**	
Value of Cooperation	0.01	Trustee Reciprocity	-0.95	Value of Cooperation	0.06
(1-7)	(0.11)	(%)		(1-7)	(0.07)
Irrigation Dummy	2.74	Irrigation Dummy	2.88	Irrigation Dummy	3.00
(1: yes)	(0.57)***	(1: yes)	(0.51)***	(1: yes)	(0.37)***
Water Association1	-1.64	Water Association1	-0.70	Water Association1	-1.28
(1: yes)	(0.72)**	(1: yes)	(0.69)	(1: yes)	(0.48)***
Water Association2	-0.44	Water Association2	-0.07	Water Association2	-0.13
(1: yes)	(0.67)	(1: yes)	(0.67)	(1: yes)	(0.46)
Water Association3	0.65	Water Association3	-0.45	Water Association3	0.38
(1: yes)	(0.80)	(1: yes)	(0.91)	(1: yes)	(0.56)
Water Association4	-1.66	Water Association4	-2.69	Water Association4	-1.90
(1: yes)	(1.29)	(1: yes)	(1.72)	(1: yes)	(1.00)*
Absolute fit measures					
χ^2	15.494		17.259		15.969
RSMEA	0.046		0.041		0.058
SRMR	0.056		0.067		0.055
Relative fit measures					
CFI	0.968		0.952		0.945
TLI	0.945		0.918		0.905
AIC	442.606		372.417		-614.634
BIC	467.463		398.319		-606.649

****p < 0.01; **p < 0.05, *p < 0.1. Water Association 1: Tupac Katari; Water Association 2: Suriquiña-Taypichaca; Water Association 3: Khara Khota-Suriquiña; Water Association 4: Taypichaca-Palcoco.*


Irrigation Dummy
Water Ass. 1
Water Ass. 2
Water Ass.3
Water Ass. 4
2.74
-1.64
Altruism
Benefits Association
0.76
0.03
Cooperation Category
Trustor Trust
2.74
Value Cooperation


Irrigation Dummy
Water Ass. 1
Water Ass. 2
Water Ass. 3
Water Ass. 4
2.88
Benefits Association
0.31
Cooperation Category
Altruism
Trust Received
Trust Level
0.21
Trustee Reciprocity

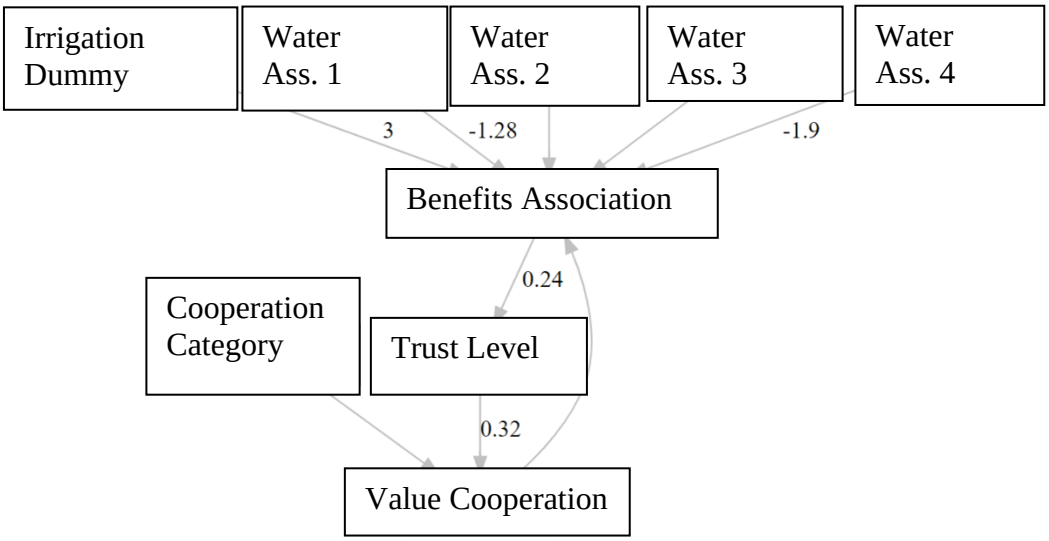


Figure 4, 5, and 6. Path Diagrams showing the significant ($p < 0.1$) coefficients of model 1, 2, and 3.

