



Synthesis

What comes after crises? Key elements and insights into feedback amplifying community self-organization

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ABSTRACT. In face of complex socio-environmental issues experienced in different social-ecological systems, we ask if comprehensive lessons could be learned from cases of community self-organization that were successful in solving collective problems at the local level. Considering that the trajectory of each community is unique and self-organization develops in distinctive settings, we sought to identify the common elements shared by six case studies in Brazil and investigate how they interact (i.e., if they generate feedback that amplifies self-organization), synthesizing the lessons drawn from each case so they may be applied to other contexts. In all cases, community self-organization provided good conditions to overcome crisis and led to desirable changes regarding the problem in question. We explored the underlying mechanisms of successful community self-organization from a social-ecological and community resilience standpoint and identified six elements in common: ability and/or willingness to find opportunities in crisis; partnerships with external actors; human and social capital within the community; generation of income opportunities and/or guarantee of rights; existence of spaces that favor social interaction; and agency oriented to collective mobilization and problem solving. Elements were interconnected and often reinforced one another, generating amplifying feedback, which is seen in the repetition and improvement of practices and attitudes over time and space. Agency was a prominent catalyst for self-organization by generating amplifying feedback that positively affected other elements; it was an element of the feedback chain reinforced by the benefits reaped at the individual level. When collective interests prevailed over individual ones, it was less likely to generate feedback that inhibited self-organization. We argued that ordinary relationships related to different cultural practices and livelihoods were important exercises of collective action that provided communities with a repertoire of responses that could be activated in times of crisis, thus enhancing their capacity to self-organize.

Key Words: *agency; Brazil; collective action; communities; community resilience; social-ecological resilience; social-ecological systems*

INTRODUCTION

Imagine the following situations: (1) A flood hits a small town, which like many others in the same region has limited capacity and resources to deal with major disasters. Later it is realized that the history of land use and management in the region was decisive for the flood, because soil degradation caused erosion, silting, and fast runoff; (2) The livelihoods and rights to land and marine areas of a fishing community are threatened by the top-down creation of protected areas (PA); (3) Similarly, the food and economic security of a riverine community is at risk because of decreasing fishing stocks and competition by larger-scale fishing operations. All these situations portray aspects of current complex social-environmental problems. Because of the complexity involved, one might imagine that effective solutions at the local level are difficult to achieve or even impossible. For example, how to coordinate actions and responses to the particularities of each location? How to act under limitations resulting from different types of pressures? And where should change start?

These are real crisis situations experienced in different social-ecological systems (Berkes and Folke 1998) in which the respective communities succeeded, through self-organization, in finding ways to face the problems in question. Knowing how communities invest their efforts to self-organize helps to understand which aspects are important to generate resilience, so that such communities may preserve their culture and livelihoods (Berkes and Ross 2013). The results of self-organization processes depend

on the resources available and the skills of the people involved (Seixas and Davy 2008, Anderson et al. 2019). Therefore, understanding what favors community self-organization is essential to support initiatives that seek solutions in the face of crises, change, and uncertainties from a local to a global level.

Self-organization is a common property of living systems that allows communities to organize themselves and to behave in an intricate manner based on a set of ground rules, thus learning, diversifying, and achieving complexity (Waldrop 1993, Meadows and Wright 2008). Self-organization can produce robust solutions to complex problems because trajectories of complex systems are unpredictable and subject to great effects caused by small changes (Waldrop 1993, Scheffer 2009). It is an emergent property of social-ecological systems, related to a system's ability to structure itself, reorganize, and diversify granting resilience (Folke et al. 2002, Folke 2006, 2016, Moore et al. 2014, Olsson et al. 2014) and adaptive capacity (Chapin et al. 2009). Given that social-ecological systems are complex systems with multiple stable states, these states do not necessarily reflect desirable configurations from an environmental or social viewpoint, and numerous environmental, political, economic, and social factors added to uncertainties cause disturbances to these systems (Walker and Salt 2006, Chapin et al. 2010). It is essential that when in a desirable configuration, social-ecological systems can maintain their structure and function in the face of disturbances, i.e., that they are resilient.

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Developed from a resilience standpoint (more specifically, social-ecological resilience, e.g., Folke 2006, and community resilience, e.g., Berkes and Ross 2013), this work aims to identify and analyze common elements present in community self-organization processes that were successful in solving collective problems, as well as exploring how they interact, i.e., we investigate whether these elements generate feedback and what effects they have on self-organization. We are ultimately interested in understanding what makes some communities resilient, and for that, we explore the elements and mechanisms that contribute to the capacity of these communities to self-organize. Therefore, we pose the following questions: What are the elements of successful community self-organization? How do they contribute to the process? What feedback is generated, and which ones enhance self-organization?

Bearing in mind that the trajectory of each community is unique, and that self-organization develops in distinctive settings, we sought to synthesize the lessons of six case studies in Brazil so they may apply to other contexts. We expect that such lessons can guide actions or create conditions for self-organization to flourish (and ultimately, for resilience to build up) in other situations at the local level and beyond. We refer to communities as groups of people who share a set of beliefs and/or sense of place, who interact directly and frequently, and who are likely to continue interacting in the future (Singleton and Taylor 1992, Seixas and Davy 2008, Cross et al. 2011).

Community resilience “is often understood as the capacity of its social system to come together to work toward a communal objective” (Berkes and Ross 2013:6). Magis (2010) highlighted the capacity of a community to thrive in the face of unpredictability and change because of community resources that existed and that are elaborated and brought together by community members. The concept of community resilience is derived from two research fields: (1) mental health and developmental psychology and (2) social-ecological systems and resilience (Berkes and Ross 2013). Many contributions to the literature of community resilience relate to recovering from disasters (Norris et al. 2008, Wilson 2014, Almutairi et al. 2020) and more recently to climate change (Fazey et al. 2018, Ntontis et al. 2020, Birchall et al. 2022, Carmen et al. 2022). Such literature was initially developed to focus on social aspects of the resilience of individuals (Maclean et al. 2016) or individual organizations (Koliou et al. 2018). Over time, focus shifted to the long-term impact on communities after events (Koliou et al. 2018); from the 2010s, studies began to target social groups and to dialogue with the social-ecological and resilience framework (Maclean et al. 2016).

