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Tesis

Analysis of the variables that contribute to self-organization for the management of family lands in the Yánesha Native Community Santa Rosa de Chuchurras, Pasco, Peru

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Analysis of the variables that contribute to self-organization for the management of family lands in the Yánesha Native Community Santa Rosa de Chuchurras, Pasco, Peru

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Abstract. This research analyzed the variables that contribute to self-organization within the general framework for analysing the sustainability of socioecological systems (SES). In our case study, a correlation analysis showed that 80% of the variables contribute to the self-organization of the community in relation to the key resource: family land. There was evidence of land use transition, initially dependent on agrosilvopastoral system, towards diverse economic activities and with it also the inclusion of informal norms (institutional bricolage). These changes stem from two circumstances that threaten community organization. The first is linked to the absence of legal recognition of family lands by the Peruvian State, despite the prioritization of family economic activities over collective actions. The second is the precarious road connectivity that makes exporting difficult, slowing down production and the quality of their supply. If these two circumstances were addressed through public policies: a) the emigration of the community's younger population would be reduced; b) foreign investment would be attractive in this community; c) would increase the flow of energy and information between the community and its environment improving social capital and trust; and finally, d) uncertainty would be reduced, strengthening community self-organization.

1. Introduction

Climate change has become a threat to ecosystems during the last decades, impacting biodiversity, altering ecosystem functions, and generating disturbances in people's quality of life [1]. For a sustainable management of natural resources, it is convenient to understand the variables that influence it, considering the complexity of SES in its ecosystemic and social dimensions (human action and its institutions) [2]. These institutions can be sources or reservoirs of collective memory for sustainable changes in the long term [3]. If community users perceive benefits in the resource system, they will invest time and energy in self-organization (through their institutions) [4] and thus self-organization can establish institutional patterns for scenarios with future sustainable opportunities [5].

The Peruvian Amazon has a forest cover of 78,278,600 ha (60.91% of the national territory) [6]. This biome has been recognized for its high biological and cultural diversity, which is expressed in 48% of the country's natural protected areas [7]. In addition, there are 2,703 native communities in the area [8]. In the valley of the Palcazú River is the Yánesha native community Santa Rosa de Chuchurras, located in the buffer zone of the Yánesha Communal Reserve, a place where a series of initiatives are being developed with conservation and sustainable development objectives. Currently, there is evidence of the predominance of sustainable development projects linked to fish farming, cattle ranching, and cocoa cultivation [9]. However, these projects have not had the expected success, which motivates emigration among the economically active population in Palcazú seeking permanent or temporary employment.



The biodiversity of the Amazon biome is, in part, a product of the domestication activities on the vegetal resources that the indigenous natives developed before the arrival of the European colonists in 1492 [10]. This ancestral relationship reflects a high potential in terms of knowledge of the users themselves towards the natural resources, which could improve their management [11]. Most of the communities have institutions that provide them with the regulations for the use of the resources that satisfy their basic needs [12], favoring commitment among users [13]. In this sense, empirical studies have helped to build theories of collective action and to understand the conditions that influence communities to self-organize [14]. Consequently, the objective of this research is to analyze the level of impact (correlation analysis) of variables on self-organization [4] in relation to the use of the resource "family land".

1.1. SES framework

SES show a bidirectional relationship between the ecosystemic and social dimensions, resulting in complex but integrated results [11]. They are characterized by being multivariable, nonlinear, cross scale and constantly changing [15]. Therefore, the SES have different levels of uncertainty. In these systems, the human dimension is constantly redefining ecosystems and ecosystems in turn influence human decisions [16]. This framework is a hierarchy of concepts and variables comprising 8 first level subsystems that affect each other and each of these subsystems is composed of multiple second level variables [4]. With methodological input from this framework, Ostrom in 2009 proposes ten variables that are linked to optimal community self-organization, which is the focus of analysis in this research.

1.2. Community self-organization

In this research, community self-organization is defined as the emergence and maintenance of structures from local interaction, an emergence that isn't determined by a single actor, but is the result of a multitude of complex, nonlinear interactions between several elements [17]. From this, three principles can be deduced that shape it [18]: a) Relationships, that are forged through experiences of participation and interaction among people who share a common history and its norms, b) Adaptation, is sharing of knowledge of the past risks, for recovery or adaptation to challenges. When shared knowledge is put into practice, most of the time it satisfies specific needs according to the SES context and c) Responsibilities, which should be clear to users and thus (re)affirm their commitment to each other.