5. Discussion

Our analysis of both the results from the trust game and the corresponding survey questions reveal a significant positive correlation between the perception of a larger beneficial impact of the communal water associations and the trust in the reciprocity of others. The inclusion of the dictator game-results in Model 1 helps to mitigate potential biases stemming from altruistic motives (J. C. Cox, 2004; Kahneman et al., 1986). This supports the applicability of the Ostrom framework (Figure 1 and Figure 3) to the hydrosocial territory of Batallas-Pucarani, and suggests that higher benefits from the associations could foster trust within and between the Aymara communities (Poteete et al., 2009).

However, upon examination of the remaining paths, one may question the extent to which the findings can be interpreted as a positive spiral of increasing cooperation and good communal governance. While our analysis of the results of Models 1 and 3 (Table 4) reveal a positive correlation between higher levels of trust and increased perceived value of cooperation (Guiso et al., 2010), the results of Model 2 suggest that trust is not associated with increased reciprocal behavior. Furthermore, our results (Table 2 and Model 2, Table 4) suggest that the reciprocity

by Players 2 is not correlated to the transfer received from Players 1. Based on these findings, we infer that the initial act of trust within the study communities does not result in an increase of reciprocity, and overall, reciprocal behavior appears to be low (Alós-Ferrer & Farolfi, 2019). This supports our first hypothesis that trust alone is insufficient to promote cooperation; initial acts of trust have to be reciprocated in order to effectively increase cooperation levels (Fehr & Gächter, 2000; Rand & Nowak, 2013). Consequently, our findings suggest that while individuals demonstrating higher levels of trust tend to place greater value on cooperation, their actions do not inherently lead to a corresponding increase in cooperation and, ultimately, as demonstrated in(Ostrom, 1990) fail to augment the net benefits derived from better-governed common resources. Reciprocity in this context does not function as conditional cooperation (Rand & Nowak, 2013), and largely fails to initiate a positive cycle of cooperation.

This observation could be explained by the prominent role of the struggle for water within the Aymara hydrosocial identity. Over centuries, the Aymara have been displaced to the more water-stressed highlands, and in recent decades, their water rights have faced further threats due to privatization and extractive industries (Boelens, 2014; Dupuits, 2019; Hailu et al., 2012). In response, the Aymara have mobilized their shared identity to initiate collective resistance, primarily through negative reciprocity (Manosalvas et al., 2021; Wutich et al., 2016). Prior research has indicated that negative reciprocators tend to be less trusting, and the negative impact of negative reciprocity on trust is stronger than the positive relationship between trust and positive reciprocity (Dohmen et al., 2008). Additionally, individual negative reciprocators are typically disinclined to engage in positive reciprocity when given the opportunity (Gervasi et al., 2022). In societies where negative reciprocity is deeply ingrained, this strong inverse relationship between trust and negative reciprocity may prevail. Moreover, existing internal inequalities within governing systems may become more entrenched as identity is used defensively against external pressures (Boelens, 2014; Manosalvas et al., 2021; Walsh-Dilley,

2017). Our findings suggest that this dynamic could lead to the suboptimal functioning of the communal governance system. Thus, our results contribute to the debate on the effectiveness of the Ostrom framework in explaining efficient communal governance, suggesting that while its design principles may be necessary, they may not be sufficient on their own (Baldwin et al., 2018; Boso et al., 2024; M. Cox et al., 2009; Dell'Angelo et al., 2016; Ostrom, 1990; Poteete et al., 2009). Although collective action and labor in the Aymara hydrosocial territory are governed in part by *ayni* and the *ayllu*, which hold significant importance and belief among the Aymara (Walsh-Dilley, 2013, 2017), it seems that internal reciprocal behavior is still hindered, leading to disruptions in water management.

Yet, the question remains why the initial moves of trust we do observe in the game behavior do not receive sufficient reciprocal answers. Our second hypothesis suggests that initiating a positive cycle of communal governance might be challenging in a society lacking intrinsic motivations for collective behavior (Berg et al., 1995; Cardenas & Carpenter, 2008; Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Kosfeld et al., 2009). Reciprocity appears to be not only low in our models but also uncorrelated with any of the behavioral or socio-economic variables, except for altruism. Intrinsic motivation is particularly important for hydrosocial territories, as integrating the common good into the group's identity positively affects its efficient management (Boso et al., 2024; Narloch et al., 2012). In case of the Aymara in Batallas-Pucarani, water governance is intrinsically motivated by indigenous practices deeply rooted in the society's shared worldview, which considers water an integral part of group identity (Alvizuri, 2009; Boelens, 2014; Wutich et al., 2017). However, external forces such as globalization and climate change introduce increasing external motivations into the territory's water governance, which might erode existing intrinsic motivational systems (Authelet et al., 2021; Córdoba et al., 2021; Hailu et al., 2012). As both trust and reciprocity in our experiment are intrinsically motivated (Fehr & Gächter, 2000), the models suggest that our sample