The psychology-mental health framework emphasizes the community level and highlights how community strengths (e.g., community networks, infrastructure, and diversified economic sources) contribute to social resilience, i.e., the individual or community capacity to cope with change (Maclean et al. 2016). The social-ecological resilience approach is based on a complex adaptive systems perspective and focuses on processes unfolding at regional and larger levels and multiple scales (Walker et al. 2004, 2006, Berkes and Ross 2013). Additionally, it focuses on systems’ properties (e.g., feedback) that shape collaborative governance and management (Maclean et al. 2016, Moraes et al. 2021). Our study is situated at the confluence of these approaches

and is supported by the idea of community resilience as a process rather than an outcome (Maclean et al. 2016); an emergent property of human-environment relationships (Walker and Salt 2012, Faulkner et al. 2018), which is critical because communities are constantly coping with pressures and changes that affect the characteristics and dynamics of communities themselves (Faulkner et al. 2018).

From a social-ecological perspective, feedback defines the internal dynamics of the system and is responsible for keeping it in a given stable state or operating regime (Chapin et al. 2009). Amplifying feedback can lead the system to desirable growth and change or to a completely opposite path of unrestrained destruction, depending on the actions or patterns that are amplified. Such feedback occurs when a stimulus produces an effect that reinforces or enhances the initial stimulus, amplifying its own effects and the changes it generates (Walker and Salt 2006, Hull et al. 2015). Stabilizing feedback, in turn, opposes any change imposed on the system, locking it in a given state (Walker and Salt 2006, Meadows and Wright 2008), which is not necessarily bad or good. Applying these same concepts to community self-organization processes, amplifying feedback can lead to positive results in relation to the problem faced (virtuous or successful self-organization) if they reinforce actions or factors that somehow contribute to self-organization. Conversely, they can lead to negative results (faulty or unsuccessful self-organization) if they reinforce practices that dampen or prevent self-organization to flourish.

METHODS AND CASE STUDIES

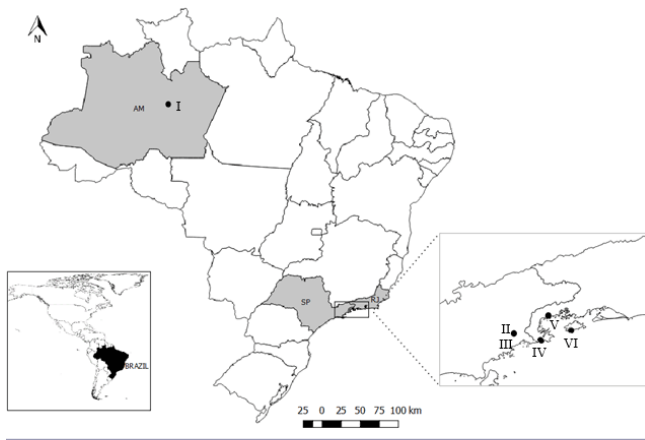
This work was part of a collaborative synthesis project (SinteSIS, https://media.fapesp.br/bv/uploads/pdfs/Brazilian_biodiversity...future_ljSOAGn_17_18.pdf) that aimed to synthesize the findings from research undertaken by our group regarding institutional arrangements to integrate natural resources conservation and development at the local level. Phases of individual and collective work alternated throughout the development of this work.

Step 1 aimed to select cases from community self-organization that solved collective problems in Brazil. The six cases selected were based on previous research developed by the authors between 2010 and 2018: one in the Amazon and five in southeast Brazil, two inland and three on the coast (Fig. 1). All cases were researched under the social-ecological systems lens (Berkes and Folke 1998), using multiple methods (Appendix 1). None had been originally researched under a community self-organization approach, however, authors identified elements of self-organization worthy of a deeper analysis. Case studies selected are identified as follows:

- Case I - Capivara fishing accord (based on Ummus 2017) refers to the process of 120 small-scale fishers in the Amazon to self-regulate fisheries in 2015.
- Case II - Reconstruction of São Luiz do Paraitinga (based on Farinaci 2012) depicts the afterwards of a major flood in 2010 displacing half of the city inhabitants.
- Case III - REDESUAPA stakeholder network (based on Moraes 2019) describes the effort made by a group of professionals to prevent disasters such as the 2010 flood in São Luiz do Paraitinga.

- Case IV - Reaction to protected areas in Trindade (based on Araujo 2014) refers to the community claim for customary rights to their territory and resource access.
- Case V - Artisanal fishing monitoring program in Tarituba (based on Dias 2015) illustrates a process of building and implementing an agreement to allow fishing in a no-take protected area.
- Case VI - Reorganization of community-based tourism at Aventureiro (based on Prado 2013) refers to efforts to navigate and overcome an eight-month ban on tourism in the community in 2006.

Fig. 1. Communities with successful self-organization to solve specific socio-environmental issues and their location in Brazil: I - Capivara Sector, Middle Solimões River, Amazonas; II - São Luiz do Paraitinga, São Paulo; III - REDESUAPA, Upper Paraíba do Sul River, São Paulo; IV - Trindade, Paraty, Rio de Janeiro; V - Tarituba, Paraty, Rio de Janeiro; VI - Aventureiro, Ilha Grande, Rio de Janeiro.



Step 2 aimed to describe and frame the cases according to the theoretical approach guiding this work. This step comprised a sequence of three stages (1, 2 and 3), which eventually provided us with a standardized description of the cases as well as a standardized framing of the self-organization process. (1) We developed an open-ended survey template to facilitate the compilation of data (Appendix 2). Core themes in the template included elements that contributed to self-organization, conceptual frameworks, methods used for data collection, and timelines for the study. We identified both descriptive (i.e., duration and type of disturbance; observation period; relevant historical/cultural and environmental characteristics; socioeconomic data; formal and informal institutional arrangements; and network of actors) and analytical variables (i.e., event/disturbance and strengths and characteristics that contributed to self-organization). The latter were based on the attributes highlighted by Berkes and Ross (2013) as important for community resilience and worked as a starting point for us to identify elements contributing to self-organization in the cases analyzed. Each author completed the template based on their original data set. (2) To foster consistency in our results and to enable an exchange

of ideas across the authors, we conducted a workshop to revise, discuss, and validate the selected variables and the data added to each variable on the template. At the end of the workshop the team developed a common understanding of the data from all case studies. (3) In a second workshop, we used the information from the template to write down the cases using the self-organization framework proposed by Heylighen (2013) that defines a system's self-organization as "characterized by global, coordinated activity arising spontaneously from local interactions between the system's components or 'agents'" (Heylighen 2013:121). Such coordination happens when the agents work together toward common goals. Coordination means structuring activity in time and space, with minimal friction and maximum synergy among the system's components and can be subdivided into four elementary processes: alignment (everyone working toward a common goal), division of labor, workflow (besides knowing what to do, each person must know when to act), and aggregation (the outcome of self-organization; Heylighen 2013). This framework provided "methodological support" to this work by enabling us to format our data into a comparable self-organization frame (Table 1) and to standardize the narratives concerning how self-organization unfolded in each case (Appendix 3).