1.3. Law 20653 "Ley de Comunidades Nativas y de Promoción Agropecuaria de las Regiones de Selva y Ceja de Selva" Title II, Article 7.-

The Peruvian State recognizes the legal existence and legal personality of the native communities, where the title of the property is communal and there isn't legal recognition of family property.

1.4. Institutions

A set of rights, rules, and procedures for decision-making in the use of resources [19].

1.5. Institutional bricolaje

Institutions for the administration of resources through collective action, are built according to the needs of daily productive activities, which reveals their informal but collectively legitimized character [20].

1.6. Family land resource

In this research, the resource refers to the use of the lands distributed among the families of the community.

2. Location and methodology

2.1. Study location

Santa Rosa de Chuchurras community is in the Palcazú River valley. Geographically, it is located at the UTM coordinates 476178.65 m E, 8880485.39 m S at an altitude of 281 m.a.s.l. It has a territorial area of 2,048 ha and has communal property title legally recognized by the Peruvian State. In the last 16 years, there has been a 55% emigration rate, reaching a total of 198 inhabitants by 2021. Likewise, the

key resource in this community is family land ranging from 5ha to 30ha. These lands are used for economic activities: agriculture, livestock, forestry, fishing and commerce and their products generated from these lands are taken to the closest market that is Villa Rica, located 140 km away. In addition, there are two external cooperatives: APAZ SanCore and Macchu-Picchu that go to the community to buy cocoa from some families. However, there is no nearby market for the meat and wood generated in the community.

2.2. Methodology

The research had a holistic approach, in which ethnographic techniques were applied in the period from March and August 2021: surveys, semi-structured interviews and participant observation with prior authorization from the community authorities. The information was obtained from members of the community's board of directors, community members and Servicio Nacional de Áreas Naturales Protegidas (SERNANP), office in charge of the protection of natural areas. The method of statistical analysis was Spearman's correlation, using IBM SPSS Statistics Base 25.0, to determine the correlation between variables and self-organization.

3. Results and analysis

3.1. Correlation between self-organization and second-level variables

For all tests, the results were considered significant at ≤ 0.05 and marginal when $0.05 < a \leq 0.10$ [21]. In this research, self-organization was analyzed through three principles (relationships, adaptation, and responsibilities) as a function of the family lands and the variables used are those shown in Table 1.

Table 1. Correlation coefficient between self-organization and second level variables^a

VARIABLE	SECOND LEVEL VARIABLE	CORRELATION
Resource system	Size of resource units (RS3)	0.487 ^b
	Productivity of resource units (RS5)	0.689 ^c
	Predictability of system dynamics (RS7)	0.580 ^c
Resource units	Resource units' mobility (RU1)	-
	Economic value (RU4) ^a	0.570 ^c
Users	Number of users (U1)	-0.669 ^c
	Leadership and entrepreneurship (A5)	0.607 ^c
	Capital social (U6)	0.500 ^b
	Informal rules of collective choice (GS6) ^a	0.580 ^c
	Knowledge of SES (U7)	0.591 ^c
	Dependence of resource (U8)	0.476 ^b

^a This is an adaptation of the SES framework according to Ostrom, 2009. The variables incorporated for the analysis are economic value proposed by Guimaraes et al., 2018 and informal norms by Cleaver, 2000.

^b The correlation is significant at the 0.05 level (bilateral).

^c The correlation is significant at the 0.01 level (bilateral).

After verifying that there is a correlation with the variables evaluated at a significant level of 0.05 and 0.01, as appropriate, we went on to analyze the aspects that respond to these correlations and how they are contributing to self-organization for the management of family lands.

3.2. Connecting the variables that influence the self-organization of resource management

3.2.1. Size of resource units (RS3) and number of users (U1). According to the statistical correlation, the size of the resource units has a correlation of 0.487. This relationship with self-organization is occurring because the community's land is divided by family and its management depends on the family nuclei, facilitating the monitoring and development of responsibilities sustaining the organization in the community. This division of areas by family land was developed when community members perceived a great loss of forest areas causing them to take actions to protect them [22]. One of these actions was to clearly define the limits per family area, since, having an extensive area without limits, the collective

management didn't have defined responsibilities. Currently, land management depends on the decisions of the family nuclei, and this facilitates the development of responsibilities, as mentioned in design principle 1 by Ostrom [23]. As evidenced, the number of users is important in this analysis, since decision making is by family units.

