



Socioecological practices and community resilience strategies for sustainable agriculture in lower Sinú, Colombia

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Abstract

This research examines the socioecological practices of rural communities as an epistemological foundation to configure community resilience strategies and face socio-environmental conflicts due to limited access to water, loss of biodiversity and ancestral knowledge. To meet this objective, a qualitative approach was used with a non-experimental transectional research design of exploratory type with a case study method in the Association of Producers for Community Development of the Ciénaga del Bajo Sinú-Asprociq, Colombia. As a main result, it is argued that the rural communities of the lower Sinú organized in associations carry out self-management models that promote the articulation of social and ecological systems, socio-environmental sustainability and make an adequate management of use and access to ecosystem services.

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Introduction

The social and economic changes of particularly the last two decades have increasingly led to environmental changes, such as climate change. The impacts of this phenomenon on peasant communities and traditional agriculture are manifested by a possible reduction of up to 50% in crop productivity due to higher temperatures, droughts and heavy rainfall (M. Altieri & Nicholls, 2008).

The effects of climate change and variability on agricultural production systems are increasingly evident in vulnerable populations in smallholder and subsistence agriculture is exposed (Doering, Randolph, Southworth, & Pfeifer, 2002; Morton, 2007). Scientific studies show that the potential impacts on maize production in Africa and Latin America by the year 2055, foretell signs of concern about the challenges of ensuring food security and reducing poverty (Jones & Thornton, 2003). Therefore, it is evident, two decades ago, the affectation on the overall productivity of the crops (Reddy & Hodges, 2000), generated in turn by recurring climate variability events (Rosenzweig & Hillel, 1998, 2008).

There is also scientific evidence of agroforestry management as an adaptation strategy for coffee agriculture in the face of possible extreme microclimate changes (Lin, 2007) and droughts and desertification in West Africa (Mortimore, 1989). These attempts to understand the ecology and ensure food self-sufficiency are being developed by rural communities highly vulnerable to climate change and in condition of poverty to ensure local quality of life (M. Altieri & Nicholls, 2008; V.M. Toledo, Carabias, Mapes, & Toledo, 1985; V.M. Toledo & Solis, 2001).

Agro-ecological innovation schemes aimed at increasing food production under the participatory model (Uphoff, 2002) and the yield advantages of intercropping and irrigation systems (Natarajan & Willey, 1986), are alternative models of peasant agriculture management that offer responses to the adversities of climate change and food sovereignty, trends that are increasingly developing worldwide (M. Altieri & Nicholls, 2012a).

In this context the notions of community resilience and the integrated system of self-organization (Berkes & Ross, 2013; Marasco, Kammouh,

& Cimellaro, 2022) are externalized as other ways of thinking about the relationship between human beings and nature, which point to new paradigms of rural development and conception of the world of life in the face of the current ecological crisis (Becker, 2012; Ocampo-Fletes & Escobedo-Castillo, 2006; Zemelman, 2000, 2003). Community resilience is understood as experiences of collective action to defend themselves from the effects of climate change and protect their crops (Belloni, 2017).

This research paper focuses on the context of socio-ecological practices of rural communities to overcome environmental problems and conflicts around water and territory (Altieri & Nicholls, 2012b; Martínez-Alier, 2008; Martínez-Alier, Kallis, Veuthey, Walter, & Temper, 2010; Sepulveda, 2015; Sepulveda, Taborda, & Fuentes, 2020; Toledo, 2013). Social-ecological practices have recently gained importance not only in rural agro-ecosystems (M.A. Altieri, 2018; LaRota-Aguilera, Delgadillo-Vargas, & Tello, 2022) as studied in this paper, but also in private organizations in their eagerness to commit themselves to the causes of the ecological crisis, although in many cases these are empty intentions or facades (Meisinger, 2022).

The interest of this research arises from the significant trajectory and management of the Asprocig association with the creation of family and collective ecological agroecosystems, positively impacting the management of soil, water and biodiversity. The resilience practices and strategies carried out benefit the community (social impact) and the conservation of nature (ecological impact), actions that are nationally and internationally recognized and are studied to explore in them, the knowledge and experiences to be discussed in scientific meetings.

From this perspective, the objective is to examine the socioecological practices and resilience strategies of three associations belonging to the Association of Producers for the Community Development of the Lower Sinú Swamp – Asprocig –, in order to validate whether they are a viable alternative to control water and territory and neutralize the driving forces that generate territorial disputes. Asprocig currently groups 13 associations located in the lower Sinú basin, Colombia.