Step 3 involved qualitative data analysis seeking common elements contributing to self-organization among cases, which were developed during another workshop. Analysis followed codification and triangulation of information from the standardized cases. We identified elements present in at least four out of the six cases for further analysis.

Finally, step 4 aimed at the identification of feedback operating in the cases, in a last workshop. First, each author elaborated a narrated description of how each element contributed to self-organization in their respective case study based on field observations, interviews, and other sources of data from their research. Descriptions were shared among authors. Key insights emerging from this description were collectively synthesized, grouping insights from all six cases per element of successful community self-organization. We searched for patterns regarding the dynamics of each element, which, in turn, enabled us to identify amplifying feedback based on a common understanding from authors. Then, each author provided written examples of the feedback loops that related to each of the self-organization elements in their case for collective validation.

MAIN FINDINGS

We identified six elements of successful community self-organization: (1) ability and/or willingness to find opportunity in crisis; (2) partnerships with external actors; (3) human capital and social capital in the community; (4) generation of income opportunities and/or guarantee of rights; (5) existence of spaces that favor social interaction; and (6) agency oriented to collective mobilization and problem solving. Except for elements (1) and (5), the others were present in all cases (Table 2).

We considered that human capital refers to skills, knowledge, work capacity, and good health (characteristics related to the individual capacities of community members), whereas social capital relates to the idea of social organization, which encompasses common rules and social relationships as an essential part of sustainable livelihoods (Ashley and Carney

Table 1. Key words and expressions from each case of successful community self-organization in Brazil related to the basic mechanisms of coordinated self-organization proposed by Heylighen (2013).

Cases	Alignment	Division of labor	Workflow	Aggregation
I- Capivara fishing accord	Common goal: to establish the accord in response to declining fish stocks, conflicts with large-scale fishing operations.	Lake surveillance and monitoring by fishers.	Cycles of lake surveillance and monitoring followed by fish harvesting.	Increase of fish stocks and income; greater control of lakes by the community.
II- Reconstruction of São Luiz do Paraitinga, SP	Common goal: to rescue all citizens (special attention to elders and disabled), provide basic conditions (food, shelter), restore infrastructure.	Mobilization of civil society, public and private sectors in activities such as cleaning the town and ensuring the provision of utilities.	Decision-making regarding emergency situations as well as initiatives to rebuild the town.	Reconstruction of destroyed historical buildings (including the main church), resuming normal life.
III- REDESUAPA stakeholder network	Common goal (2010): to avoid future natural disasters such as the 2010 flood. Common goal (2015): to re-align values and common goals.	2010: development of projects focusing on conservation strategies (soil, water) in the rural area. 2015: development of one workshop with an external facilitator.	2010: seeking funding, contact with smallholders, implementation of actions. 2015: meetings, discussions and reflections; new members joined the group.	2010: income generation for smallholders; implementation of alternative production systems. 2015: creation of REDESUAPA network.
IV- Reaction to protected areas in Trindade, RJ	Common goal: to mitigate/solve conflicts between the community and the protected area.	Members of two local associations planned several initiatives.	Implementation of the initiatives (e.g., representation in PA steering committees; negotiation with PA; hiring of qualified advisory services; strengthening of partnerships in local/regional networks).	Building of a headquarters for local associations; building of the School of the Sea.
V- Artisanal fishing monitoring program in Tarituba, RJ	Common goal: to mitigate conflicts between fishers and the marine protected area by establishing an agreement to allow artisanal fishing under specific conditions.	Different stakeholders involved contributed to the construction of a monitoring program from their individual viewpoints.	Decision-making by the protected area steering committee regarding the monitoring program set the pace of the actions involved in its construction.	Establishment of a directive with defined goals and indicators.
VI- Reorganization of community-based tourism at Aventureiro, RJ	Common goal: to reestablish local tourism (campgrounds) and other activities related to local livelihoods.	Local leaderships and residents and external partners looking for alternative livelihoods.	Rounds of legal negotiations involving stakeholders.	Admission and regulation of local tourism by a formal agreement.

1999). Relationships of trust, reciprocity, exchange, connectivity, collective action, and social networks were constituent aspects of social capital comprising a set of resources that helped individuals and groups achieve their individual or collective purposes. Social capital does not exist in a political and institutional vacuum but is influenced by power relations between individuals, groups, or institutions (Pretty and Ward 2001, Adger 2003). In the cases studied, human and social capital are connected, therefore, we kept them under the same element, although they are distinct concepts. We used the definition from Berkes and Ross (2013:15) of agency: “the capacity of an individual to act independently and to make one’s own free choices.” This concept highlights the active role of individuals debunking the view of victims of disasters or environmental threats (Brown and Westaway 2011) and can also be extended to collective action (McLaughlin and Dietz 2008).

In many of the cases studied, we observed that the elements generated amplifying feedback loops, that is, their effects increasingly fed back into essential social phenomena for community self-organization. Such positive feedback was seen in the repetition and improvement of practices and attitudes that strengthened over time, expand in space, and produce elements that further strengthened self-organization, such as autonomy, identity, and knowledge. We discuss how each element contributed to self-organization and present a compilation of the amplifying feedback generated (Table 3).

Ability and/or willingness to find opportunity in crisis

All cases involved at least one crisis that triggered self-organization. Except for the Capivara fishing accord, the existence of community members with ability or willingness to find opportunity in crisis was a striking aspect in the mobilization for collective solutions to face the difficulty. In the reaction to protected areas in Trindade, pressure from the PA mobilized the local community associations to join efforts and negotiate their demands. The same happened in the reorganization of community-based tourism at Aventureiro in which the community sought help and organized itself internally after the crisis triggered a ban on tourism. In the artisanal fishing monitoring program in Tarituba, a ban on artisanal fishing triggered collective action aimed to resolve or mitigate its effects.