population might indeed not strongly react to this kind of incentive (Fehr & Falk, 2002). In relation to (Figure 1), the behavior exhibited in the experiment might indicate a lack of motivation for the water association members to react accordingly to moves of trust (Cardenas & Carpenter, 2008; Henrich, Boyd, Bowles, Camerer, Fehr, & Gintis, 2001; Poteete et al., 2009; G. Wright et al., 2023). While the disruption of the communal governance cycle might originate in a lack of reciprocity, resolving this issue should primarily target intrinsic motivation to engage in reciprocal behavior. To transition from higher levels of trust and value for cooperation to increased levels of cooperation, these motivations should trigger individuals being trusted not to free-ride but instead enter into a cooperative relationship (Kosfeld et al., 2009; Rand & Nowak, 2013; Ruiz-Mallén et al., 2015).

6. Conclusion

In summary, our study highlights the crucial role of reciprocity in the functioning of communal governance systems within hydrosocial territories. We have demonstrated that low levels of reciprocity can significantly contribute to the inefficiency of such systems. Reciprocal behavior acts as a bridge between initial trust and sustained cooperation, playing a conditional role in facilitating cooperative relationships. While trust may increase the perceived value of cooperation, true cooperation only flourishes when trust is reciprocated.

Drawing on the example of water associations managed by Aymara communities in the Batallas-Pucarani hydrosocial territory, we have underscored the challenges faced by societies deeply rooted in traditions of resistance and negative reciprocity toward outsiders. Despite relying on intrinsically motivated reciprocity and collective action for self-governance, the prevalence of negative reciprocity within these communities can hinder the effectiveness of collaborative systems such as water associations.

Our findings underscore the imperative for interventions aimed at fostering sustainable communal governance to transcend the sole focus on trust-building and instead prioritize the cultivation of positive reciprocity. Presently, efforts tend to center around organizing cooperative relationships with clearly delineated rules, systems of control, and expectations, whether rooted in indigenous customs or emerging from more contemporary forms of organization. However, this emphasis on extrinsic motivations may prove problematic, as reciprocity in prosocial societies thrives best when underpinned by intrinsic motivations aimed at garnering social approval and cultivating a positive reputation.

However, we realize “promoting intrinsically motivated reciprocity” might be easier said than done. It necessitates the nurturing and reinforcement of cultural values, the cultivation of a profound sense of community belonging, and the encouragement of active engagement with one's role within the social fabric. Both indigenous policymakers and stakeholders within the Bolivian state must underscore the importance of preserving Aymara culture, including its principles of reciprocity, cooperation, and community solidarity. Such endeavors can be advanced not only through legislative measures but also by fostering avenues for participatory engagement and collaboration within communities. Initiatives such as communal work projects, cultural events, and decision-making forums rooted in existing and trusted indigenous systems can serve to instill a heightened sense of collective responsibility among community members.

We must acknowledge the exploratory nature of this research. It represents a first attempt to measure trust within hydrosocial territories using experimental economics. Our aim was to shed light on potential trust-related issues that might explain the observed inefficiencies in water associations. One notable limitation of our study is the lack of detailed exploration into the motivational aspects, primarily due to data constraints. Future research could delve deeper into this topic, exploring not only how hydrosocial territories are currently organized around

cooperative systems driven by extrinsic motivations but also how communities and societies can transition towards more intrinsically motivated forms of trust and collaboration. In the same vein there is room for refining the design of the trust game used in our study. Introducing modifications that allow for the distinct measurement of both positive and negative reciprocity could yield more precise insights into the dynamics observed. Additionally, replicating the experimental methods employed in this study across various communal governance systems and hydrosocial territories worldwide would offer valuable comparative insights, helping to validate and generalize our findings.

In conclusion, we aspire for this research to contribute to the identification of strategies aimed at overcoming the challenges posed by entrenched tendencies towards non-cooperative equilibria. By facilitating more effective collaboration, we aim to ultimately enhance the well-being and sustainability of communities within hydrosocial territories and beyond.

7. References

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