Asprocig was created in 1987, in the municipality of Lorica, department of Córdoba, near the perimeter of the Ciénaga Grande del Bajo Sinú (Colombia). It is a grassroots community organization, organized by peasants, fishermen and indigenous people who bring together 6,200 families in 2,332 areas of land (hectares) (CORSOC, 2016). Its proposal for territorial rural development seeks to rescue the ancestral culture of the Zenú people, in relation to water management for agricultural activities, the integrated management of local wetlands, the promotion of agroecological production and the training/administration of community projects.

The model is based on the principles of non-violence (peaceful resistance), autonomy, solidarity, resilience, adaptability, cooperation and sustainability. It is a commitment to life and the need to consolidate actions that contribute to improving the well-being of communities and the conservation of the region's natural resources, especially water.

The history of Asprocig can be divided into four moments; the first from 1990-1994 was characterized by the beginning and reorganization of the association; the second from 1995-1998 which explains the struggles for the defense of the territory and culture; the third from 1999-2000 period in which political and economic forces were acquired to carry out the institutional mission. Two important social and legal events stand out in this period: the resistance to the URRA I dam and the tutela action brought before the Constitutional Court in 1999, with a ruling in favor of Asprocig. In economic terms, alternative agriculture and aquaculture programs were developed and later consolidated as family and collective agroecological systems with a positive impact on the community.

The fourth period, 2001-2004, was characterized by Asprocig's strong opposition to the execution of the URRA I hydroelectric power plant, the development of the local shrimp industry and the construction of several irrigation canals that affected the water dynamics of the Sinú river basin.

The paper is organized in four sections. The first one presents the theoretical bases of socioecological practices and community resilience strategies, then in materials and methods (second section), the research approach is explained, which is qualitative and exploratory, with case study method and bibliographic repertoires techniques, participant observation and in-depth interviews with 30 reporting members of the Asprocig association. The processing and analysis of the information was done with the use of Atlas.ti V8 software. The third section presents the results. At the end, some conclusions are drawn.

1. Background

1.1. Theoretical bases of social-ecological practices and community resilience strategies

Ariztía (2017) indicates that research on the theory of social practices is studied from three standpoints, namely sociology (Giddens and Bourdieu), ethnomethodology (Harold Garfinkel), and philosophy (Theodore Shatzki and Wittgenstein). The author indicates that in this disciplinary field, the advances in the field of environmental sociology and sustainable consumption are recognized, which lead to the understanding of the social world as

a practical result, and constitutes a theoretical reference to explain the processes of transformation and social change through the categories of structures, relations, dynamics and evolution in the spectrum of social and environmental practices.

The notion of social-ecological practices has been investigated in recent scientific literature. Theoretical and methodological contributions revolve around the study of the social-ecological resilience of agroecosystems to the effects of social and environmental phenomena, the most important of which are climate change and human appropriation of nature (M. Altieri & Nicholls, 2012b; Belloni, 2017; Henao Salazar, 2013; Nicholls Estrada, Ríos Osorio, & Altieri, 2013; Sepúlveda & Diaz-Cid, 2019; von Glasenapp & Thornton, 2011).

The concept of resilience has been of great academic use in various disciplines, including physics, which is considered the pioneer in using it to express the condition of elasticity and plasticity of a substance (Greene, R. y Conrad, 2002). On the other hand Holling (1973) uses the term to explain the complexities of ecological systems, contributions that contribute to the social sciences, particularly psychology, with Rutter (1993) and Werner (1994) guiding to the study of successful adaptations in the individual in the face of perturbations due to biological risk factors.

The studies of individual resilience approached from psychology contributed to other fields of social sciences to recognize in the concept a response to conflict and crisis situations, no longer in the context of the individual or family but rather at the social or community level. Thus, since the end of the 1980s, discourses with different points of view have become known, debating the so-called “crisis of civilization”, understood, in some cases, as a crisis of the economic rationality of capitalism and where rural peasant communities are shown as the basis for the construction of community or social resilience in the face of the crisis of civilization with the development of local knowledge to face socio-environmental problems in their territories (Azkarraga *et al.*, 2012; Fuente, 2012).

In this regard Zemelman (2000) reflects on how to minimize the risks of pressure on the current economic system, which translates into a call to life in general and to lessen the pressures and ideologies that promote limitless consumerism and productivity engendered in the capitalist system. Therefore, it is urgently necessary the construction of a social knowledge that recovers the link between human being-nature, between the subject and the conflicting thing.