In some cases, it became clear that the attitude of some individuals was contagious, positively impacting other people involved, thus reinforcing/amplifying self-organization. In the reconstruction of São Luiz do Paraitinga, many viewed the crisis caused by the flood as a source of new opportunities for both individuals and the community. This “keep the ball rolling” attitude prompted community members to take advantage of opportunities that emerged as the town was rebuilt. An example is the investment in infrastructure that was made after technical and financial assistance was provided, which normally would not have been possible with the town’s tight budget. Every small victory in terms of rebuilding the town kept up the spirits, prevented citizens from giving in to hopelessness, and reinforced self-organization. Regarding REDESUAPA stakeholder network, the various

Table 2. Elements present in the case studies of successful community self-organization in Brazil.

Elements	Case studies					
	Capivara fishing accord	Reconstruction of São Luiz do Paraitinga	REDESUAPA stakeholder network	Reaction to protected areas in Trindade	Artisanal fishing monitoring program in Tarituba	Reorganization of community-based tourism at Aventureiro
Ability and/or willingness to find opportunity in crisis		x	x	x	x	x
Partnerships with external actors	x	x	x	x	x	x
Human capital and social capital in the community	x	x	x	x	x	x
Generation of income opportunities and/or guarantee of rights	x	x	x	x	x	x
Existence of spaces that favor social interaction	x	x	x	x	x	No data available
Agency oriented to collective mobilization and problem solving	x	x	x	x	x	x

difficulties experienced (e.g., discord among members, financial restrictions, and a severe drought in 2013/2014 affecting pilot projects) were faced by jointly seeking strategies for concrete action. This amplified self-organization because it strengthened the bond among members and, consequently, enabled the continuity of the work.

Partnerships with external actors

All cases included partnerships with external actors, which contributed to the achievement of the desired goals and/or provided greater alignment in the community, which, in turn, fed back and amplified self-organization. In the reorganization of community-based tourism at Aventureiro, the support of NGOs, researchers, and tourists was key to ensuring legal advice, compiling scientific research findings, producing documents and opinions, and providing media coverage of the ban on community tourism. In the artisanal fishing monitoring program in Tarituba, mediation by a university research group made it possible to reconcile different interests of stakeholders involved in drawing up the artisanal fishing monitoring program. This process enabled the inclusion in the program of ecological indicators for environmental conservation as well as indicators of the socioeconomic relevance of fishing for the community. In the Capivara fishing accord, external informal partners of the community (professionals, friends, and supporters) contributed key skills to the process at essential stages, such as providing technical and scientific validation of “pirarucu” and monitoring and fostering previously inexistent interaction among local actors.

Since its very inception, REDESUAPA stakeholder network has been a partnership between local community members and external individuals working at different institutional levels, favoring alignment between local demands and the projects implemented by the group. In the reconstruction of São Luiz do Paraitinga, partnerships with universities and research centers provided diagnoses of geotechnical risk, urban planning projects, and legal assistance among other services. These resources, in turn, were efficiently used by the local community, thus contributing to speed up reconstruction. In the reaction to protected areas in Trindade, the permanent partnership with the Indigenous and traditional communities’ forum enabled the social mapping of the community, a tool that empowered it in negotiations on the use and access to its lands inside the PA. Also

in Trindade, partnership with a research group provided training courses on security, tourism, environmental legislation, and management of protected areas, a demand from both the community and the PA management.

Human capital and social capital in the community

Human and especially social capital were important elements for self-organization. It seems that such capacities were latent in the community and activated at appropriate times, for instance, by organizing a festivity or reacting to a major flood. Concomitantly, the outcomes of self-organization contributed to enhance these capitals in an amplifying feedback loop.

In the reaction to protected areas in Trindade, both capitals were particularly important to nurture self-organization. Most of the current community association leaders were around 30 to 40 years old with secondary-level education (at least), having connections with other groups and social movements that also struggled to guarantee their land rights. This has allowed the associations to strengthen their representation in PA committees in the region, make progress in negotiations on tourism activities in a PA’s marine area, and develop independent initiatives for cultural and territorial affirmation. Such initiatives, in turn, worked as opportunities to enhance the community’s human capital (e.g., increasing members’ personal experience and skills) and social capital (e.g., strengthening connections with other groups), feeding back to self-organization. Similarly, REDESUAPA stakeholder network had high human capital, i.e., members with technical and local knowledge, as well as a willingness to undertake change and high social capital. Both local leaders and external members participated in other personal and/or professional networks, which enabled the group to successfully cope with the crises experienced, which amplified self-organization because it strengthened the group itself and its subsequent actions.

A striking example in reconstruction of São Luiz do Paraitinga was the work of more than 40 people trained in rafting techniques (thanks to local ecotourism enterprises), who rescued hundreds of people stranded in houses and buildings during the flood (Correa 2010). This includes individual (human capital) and collective (social capital) skills because rafting requires cooperation. Another example is the residents’ great experience in organizing religious festivities, which enhances social capital

Table 3. Elements and examples of feedback amplifying community self-organization in the analyzed cases.