The variable number of users has a correlation of 0.669 with self-organization, this relationship is occurring because the families know each other and there is an average degree of compliance with the rules and responsibilities established by the community and the main motivation isn't to lose the benefit of family land ownership. Likewise, having family properties, the surveillance effort is minimal. It must be taken into account that the population of this community is decreasing, but there is still a viable degree of compliance with the responsibilities assumed.

It is only not possible to find a higher correlation value in these variables because the migration rate of young people is high, which affects the community organization, as they interrupt the continuous flow of knowledge of the SES [24] and weaken the coordination network with the entire community.

3.2.2. Productivity of resource units (RS5) and knowledge of SES (U7). This analysis focused on agricultural and livestock productivity since forestry activity for reforestation purposes is developed with low intensity. In the study area, the productivity of family land varies according to land size, investment, and labor availability. It can be seen in Table 2 that, despite having a large area of family land, if there is not enough economic availability and paid labor, it will not be productive.

Table 2. Family land's productivity^d in the community Santa Rosa de Chuchurras

Variables	Agricultural (Cocoa)		Livestock	
	Case 1	Case 2	Case 1	Case 2
Land size	0.5ha	3ha	10ha	7ha
Annual investment	1st year = 450 USD 2nd year at + = 200 USD	1st year = 4150 USD 2nd year at + = 400 USD	1700 USD	2600 USD
Available personnel	01	03	04	03
Productivity	80 kg/harvest	800 kg/harvest	6 head/year	8 head/year
Annual return	1st year = 230 USD 2nd year at + = 480 USD	1st year = 2078 USD 2nd year at + = 5828 USD	7060 USD	9080 USD

^d These cases are only a sample of opposing situations to illustrate the diversity of variables that affect agricultural and livestock productivity.

According to the analysis, productivity has a correlation of 0.689. This relationship with self-organization is occurring because we evidenced that they have been developing actions to improve the productivity of family land, through a process of institutional bricolage, since internally they have designed other ways of organizing themselves not explicitly contemplated in their formal institutions (statutes), with the objective of optimizing the profitability of their lands, for example: the purchase and sale of family land through a third party possession certification (only intra-communal transaction), allowing the development of access controls and obtaining benefits at the collective level [25].

However, this recognition of family ownership is not valid outside the community, which limits the backing capital for bank loans and reduces investment in the family lands, thus discouraging villagers from remaining in the community. As a result, they have been developing other economic activities other than agrosilvopastoral: commerce, transportation, lodging services, work with NGOs and construction, thus impacting the flow of SES knowledge.

This knowledge of the SES has a correlation of 0.591 with self-organization, this relationship occurs because the young and adult population is acquiring knowledge through their experience and observation of the dynamics of other nearby SES, since the acquisition of knowledge is necessary for social and spatial organization [26]. Human occupation of the community dates back about 70 years and the distribution of property for families occupies 100% of the territory, only the older population is the most familiar with the territory. In addition, part of the young population (60%) emigrates to other places, affecting the knowledge transmission chain, so its flow is discontinuous among users, which explains why they do not have a higher correlation value.

3.2.3. Predictability of system dynamics (RS7) and resource units' mobility (RU1). The predictability of system dynamics has a correlation of 0.580 with self-organization. In this research, predictability is supported by three factors: the mobility of the resource [4], the historical perspective of the local population [27] and the use of information systems [28]. The key resource in this research is family land and it's a fixed resource and as such generates greater predictability of the environment and users can estimate what is going to happen and can organize themselves in the face of future events [4]. In Santa Rosa de Chuchurras the fixed resource (family land) is managed at the level of the family nuclei and does not respond to the conceptual criteria of the variable "resource mobility" that were frequently conceived at the level of collective use. For this reason, we have not considered this variable as a determinant factor in self-organization and, therefore, it has not been considered in the statistical correlation.

Whereas the historical perspective of the population and the use of information systems (U9) are fragmented. It is evident that more than half of the population was losing cultural roots due to emigrations that weakened the flow of empirical knowledge about the good and bad years. In addition, the lack of knowledge and training on information systems for forecasting future events is generating uncertainty. These two factors weaken the correlation with self-organization.

3.2.4. Economic value (RU4) and dependence of resource (U8). Economic value has a correlation of 0.570 with self-organization. This relationship is occurring because the economic benefits perceived from family lands partially satisfy their basic needs. Although these are long-term investments, they maintain an order in the community so as not to lose the designated land. When the economic values of the resource are high, the willingness to participate in collective actions increases [29]. In this research, two dimensions of the economic value of family land were considered: the value of the products generated [30] and the property value [31].