According to Maldonado (2014) such a link is achieved by reducing the arrow of time of entropy that is produced in the current economic system, by another arrow of time, that generates both life and possibilities, capable of building a new civilization. This other arrow corresponds to what

Prigogine called “dissipative structures” that are far from equilibrium, from the dominant order and with the capacity to self-organize a new order. In this regard Angel Maya (2002) states that “it is not possible, however, to confront the environmental crisis without a profound reflection on the very foundations of civilization” (p. 23), where Leff (2014) calls for the recovery of nature’s capacity to regenerate, that is to say, the negentropic capacity of the ecological system. In this order of ideas, it is urgent to reduce the entropy that cohabits in the socioeconomic system, energy in disorder that reduces the possibilities of life of the planet.

Taking into account the what precedes and the considerations that ecology is an essential dimension for the life of rural communities, it is evident that there is a declared emergency, widely debated in the scientific community on the notions of traditional practices, local knowledge and exchange of ancestral knowledge, which seek to question the unfavorable actions of the dominant system and in turn offer solutions with ecological agriculture schemes (Einbinder *et al.*, 2022; Favretto, Stringer, Dougill, & Kruger, 2022).

2. Materials and methods

2.1. Research hypothesis

The research hypothesis here is that Asprocig socioecological practices and resilience strategies help promote socio-environmental sustainability and make an adequate management of local natural resources to guarantee the use and access to ecosystem services.

2.2. Research design

A qualitative approach is used via a non-experimental transectional research design of exploratory type, which allows getting to know a community and its context at a given time, addressing a “previously unknown or little addressed phenomenon” (Hernandez, Fernandez, & Baptista, 2014, p. 91). The case study method is recommended to investigate socioeconomic events in communities and population groups (Hakim, 2000), which allows measuring and systematizing the behavior of people who are part of the studied phenomenon from qualitative and quantitative sources of information, the former being frequently used for exploratory, descriptive and explanatory research (Martínez, 2006).

The case study method is relevant for this research, because it aims to explore and understand the worldview of the affected communities and the forms of action in the face of a specific phenomenon that arises from everyday

life, with the use of qualitative techniques such as in-depth interviews. that obtain narrated data from the subjects from their explanations (Castro, 2012). Table 1 shows methodological aspects, theoretical and conceptual framework and general research questions that guide data collection.

Table 1 - Theoretical-conceptual and methodological framework guiding data collection

Theoretical framework	Conceptual framework	Methodological aspects of the research		Data capture research questions
Agroecology		Methodology		
Political Ecology	Socioecological practices		Qualitative	¿What are practices for the association and how do you systematize them?
	Community resilience strategies	Method Technique	Case studies Bibliographic repertoires In-depth interviews Participant observation	¿How do the daily experiences and practices create knowledge for the association's management? ¿What are the main strategies of the association to face and overcome the adversities of climate change and food insecurity? ¿How to guarantee food security to the families grouped in each association based on the socioecological practices developed by Asprociog?

Source: Own elaboration (2021).

2.3. Sample and data collection techniques

Supported by the non-probabilistic purposive sampling technique (Otzen & Manterola, 2017), a sample of fifty-two (52) bibliographic repertoires was selected taking into account the organization of the documents indicated by Miguel *et al.* (2012) by subgroups, namely; scientific articles consulted in databases (Elsevier, Redalyc, Scielo, Latindex), electronic periodicals libraries (Dialnet, institutional repositories of public and private universities) and books. The selection criteria for the repertoires were made using search equations after formulating research questions (Gómez *et al.*, 2014) (see Table 2).

Table 2 - Sample of bibliographic repertoires

Search equation	Bibliographic repertoire consulted	Type of repertoire	Quantity
Agriculture AND climate change	Scientific articles	Electronic	Eighteen
Civilizational crisis OR alternatives to development	Scientific articles	Electronic	Twelve
Social AND socioecological practices	Scientific articles	Electronic	Ten
Resilience AND community resilience strategies	Scientific articles	Electronic	Ten
Exploratory research	Scientific articles and books	Electronic	Two
Total ...>			fifty-two

Source: Own elaboration (2021).

On the other hand, for the in-depth interview technique, a non-probabilistic convenience sampling was used (Otzen & Manterola, 2017) given the attributes of accessibility and proximity of the informants members of three (3) associations attached to Asprocig, (in total there are 13 associations) and that in the opinion of the researcher determined by convenience four selection criteria for data capture, namely; seniority of the member (more than 10 years), community leadership (positions on the board of directors), knowledge of family and collective agroecosystems (proven experience in agroforestry systems) and internal knowledge of the association (decision-making capacity). In this sense, the convenience sample size was thirty informants, distributed ten per association.