Elements that contribute to self-organization	Cases presenting feedback amplifying self-organization	Examples of amplifying feedback related to each element contributing to self-organization
Ability to find opportunity in crisis	Except “Capivara fishing accord”	Reconstruction of São Luiz do Paraitinga: investment in infrastructure undamaged by the flood made possible by technical and financial assistance received because of the disaster. REDESUAPA stakeholder network: the 2013/2014 drought destroyed several areas of pilot projects (crisis); the group then intensified its technical assistance to smallholders to avoid greater loss and abandonment. Capivara fishing accord: informal partnerships enabled validation of pirarucu monitoring, strengthening the fishing accord.
Partnerships with external actors	All	Reaction to protected areas in Trindade: partnership with the Indigenous and traditional communities’ forum enabled social mapping. Artisanal fishing monitoring program in Tarituba: inclusion of indicators of the socioeconomic relevance of fishing for the local population favored the autonomy of fishers and strengthened self-organization.
Human and social capital in the community	All	Reconstruction of São Luiz do Paraitinga: individuals trained in rafting techniques (human capital) provided organization and collective action (social capital) for rescuing people stranded by the flood. Reaction to protected areas in Trindade: constant development of initiatives by the associations to affirm culture and land rights enriched human and social capital. Reorganization of community-based tourism at Aventureiro: social capital favored the search for alternative livelihoods to tourism, which also favored the development of human capital.
Generation of income opportunities and/or guarantee of rights	All	Capivara fishing accord: income obtained from managed fishing was invested in new monitoring cycles of the fishing accord. REDESUAPA stakeholder network: income generated for smallholders strengthened and amplified the network’s performance. Reaction to protected areas in Trindade: economic security provided by tourism activities is vital for activities related to community causes. Artisanal fishing monitoring program in Tarituba: income generated by artisanal fishing and the struggle for fishing rights stimulated fishers’ interest in contributing to the collective development of the monitoring program.
Spaces conducive to social interaction	“Reconstruction of São Luiz do Paraitinga” and “Capivara fishing accord”	Reconstruction of São Luiz do Paraitinga: main town square, boulevard, and center for sustainable reconstruction brought together actors interested in reconstruction, enabling information flow and favoring collective decision-making. Capivara fishing accord: self-organization led fishers to build a multi-purpose floating shed for meetings and lodging, which favored interaction and reinforced self-organization.
Agency oriented to collective problem solving	All	Capivara fishing accord: leadership engagement provided personal “benefits” and helped support the fishing accord. REDESUAPA stakeholder network: key individuals identified moments of crisis and mobilized the group to take appropriate action. Reaction to protected areas in Trindade and Artisanal fishing monitoring program in Tarituba: coordination of various activities that strengthened sense of community and helped face issues arising from the implementation of no-take protected areas. Artisanal fishing monitoring program in Tarituba: leadership engagement favored the building of bonds of trust with external partners and mobilized the participation of other fishers in the development of the monitoring program.

by requiring everyone to interact and cooperate with the skills they already have and to learn and improve new ones. In the artisanal fishing monitoring program in Tarituba, social capital facilitated the mobilization of fishers and encouraged them to take part in workshops to develop the monitoring program. Many of the fishers participated because they were invited by local leaders. Human capital was also important in building monitoring goals and reaching a collective understanding that such monitoring had to investigate the ecological impacts of fishing as well as demonstrate how fishing was relevant to the community. In the Capivara fishing accord, skills related to forming associations, dialoguing with external actors, and organizing meetings developed over a few decades of social movement and partnership with social organizations were decisive for the performance of leaders and mobilizing the community to design the fishing accord.

In the reorganization of community-based tourism at Aventureiro, social capital favored mobilization and division of tasks related to legal issues and the search for an agreement with

the environmental agency responsible for the PA in addition to finding livelihoods to compensate for the loss of income from tourism. The reaction to the ban on tourism favored the development of human capital; e.g., some of the young leaders developed various skills in community-based organization issues, which turned out to be important for self-organization (feedback).

Generation of income opportunities and/or guarantee of rights
 In all cases, we observed that the self-organization process would generate income opportunities for those involved, or that the process itself would lead to the guarantee of rights. Such achievements provided material support for self-organization to develop and boosted the actual process and generated amplifying feedback in some of the cases. The management of fishing resources in the Capivara fishing accord generated income that was invested in upholding the agreement in new monitoring cycles (amplifying feedback) that allowed for an increase in fish stocks and greater control of the lakes by the community after a few years. The flow of people involved in the reconstruction of São

Luiz do Paraitinga fed back into the reconstruction process itself because it stimulated the reopening of businesses to provide food, lodging, and building supplies, etc. This generated economic incentive for more people to recover their lost assets and invest in new ventures. In the reaction to protected areas in Trindade, thanks to the economic security provided by tourism, local associations gained autonomy to continue investing in social participation and community mobilization, thus strengthening and reinforcing self-organization. According to community leaders, this is a strategy to counter the pressures faced by the community. REDESUAPA stakeholder network fostered income opportunities for smallholders, which ended up benefiting the network itself because they became partners reporting their good results to other producers, helping local projects scale up, and creating conditions for their continuity (amplifying feedback).

The guaranteed rights of communities to their land, ways of life, natural resources, and cultural heritage clearly strengthened local self-organization in four cases. In the reorganization of community-based tourism at Aventureiro, besides the right to remain on the land and develop tourism activities, it led to further demands such as provision of school transport and regular garbage collection by the local administration. In the artisanal fishing monitoring program in Tarituba, the development of the program was important to ensure the right to traditional fishing areas including the guarantee of income generation through the sale of fish. In the Capivara fishing accord, guarantee of control over the land and other resources (fishing and hunting) promoted greater engagement in the actual fishing accord. In the reconstruction of São Luiz do Paraitinga, the guarantee of social participation in decisions on the undertaking of important restoration work encouraged the involvement of the population and ensured alignment with cultural identity values with positive repercussion also in the REDESUAPA stakeholder network.

Existence of spaces that favor social interaction

In five of the six cases analyzed, the existence of suitable spaces for social interaction provided greater social participation, which contributed to self-organization, and in two of the cases, we identified amplifying feedback.

In the reconstruction of São Luiz do Paraitinga, these interaction spaces were (1) the main town square and the boulevard where the inhabitants usually gathered to chat and (2) the Center for Sustainable Reconstruction of São Luiz do Paraitinga (CERESTA), a venue created to bring together people interested in planning reconstruction after the flood. CERESTA originally housed the group that would later become the REDESUAPA stakeholder network. When this space ceased to exist, the members of REDESUAPA were able to find other suitable spaces to continue their activities. In the artisanal fishing monitoring program in Tarituba, the school housed the entire process of preparing the monitoring program because it was an easily accessible place where community members felt comfortable, which favored greater participation of fishers. In the reaction to protected areas in Trindade, the community used three spaces to gather and address collective issues: (1) the public school, (2) the beach where fishers and boaters dock their boats and fishing nets, and (3) the headquarters for the local association. Their existence contributed to community self-organization by providing better structure for the community to plan and discuss their actions. In

the Capivara fishing accord, the space in question resulted from the self-organization process; the fishers built a multi-purpose floating shed for meetings and lodging, which consequently favored the group's interaction and fed back into their self-organization by reinforcing it.