The value of the products generated in the community depends on the production of cocoa, meat, and wood. However, these are not constant throughout the year and their sales niche is limited, which implies that the villagers emigrate in search of better job opportunities, impacting in the resource dependence variable [19], which has a correlation of 0.476 with self-organization.

The communities prefer their family properties to be titled so that it becomes capital for them [31]. In addition, it is evident that in the communities there is a greater preference for the use of the resource under family management (more economic benefits) than under collective management, strengthening communal organization [16]. In the Santa Rosa de Chuchurras community, family management also prevails over collective management, even though families currently have a certificate of land possession, but this is only valid within the community, making it difficult to access significant bank loans.

However, sporadic technical training and the distant location of the community from urban centers (a 5-hour trip on an unpaved road) make it difficult to sell their products. There is also evidence of shortcomings that are contributing negatively to the expansion of market networks and the maintenance of the economic value of the land resource and its products.

3.2.5. Capital social (U6) and informal rules of collective choice (GS6) and Leadership/ entrepreneurship (A5). According to the statistical correlation, it was determined that there is an average correlation expressed as: 0.580 (social capital) and 0.500 (informal norms of collective choice).

Social capital is linked to a) trust and norms of reciprocity; b) networks and forms of participation; and c) institutions (formal and informal norms) that contribute to collective action [32]. In this community, reciprocity has been monetized, for example: if a person from outside the community buys land, he or she is registered as a member of the community and must make annual payments (these payments compensate for activities not carried out in the community: work, agreements, attendance at meetings and support for vulnerable people). In addition, there is support for the management of community governance, since, in the absence of the chief, it is the board of directors that participates in decisions and monitoring. Also, social capital is strongly linked to collective choice rules, when users have full autonomy at the collective choice level and enforce their own rules, managing a resource is easier [22]. The formal institutions (statute) of the community were established in 2005, since then there

has been no change in this, so currently a process of institutional bricolage is taking place through the creation of informal institutions (collective choice rules), since community members identified that the benefits obtained from land management outweighed the costs of complying with the rules (design principle 2), which provided an incentive to organize [33].

The variables noted above are linked to leadership and entrepreneurship [19]. According to the statistical correlation, it was determined that the latter variable has a correlation is 0.607 with self-organization. This relationship is given since community leaders enforce the rules and sanctions that are in the established institutions and what prevails in their role is the order they put after the events that alter the organization of the community, since the presence of strong leaders with previous experience in resource management, innovation, networking, conflict resolution or rewards can contribute to the success of self-organization [14]. In terms of entrepreneurship, there are two types depending on the results: subsistence and transformational [34]. The entrepreneurship that has been occurring in the community is of both types, one related to subsistence (agrosilvopastoral activities) and the transformational, as is the case of those users who have extensive areas of land and invest in local labor.

4. Conclusions

The correlation analysis showed that 80% of the variables analyzed contribute to community self-organization in relation to family land management, which implies the need for holistic and interdisciplinary approaches to make decisions in the management of a resource and contribute to its sustainability [35].

Based on this study, it's considered that there are two circumstances that weaken community organization. The first is linked to the lack of legal recognition of family property by the Peruvian State, which reduces the backing capital for loans and investments. The second circumstance is the precarious road connectivity that makes exporting difficult, slowing down production and the quality of their supply, which explains the little or no investment in technology to process their products or obtain information to make the use of their resources more predictable and efficient. If these two circumstances were addressed through public policies: a) the emigration of the community's younger population would be reduced; b) foreign investment would be attractive in this community; c) Would increase the flow of energy and information between the community and its environment improving social capital and trust; and finally, d) uncertainty would be reduced, strengthening community self-organization.

Natural resource conservation programs in rural areas will not be sustainable despite budget and technical assistance, as they will be weakened by low population density due to emigration and increasingly weakened self-organization.

In this community there is a vocation for family management of resources rather than collective management, which leads us to consider that another variable that would explain self-organization is the degree of strength of the family units. This variable could be added to already defined to explain self-organization, most of which are linked to the decisions and actions of the users. Further research will be needed among other SES to highlight new evidence to support the hypothesis that organizational capacities are determinant for the sustainability of resource management.

Finally, when the State does not provide optimal management of public goods (common access resources), the State itself must create the legal conditions (e.g.: legal recognition of family ownership) for the community organization to manage these resources in accordance with its interests.

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