Finally, the participant observation technique practiced by the main researcher evidenced the functioning and organization *in situ* of the family and collective agroecosystems, information that allowed validating with the techniques of bibliographic repertoires and in-depth interviews, the level of equivalence of the data obtained through the triangulation process (Okuda & Gómez, 2005), considered appropriate for qualitative research.

2.3. Information analysis

Based on Miguel *et al.* (2012) and Fox (2005), the analysis of the information in the bibliographic repertoires was carried out in three sequential stages: 1. documentary analysis of the contents. 2. summary, synthesis and condensation of the information. 3. drafting of the literature review or review article on the study of the interrelationships and structures (Kabalen & Sanchez, 1997) of the conceptual framework socioecological practices and community resilience strategies, as a dynamic process to organize and represent the knowledge patented in the documents (Perelló, 2011), in order to analyze from a historical perspective and critical thinking (Gómez *et al.*, 2014) the characteristics of the problematic phenomenon and the solution alternatives presented.

The analysis of the data from the in-depth interviews and participant observation was carried out in two stages: first, the organization and transcription of the narrated and observed data, and second, the coding of recurrent categories of interest to the researcher. The Atlas.ti V.7.0 software used facilitated the structuring of semantic networks of the main categories socioecological practices (presented as an emerging category) and the five resilience strategies implemented by the three Asprociog associations.

3. Results and discussion

3.1. Association of Producers for Community Development of the Ciénaga del Bajo Sinú-Asprociog: Community resilience strategies

Organizations that spend time reflecting on their own practice are learning organizations.

(Asociación de Productores para el Desarrollo Comunitario de la Ciénaga del Bajo Sinú [Asprociog], 2006, p. 103)

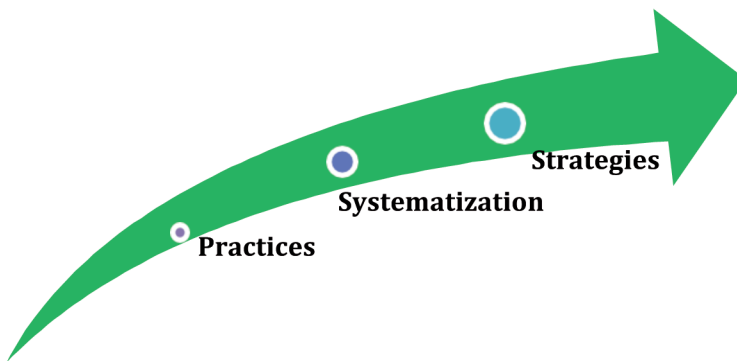
Practice is the most notable source of learning for grassroots organizations working for local development. It makes it possible to achieve a stable and sustained product, from which it is possible to transfer the experience built, check it with others and favor the accumulation of knowledge based on and towards praxis. In this context, this research defines practice as the set of individual or collective daily experiences that are shared within the community to rethink and recognize alternative ways of integrating social-ecological systems (Sepulveda *et al.*, 2020)

The practice of each family or collective is the main input to build and systematize the community experiences. From the meetings and debates, the

successful cases of greater contribution in the man-nature relationship are filtered, to then socialize it with all the associates of the organization and its implementation (Asprocig, 2006).

From this perspective, the process of knowledge construction as a factor of social accumulation of power, starts from the systematization of experiments that each member unit tests and knows the benefits, to then spread among all partner units. The teachings are developed in the so-called agroecological schools, which are open training spaces for all affiliated members (Asprocig, 2006). Figure 1 shows the sequential process of creating resilience strategies based on the practices of the agroecological schools.

Figure 1 - Asprocig sequential process of community strategy building

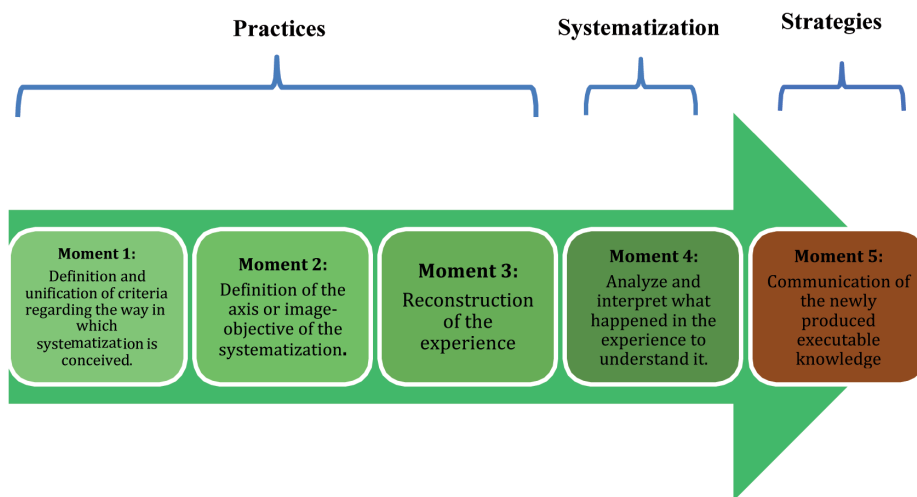


Source: Own elaboration (2022).