Agency oriented to collective mobilization and problem solving

In all cases, the agency of certain individuals was placed at the service of community interests to mobilize people and collectively solve problems, thus amplifying the capacity for self-organization directly or through feedback. This was observed with respect to some of the leaders of the residents' association in the reorganization of tourism at Aventureiro, who conducted the legal negotiations for the authorization of tourism activities. In the Capivara fishing accord, some individuals played a vital role in collective problem solving, motivating and offering a vision of the future, mobilizing and organizing, and dialoguing with external actors, which resulted in the fishing accord. In the reconstruction of São Luiz do Paraitinga, people did not wait for someone to tell them what to do to face the crisis; they simply identified the needs and started to act with several individuals playing key roles in coordinating the initiatives.

At the REDESUAPA stakeholder network, key individuals identified moments of crisis and mobilized the group for appropriate action. When poor alignment within the group was identified, the issue was discussed openly and led to a collective decision to seek guidance from an external facilitator. This resulted in the definition of the group's goals, vision, and values, and gave the network an identity, which in turn reinforced its plans and actions. In the artisanal fishing monitoring program in Tarituba, the participation of community leaders in the workshops legitimized the process and encouraged the engagement of other community members, i.e., feeding back to self-organization and amplifying it. In the reaction to protected areas in Trindade, local leaders were aware of their role in continuously mobilizing the community (for example, through traditional festivities) because this strengthened the community, generated social capital, and helped deal with common problems, i.e., feeding back and reinforcing self-organization.

One of the expressions of such agency is the role of these individuals in, for example, coordinating partnerships, mobilizing resources, and generating benefits for the community or themselves. In this sense, the agency is an element of the feedback chain that is reinforced by the benefits reaped at the individual level. This aspect can generate stabilizing feedback of self-organization, as discussed below.

DISCUSSION

Our framing of self-organization combining community resilience, social-ecological resilience, and system dynamics distinguishes this work. There are a few publications under a social-ecological perspective that combine community self-organization and resilience (e.g., Saxena 2020, Gabriel-Campos et al. 2021, Almudi and Sinclair 2022), however, community resilience and operating feedback loops are not addressed. Likewise, although previous work investigated the resources, capitals, strengths, and capacities of communities regarding their resilience and ability to self-organize (e.g., Magis 2010, Berkes and Ross 2013, Atkinson et al. 2017, Faulkner et al. 2018, Saxena

2020, Almudi and Sinclair 2022), our work takes a further step. Besides analyzing and synthesizing what enables communities to overcome crises through self-organization, we unpacked the dynamics of such processes and were able to identify feedback mechanisms that strengthened self-organization. Our results show that the elements identified in successful cases of community self-organization were interconnected, that is, they affected and often reinforced one another, consequently amplifying self-organization. It is not feasible to establish linear cause-and-effect relationships because these are complex systems, and it is difficult to determine what is more important or what comes first. Therefore, the individual presence of these elements was probably not a determinant factor for the success of self-organized initiatives. Perhaps more important were the properties that emerged from the group of elements, how the elements interacted among themselves, and how they were activated by community members (Seixas and Davy 2008, Berkes and Ross 2013, Anderson et al. 2019). The six elements identified in our work dialogue with (and therefore confirm) different strengths and characteristics that assisted with the development of community resilience (Berkes and Ross 2013). Some differences exist, though, especially with respect to how agency connected with other elements of self-organization.

The literature on social-ecological resilience has many examples of system crises that make room for innovation or reorganization (Seixas and Berkes 2003, Marschke and Berkes 2006, Prado et al. 2015, Faulkner et al. 2018, Leite et al. 2019, Araujo et al. 2020). In the cases studied, crises served as triggers for self-organization. The willingness or ability to find opportunities in crises is precisely what validates them as favorable times for reorganization (cases III, IV, VI), renewal (case II), or innovation (cases I and V). In our view, such ability can be individual or collective and dialogues with a positive outlook, a trait related to community resilience (Berkes and Ross 2013, Maclean et al. 2016). However, some community members must grasp this beforehand, otherwise the system may reorganize itself by repeating the logic that generated the crisis, through memory or path dependence (Nykqvist and von Heland 2014, Choudhury et al. 2021), or even through rigidity and poverty traps, among others (Cumming 2018, Haider et al. 2018).

We also observed that self-organization in response to a crisis may follow a pulse-like behavior over time; when the crisis is no longer a concrete threat, or when the window of opportunity closes, there may be a tendency to demobilize. In other words, when the pressure eases, the tendency is to relax. Nevertheless, previous experiences of crises are important to confer community resilience (Faulkner et al. 2018). In this sense, our results suggest it is essential to keep latent in the community the set of factors that favor self-organization, such as available resources to meet new demands to solve problems or disturbances that are less intense in the short term. A promising mechanism that feeds back into self-organizing capacity is the ongoing exercise of community activities that enhance community resilience (Berkes and Ross 2013), for instance, through the preservation of traditional celebrations, which are based on collaboration, i.e., organized, financed, and executed with widespread community participation (Derrett 2009, Santos 2016, Araujo et al. 2020, Saxena et al. 2020). This has proved especially effective in the reconstruction of São Luiz do Paraitinga and in the reaction to protected areas in Trindade.

Long-term and continuous resilience building benefit from interconnections between slow-changing elements, such as human and social capital, and related collective values and social norms (Carmen et al. 2022). Carmen et al. (2022) argued that the role of social capital in community resilience is less discussed than its subjective socio-cultural dimensions such as sense of place and social norms. These dimensions are connected to community networks influencing the emergence of resilience and making them relevant to strengthen social capital. Social capital can be fostered by the practice of cultural activities that preserve group identity and collective memories of collaborative practices (cases II, IV, V, and VI), or built through the continued practice of social organization in the struggle to affirm rights (cases I and IV). The traditional celebrations and livelihood activities (e.g., fisheries and tourism) have played relevant roles as permanent exercises of interconnecting skills, knowledge, and abilities as well as perpetuating subjective aspects of belonging and community rules, such as sharing fish.

Social capital has a synergistic character that contributes to minimizing potential friction among individuals. In this sense, when social capital is established prior to the crisis, it enhances self-organizing responses, i.e., it predisposes the community to collective action and creates conditions for self-organization to flourish. Seixas and Davy (2008) stressed the importance of social capital in self-organized community conservation and development initiatives. Aldrich (2012), in his research on the recovery of different neighborhoods in Tokyo after the 1923 earthquake, highlighted the greater importance of social capital compared to other factors such as disaster intensity, population density, human capital, and economic capital.