The systematization of experiences is a modality of knowledge production born from popular education and incorporated into social practices and community development (Torres, 1998). In this regard, the author states Systematization is understood as a form of collective knowledge on intervention and social action practices, which, based on the recognition and critical interpretation of the meanings and logics that constitute them, seeks to qualify them and contribute to the theorization of the thematic field in which they are inscribed (p. 3).

The process for the production of new knowledge from community practices is developed in five moments, each of which has its own particularities that ultimately allow the design of Asprocig resilience strategies. Figure 2 shows the moments for the generation of new local knowledge.

Figure 2 - Asprocig process for the production of new knowledge



Source: Own elaboration (2022) – adapted from Asprocig (2006).

Moment 1, the participants gather to present their points of view, discuss them and define the agreements that allow the construction of the what, how and for what of the topic in question. In moment 2, what is going to be systematized is specified, i.e., the first ordering of the experience where information is extracted from the experiences in order to place it later in the field of knowledge.

In 3, the process as it was developed is explained in detail, taking into account the diversity of sources of information such as: programming, progress reports and evaluations, records and memories of the participants. The 4th is considered the most complex for understanding what happened, through which the bases for the construction of learning and systematization are acquired. Finally, 5 is the communication and socialization of the new executable knowledge in the community, which are the strategies.

In the development of these five (5) moments, Asprocig has created a methodological approach called “Z” work methodology, which is conceived as a decentralized and pedagogical entity where experience and knowledge are the transverse axes of its actions. It is a teaching-learning strategy that is developed in communities with agroecological work.

Each agroecological community socializes with others, the practices and learning found in the process of knowledge production. The objective is to optimize methods and techniques developed in the experiences, making known the weaknesses and strengths presented in the plots and

yards, through the exchange of learning. These spaces for reflection and construction of new local knowledge are called agroecological spirals (Asprocig, 2006).

To evaluate the performance of the agroecological spirals, a certificate of trust was created (see Figure 3), which recognizes good sustainable and social practices and assesses them through the application of 32 indicators for plots and 28 for yards (Asprocig, 2006). In the research conducted by Ortiz *et al.* (2007) shows some of the results obtained.

For the second half of 2004, 234,419 m² of yard areas were evaluated and a total of 190,144 m² were certified, equivalent to 63.7% of the total number of members registered in the agroecological spirals. In the first years of operation of the Z methodology, in the case of plots, 1'167,180 m² were evaluated and 702,000 m² were certified (p. 85).

Figure 3 - Agroecological rice trust certificate



Source: Asprocig (2016).

In this way, the Z methodology represents a working tool for communities to exchange learning and produce new local knowledge in the agroecological spiral meetings (Figure 4).

Figure 4 - Methodology of work Z based on ancestral knowledge and lived community experience



Source: Own elaboration (2022) – adapted from (Asprociq, 2006).

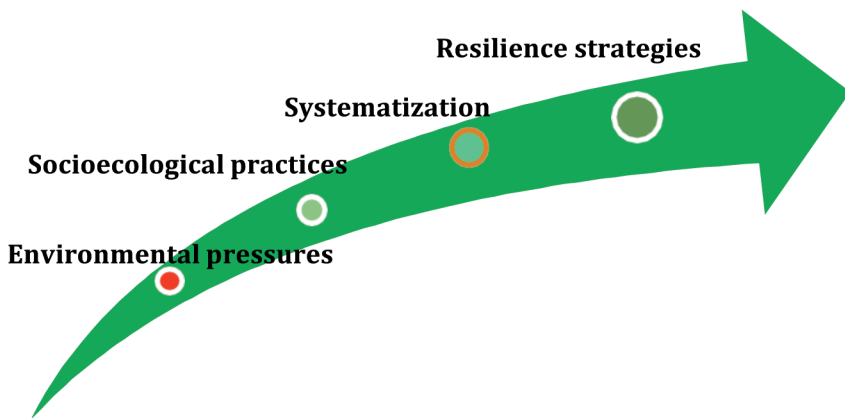
The letter “Z” defines two horizontal categories; ancestral knowledge and community experiences and another transversal one which are traditional and cultural values. All three are the foundations for developing family and collective capacities in the face of adversities that threaten the stability of agroecological communities, hence, the conceptual appropriation of resistance and resilience are the main mission strategies of Asprociq for the management of water and territory.

The first focuses on the defense, rescue and reappropriation of the ancestral knowledge of the Zenú culture, especially in relation to water resource management. The second is oriented to rethink and remake alternative socioeconomic models in order to strengthen the community economy and sustainability.

In this context, the present research defines strategy as the set of actions that aim to strengthen the community economy through the self-management of all its members in order to achieve good management of environmental sustainability. From this point of view, Asprociq resilience tactics are classified into two groups: ecological and socio-cultural. The former are ecosystem and species conservation, while the latter are related to local social knowledge that guarantees quality of life for all associates.

Both are aimed at reducing water conflicts, a process that is achieved with the empowerment and development of particular categories of critical consensus and life expectancy, which allow the construction of a larger category (general), which emerges in this work, as new; *socioecological practices*, and which are the result of a historicity manifested by environmental pressures such as surface water pollution, the drying up of wetland systems, disputes over territorial control, institutional absence, deforestation, erosion and sedimentation. The process of structuring resilient strategies is detailed in Figure 5.

Figure 5 - Structuring of *Asprocig* resilience strategies



Source: Own elaboration (2022).

Figure 5 shows that there is a logical, coherent and dynamic order in the process of organizing resilience strategies. The triggering elements that incite the structuring of collective actions in the communities are environmental pressures, leading to the creation of socioecological practices. These arise from daily life, subjected to *in situ* experimentation (plots or backyards) and which, after systematization, provide the referential framework for organizing resilience tactics.

3.2. *Socio-ecological practices: an emerging category of analysis*

Socioecological practices are a new category of analysis that arises from the application of qualitative research techniques. It arises from merging community resilience and family and collective agroecological systems

of Asprocig communities, to build collective actions in pursuit of the association's mission purposes and to counteract conflicts over water and territory. In this order of ideas, the resilient strategies that emerge from the emerging category configure Asprocig rural development model.

The conceptual characteristics of socioecological practices are built from the communities' interest in life, biodiversity conservation, family cohesion and defense of water and territory. It is a community paradigm that recovers from Zenú ancestral knowledge the social and economic devices to oppose modern capitalist logics that stimulate capital accumulation with severe environmental damage. From this perspective, the emerging category is related to the solution of environmental problems related to water in the lower Sinú.

Within the emerging category are the subcategories of critical consensus, rural water management, soil management in peasant and indigenous communities, agroecological systems management, ancestral knowledge as a social factor of power, family cohesion, fishing in ponds, ecological and organic agriculture training, and life expectancy. All of them prioritize nature and human existence (and not only markets) as the fundamental.

Asprocig socioecological practices try to transmit to other communities to cooperate and communicate that there are different ways of production such as zero tillage practices, which favors the presence of organic matter and humus necessary for the health and fertility of the soil and therefore to maintain crop productivity (ecological) and income generation (economic). This requires the abandonment of conventional agriculture, which is mechanized, monoculture and short term, for other, conservation and good soil management, such as ecological agriculture, which is alternative, polyculture-oriented and highly productive in the medium and long term.

The need to move from conventional practices to alternatives is based on the urgent need to face the current ecological crisis, understanding the current damages as irreversible. The transition schemes should recover and/or strengthen the epistemological contributions developed by biology in the understanding of the natural world such as biodiversity of species, self-organization; from physics with resilience and entropy; and more recently from the science of complexity with dissipative structures, categories that are read and understood in the daily life of communities and are necessary for the escape from the ecological conflicts that affect them.

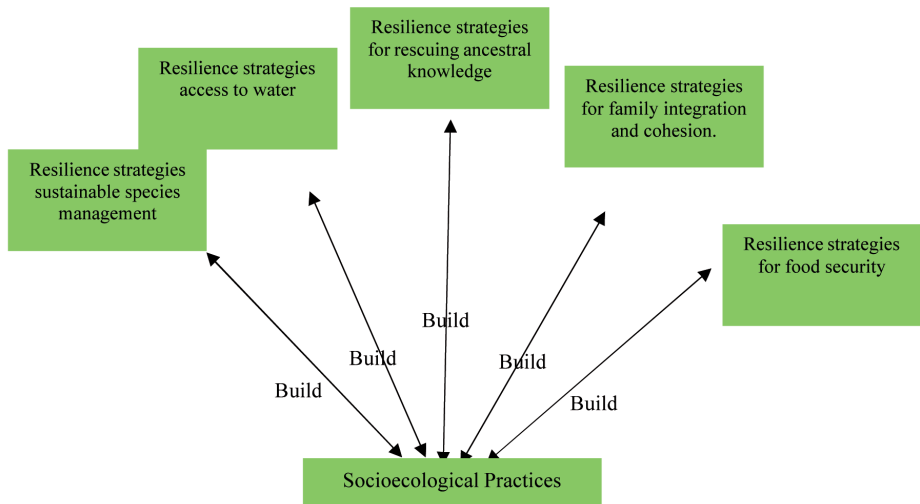
It takes up concepts from agroecology, ecological economics and political ecology to configure, from community practices, a style of production that articulates community work with nature, which leads to guaranteeing the balance of natural functions in order to conserve it in the long term.