Partnerships with external actors and the performance of bridging organizations can increase both social and human capital (Prado 2020, Saxena 2020) expanding self-organization through training and courses (cases III and IV) and cultural mobilization (cases II and IV). This element relates to social networks from Berkes and Ross (2013). Bridging organizations play important roles, especially by encouraging initiatives that favor cooperation and confidence building, knowledge sharing, learning situations, identification of common interests, and flexibility in interactions and conflict mediation (Hahn et al. 2006, Kowalski and Jenkins 2015, Berdej and Armitage 2016, Saxena 2020). Networks that benefit from the action of bridging organizations can access resources or human and social capital that do not exist in the community (Seixas and Davy 2008, Chapin et al. 2016). In our cases, the external partners played different roles, preventing the self-organized process from being interrupted or becoming sluggish. In the specific case of the reconstruction of São Luiz do Paraitinga, the external agents found excellent human and social capital in the community, which used the resources at hand efficiently and autonomously in institutional designs that tended more to partnership and cooperation than assistance or charity. Like partnerships with external actors, economic incentives are essential for self-organization (Seixas and Davy 2008, Berkes and Ross 2013, Anderson et al. 2019) and may frequently lead to enduring behavioral change (Muradian 2013). In our study, we linked the generation of income opportunities and the guarantee of rights because both relate to the ability to preserve a community's way of life and cultural reproduction. In addition, both provide material conditions for the process to keep "the wheel of self-

organization spinning,” i.e., they build momentum by generating amplifying feedback of self-organization. Indeed, in all cases, the self-organization processes were triggered by crises that directly impacted the livelihoods of communities.

Many of the elements that emerged from our cases are crucial for community self-organizing processes in other contexts of the global south, especially the role of external partnerships when the state is often absent or there are no established public policies to deal with common crises in natural resource governance (Prado et al. 2022). Partnerships that go beyond an occasional philanthropic support but are ongoing and have the potential to change the status quo have been important in other cases as well (Angeles and Gurstein 2000, Bockstael 2017, Anderson et al. 2019, Prado 2020). Such partnerships can also generate knowledge and security to face future situations; in the case of the artisanal fishing monitoring program in Tarituba, we hypothesized that access to information generated from the monitoring activities may favor fishers’ autonomy and emancipation, thus strengthening the group’s self-organization in the future.

The existence of spaces that favor social interaction may relate to what Berkes and Ross (2013) pointed out as community infrastructure. They emphasize the nonmaterial importance of such spaces, which serve as sites for free conversation, thus increasing participation and building momentum for self-organization. Such spaces allow information to circulate among a greater number of stakeholders compared to one-on-one interaction, which contributes to collective decision-making (Zank et al. 2019, Saxena 2020). Similarly, in self-organized initiatives of community conservation and development, information flow was also favored through workshops and meetings among stakeholders, which made it possible to plan and implement projects (Seixas and Davy 2008). We stress that being politically neutral (e.g., a school or public square), such spaces allow explanations and different opinions, favoring the construction of understanding about the situation through debate at a site that is legitimate for everyone involved. In turn, it prevents polarization that potentially occurs in spaces frequented only by members of a certain group or opinion. Additionally, it is possible that such spaces may favor the development of deeper social relations among stakeholders, strengthening collaboration among them, and affecting collaborative outcomes (Bodin 2017); however, this remains to be explored by future research.

Agency is a determining factor in how individuals or communities respond to different environmental stressors and is clearly linked to the concept of adaptive capacity from the social-ecological viewpoint (Brown and Westaway 2011). In the cases analyzed, agency plays a prominent role in community dynamics, acting as a catalyst for self-organization by generating amplifying feedback that positively affects other elements. Different from Berkes and Ross (2013), in which community strengths and characteristics lead to agency and self-organization, we observed that agency stimulated the construction or strengthening of human capital (cases III and IV) and social capital (cases I, IV, V, VI); favored partnership with external actors (cases I and VI); contributed to the generation of income opportunities (cases I and III) and the establishment of spaces favorable to social interaction (cases I and IV); and encouraged action (cases II and III). It is also

noteworthy that agency is not in itself a prerogative of successful self-organization, not least because self-organization occurs in living systems at all levels, from cell to biosphere (Meadows and Wright 2008), and does not presuppose intention, will, or intelligence. However, we note the importance of agency being oriented toward collective rather than individual interests. When collective interests prevail over individual ones, it is less likely to generate feedback that will inhibit the self-organization process, which occurs when individuals have polarizing ideas and establish power-conflict dynamics.

Finally, this study is aligned with the current trends of commons’ studies based on the social-ecological systems (SES) framework (Ostrom 2009), which has broadened SES research through the development of multiple conceptual approaches based on different literatures and with emphasis at the community level (Partelow 2018). Our study is a synthesis with results based on primary data drawn from multiple empirical studies of different sectors that may potentially add to the literature directly engaged with the SES Framework (Partelow 2018). Ostrom’s framework presents a list of social and ecological variables influencing cooperation in solving social dilemmas, including “self-organizing activities” as a second-tier “interactions” variable. Around 15 out of 92 articles reviewed by Partelow (2018) included this variable in the analysis, despite its relevant link to institutional change and collective action theories. Although not based on Ostrom’s framework, our results support/confirm the hypothesis that community agents are capable of cooperating and self-organizing under different social and ecological conditions to solve collective problems. This work contributes to the debate on collective action because it discusses how different elements interact and produce amplifying feedback when communities act collectively in face of crises. Our approach allowed us to (1) standardize and compare different empirical cases of self-organization from primary data; (2) identify common elements of community self-organization; (3) explore how these elements influence the dynamics of self-organization beyond mere “ingredients” of a formula. We moved forward to understand which interactions (feedback) have arisen and contributed to self-organization.

SPECULATION

We also observed the existence of some potentially stabilizing feedback of self-organization. Examples were internal conflicts in the communities, which may generate feedback that inhibits self-organization by increasing discord and disputes (and even polarization) among community members. Despite pervading ongoing social processes in our cases, conflicting interactions did not prevent alignment around common interests. Cases in point are the development of the artisanal fishing monitoring program in Tarituba, in which some fishers did not take part because of the presence of other fishers with whom they had some type of conflict, and in the reaction to protected areas in Trindade and in the reorganization of community-based tourism at Aventureiro, where, power clashes occurred between community leaders.