The paradigm on which the emerging category of analysis is based recovers the importance of ecology in the economic activities of agricultural

production, considering that the elements of the biosphere, especially water and land, are fundamental to overcome the current ecological crisis with new management approaches.

However, as these contributions of knowledge do not come from the academy or the scientific world, it is necessary to investigate other epistemologies that broaden the radius of understanding in the human-nature relationship, such as those offered by the communities of the lower Sinú. In this sense, the socioecological practices enunciated in this research allow the understanding of Asprocig resilience strategies in the face of socio-environmental conflicts. Figure 6 shows the set of tactics born from the practices after following the described process.

Figure 6 - Social-ecological practices and resilience strategies of Asprocig



Source: Own elaboration (2022).

Each resilience strategy aims at achieving a purpose, which form the essential foundations for the configuration of Asprocig organizational, social and cultural project. In this order of ideas, the proposed category of socioecological practices is understood as the historical-sequential, structured and empirical process that contributes to the construction of new local knowledge (own knowledge) and that, when systematized, allows the configuration of community resilience strategies to face diverse local environmental pressures.

In this sense, the socioecological practices represent the actions that are applied in each family agroecosystem and that are subjected to the Z methodology, to then be socialized in the agroecological training schools or agroecological spirals. From here emerges an own knowledge that allows the configuration of resilience strategies, which is explained below.

3.3. Asprocig Community Resilience Strategies

Based on the data and information obtained from the three associations investigated, it was possible to classify Asprocig's community resilience strategies into five groups, which represent collective actions to defend the territory and confront the appropriation and dispossession of water, generators of water conflicts in the last two decades. Each of them is presented below.

The first is the strategy for the *sustainable management of species*, which has two missionary purposes: to increase the sustainable supply of fish resources and the sustainable production of plant and animal species favored by the organization. Priority is given to increasing the supply of bocachico, cachama and tilapia fish for two reasons; first, to conserve the work inherited from the associates with the fishing activity and second because fish is the main source of protein for these communities.

This strategy led to the construction of ponds for fish farming and the adaptation and implementation of agro-ecological systems in all the associations for the production of poultry, pigs and six (6) types of medicinal plants, fundamental for the configuration of Asprocig community development model

Access to water is the second strategy. Its mission purpose is focused on three aspects; the defense of the resource from contamination and wetland drying processes, increase of water harvests through ponds and adaptation to climate change. The achievements are evident as shown in the three associations investigated, in essence each association has a harvesting system that allows facing adversities in periods of drought and giving continuity to the production of plant species within each agroecological system.

In addition, the construction of embankments or high dams based on Zenú hydraulic technology has allowed them to face the frequent floods in the lower Sinú, which have been recurrent in the last decade. Although water contamination and the drying of wetlands is revealed as an external situation not controlled by the communities, self-management actions have allowed them to maintain a cyclical state of equilibrium in the face of the adversities of climate change.

The third resilience strategy is the *rescue of ancestral knowledge* for the implementation of pre-Hispanic technologies related to the management of water, land, crops and political and social organizational systems. It is a philosophy born from the communities that has the firm intention of reestablishing the link between culture and nature, recovering the practices of the Zenúes settled in the Sinú and San Jorge valleys between the 1200 b.d. and 800 a.d.

The achievements attained are shown in Asprociig member associations, with the implementation of agroecological systems that develop sustainable water and soil management. This strategy is transversal and integrative to all the others and sends signals to the associates about the need to work with criteria of productivity, adaptability, resilience, equity and self-management in each agroecosystem.

The fourth strategy is related to *family integration and consolidation*. Its mission is focused on strengthening community management capacity, integrating the family in the development and implementation of family and collective agroecological systems, as well as encouraging the commercialization of products in their own distribution channels. Its main characteristic is the importance given to women and the other members of the family nucleus in cooperating in all economic, social and political activities of the organization.

The central point is to increase family cohesion as a way of conceiving family teamwork, which was fundamental in the Zenú culture. For Asprociig, this tactic allows redefining the concept of agroecology, arguing that it not only refers to processes that make a sustainable management of agrological activities, but also to the form of participation with which the different members of the family are integrated in the different community activities. This indicates a new *community ethos* with the re-emergence of social empowerment in *praxis*.

Finally, there is the strategy for *food security*, which seeks to improve family and collective agroecological production models that minimize threats to community well-being. It is the most significant of all Asprociig resilience strategies, defined as the capacity to take advantage of the flow of matter and energy from natural ecosystems and reduce waste that generates high entropy through the increased reuse of biomass in the agricultural production cycle.

The lower energy dissipated in agroecological systems with good management and conservation practices is a product of rural skills that lead to new forms of rural development. As the capacity to recover, reuse and preserve ecology increases, the high entropy of the economic subsystem decreases and resilience for equitable food access increases.

The strategy defines as a priority the access to food for members and non-members of Asprociig, to realize a fair trade of agroecological products from

the surplus production, which is carried out in the facilities of Asprocig in the city of Lorica, Colombia and improves the income of families and therefore their quality of life.

It is clear that the experience represented by Asprocig is not isolated; the phenomenon under investigation has been studied considerably in recent times in different parts of the world. The concern of organized peasant communities to fight and defend their territories, confront current socio-environmental conflicts and propose alternatives for sustainable local development has intensified since the 1980s (Wolf, 1973; Toledo, 1992,1996; Zemelman, 2000, 2003 Toledo y Barrera-Bassols, 2009; Wlaler, 2009; Altieri y Nicholls, 2012a; Swyngedouw, 2013; Batterbury, 2015; Sepulveda, 2015; Sepulveda *et al.*, 2020).

The findings coincide with the need to strengthen governance around the relationship between economy and nature (United Nations, 2018), prioritizing efforts to promote sustainable agriculture in order to reduce hunger through food security and improved nutrition (Altieri, 2019). Faced with this global challenge, research has been developed that explores and explains the management and evaluation of agroecosystems with the use of quantitative and qualitative approach methodologies and participatory and cooperative processes, which attempt to measure the agroecological resilience of social-ecological systems through sustainable agricultural practices. The aim is to improve the efficiency of agroecosystems and the well-being of communities (Torre *et al.*, 2023; Puech & Stark, 2023; Davis, Huggins & Reganold, 2023; Rice, Einbinder & Calderón, 2023; Benabderrazik *et al.*, 2022; Little & Sylvester, 2022; Mudombi-Rusinamhodzi & Rusinamhodzi, 2022; Bartl, 2020).

Research efforts towards sustainable agriculture in the context of the community economy should be strengthened by both local and regional governments in order to promote food sovereignty and security, mitigate socio-ecological vulnerability and consolidate the collective commitment towards sustainable rural development.

4. Conclusions

The exploratory research developed in this work allowed us to verify that Asprocig socioecological practices and resilience strategies promote local socio-environmental sustainability and ensure the adequate management of natural resources to guarantee the use of and access to ecosystem services.

Meaningfully, the experiences, practices and knowledge arising from Asprocig can be safely understood as valuable and successful alternatives to development, one seed of a new civilization. Generally speaking, the agroecological school is a clear-cut example of bioeconomics taken as a critique

of political economy (Maldonado, 2022), i.e., a critique of the production function *après la lettre*.

The central element of this model of community economy is the local knowledge that is built from socioecological practices, which are subjected to a verification process with its own methodological scheme and shared in spaces of reflection with training through the agroecological school created by them. The process of configuring new local knowledge begins with the lived experience and appropriation of ancestral knowledge, which is then systematized to analyze and interpret what was found in the experience and in this way, codify collective actions to establish strategies. The conceptual notions of resistance and resilience are Asprociq main mission strategies for water management and territorial defense. Based on these, community resilience strategies are self-managed, which are essential in the sustainable rural development model: sustainable management of species, access to water, rescue of ancestral knowledge, family integration and consolidation, and food security.

One aspect to highlight is the self-management scheme of the board of directors. It is made up of the members of the association, rotating periodically and all of them must direct their administrative and financial efforts towards the consolidation of the mission and the resilience strategies; in such a way that the social (members of the three associations), economic (development of family and collective agroecosystems that develop farming and fish farming activities) and environmental (biodiversity conservation) dimensions, constitute the epistemological referents to contribute to the achievement of Asprociq's mission purposes.

Finally, local and regional governments are urged to manage environmental public policies that respond to the global call contained in the Sustainable Development Goals and promote alternative models of rural development, such as agroecological markets managed by organized rural community associations with small-scale agricultural production systems

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