It is important for a community to have a diverse range of ideas and opinions to draw on for the resolution of common problems. These ideas may be divergent, and whether such divergence favors the search for creative solutions or generates friction to the point

of undermining self-organized action is a hard point to determine. Conflicts may be transformed or temporarily minimized according to the intensity of the disturbance, for instance in the reconstruction of São Luiz do Paraitinga in which lives were at risk, or in the reorganization of community-based tourism at Aventureiro and the Capivara fishing accord, reaction to protected areas in Trindade and the artisanal fishing monitoring program in Tarituba in which the families' livelihoods were threatened. Thus, having mechanisms that allow the alignment of local agents around common goals is key for community self-organization processes.

The discussions raised led us to reflect on the role of the state in community self-organization in the face of disturbances in local social-ecological systems. States and other dominant agents may weaken/undermine self-organization at the local level by deviating such processes from their course of action toward rigid political forms of organization and action (Atkinson et al. 2017). Nonetheless, the state's recognition of the right of local users to create their own institutions (i.e., to self-organize) is one of the guiding principles for the successful management of commons (understood as social-ecological systems) according to Ostrom (1990). The lack of such recognition regarding the legitimacy of locally established initiatives generates stabilizing feedback, which discourages community self-organization. This is illustrated by what happened in the artisanal fishing monitoring program in Tarituba, whereby the initiative to develop a statement of commitment for artisanal fishing in the PA emerged locally among PA management and local fishers in 2012. When it was submitted to the headquarters of the PA Federal Agency in 2013, approval was delayed for four years because of ideological disputes within the agency (Seixas et al. 2017, Dias and Seixas 2019). This event discouraged the participation of fishers in other initiatives and undermined the PA managers' credibility with them. Even if government actions do not intentionally favor interactions that may develop into self-organized processes to address disturbances in local social-ecological systems, it is vital that they should not produce the opposite effect, undermining such initiatives through a technocratic and centralized work logic.

CONCLUDING REMARKS

Our approach to synthesizing the findings of six cases of successful community self-organization allowed us to shed some light on how such processes are structured and developed. We explored how common elements of successful community self-organization combine and interact, favoring self-organization directly or indirectly by generating amplifying feedback of these very processes. We observed the ability to transform crisis into an opportunity to invest resources (material and human) with the potential to generate income. In these processes, bridging organizations played an extremely important role, but a minimum of human and social capital must be established and structured in the communities to enable opportunities to be taken. It is also important to have physical spaces for interaction (both among members of the community and between them and external partners) where people feel at ease to express their opinions. Such spaces enable the flow of information and collective decision-making around common goals. Another factor that proved to be important was agency oriented to collective goals, mediated by a community's common identity or sense of place.

Different cultural practices and livelihoods are exercises in collective action, which provide communities with a wide range of responses that can be activated in times of crisis, affording them the capacity to self-organize. This indicates, therefore, that the incentive to preserve cultural practices is an issue that goes beyond the actual cultural dimension. Thus, public initiatives and policies that foster cultural practices of a community have the potential to reverberate in other apparently unrelated fields, such as the ability to respond to a disaster, to evaluate the impacts of fishing activities, and to plan land-use strategies. Additionally, they can reverberate in work methodologies based on collective action practiced over generations, analogous to what we know today as crowdsourcing and crowdfunding, such as mutual-aid farming, house building, fundraising, and traditional festivals.

Lastly, as food for thought, we propose considering to what extent individualism, which has increased in contemporary Western society, can affect relationships usually based on common identity, cultural practices, trust, and reciprocity, and its potential implications for the capacity for community self-organization. Is there a disturbance threshold in which acting collectively becomes an imperative for individual survival and not just an option for coping with crises?

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Data/code sharing is not applicable.

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Appendix 1. Summarized information about each case of successful community self-organization in Brazil.

Case study	Source	Fieldwork	Data collection
I- Capivara fishing accord	Ummus (2017)	February to August 2016	Participant observation in fishing; Semi-structured interviews with key informants; Direct observation of meetings; Secondary data (meeting briefs)
II- Reconstruction of São Luiz do Paraitinga, SP	Farinaci (2012) and Farinaci's unpublished fieldnotes	April 2014 to May 2015	Semi-structured interviews with key informants; Focus groups; Secondary sources (videos, newspapers)
III- REDESUAPA stakeholder network	Moraes (2019)	August 2014 to August 2018	Direct and Participant observation in meetings; Non-structured and semi-structured interviews; Participant observation in community activities
IV- Reaction to protected areas in Trindade, RJ	Araujo (2014) and Araujo's unpublished fieldnotes	April 2010 to February 2013; June 2017 to July 2018	Open-ended interviews with key informants; Direct observation of meetings; Secondary data (meeting briefs)
V- Artisanal fishing monitoring program in Tarituba, RJ	Dias (2015)	March 2014 to April 2015	Semi-structured interviews; Participatory mapping; Planning workshops
VI- Reorganization of community-based tourism at Aventureiro, RJ	Prado (2013)	August 2011 to July 2012	Structured and semi-structured interviews; Participant observation in meetings; Participant observation in community activities

Appendix 2. Open-ended survey template containing a set of descriptive and analytic variables, designed to facilitate the compilation of data from the six case studies. Attributes from Berkes and Ross (2013) are followed by *.

		Case I – Capivara fishing accord	Case II – Reconstruction of São Luiz do Paraitinga	Case III – REDESUAPA stakeholder network	Case IV – Reaction to protected areas in Trindade	Case V – Artisanal fishing monitoring program in Tarituba	Case VI – Reorganization of community- based tourism at Aventureiro
Descriptive variables	Type of disturbance/ shock						
	Year/period of the disturbance/ shock						
	Year/period of observation						
	Number of people in the community						
	Relevant historical/cultural characteristics						
	Relevant environmental characteristics						
	Socioeconomic characteristics						
	Formal and informal institutional arrangements (introduced or created)						
	Constellation of social actors						

		Case I – Cativara fishing accord	Case II – Reconstruction of São Luiz do Paraitinga	Case III – REDESUAPA stakeholder network	Case IV – Reaction to protected areas in Trindade	Case V – Artisanal fishing monitoring program in Tarituba	Case VI – Reorganization of community- based tourism at Aventureiro
Analytic variables	Phase of the adaptive cycle in which the disturbance occurred						
	Analyzed phases of the adaptive cycle						
	Landmark events						
	Factors hindering self-organization*						
	People-place connections*						
	Values and beliefs*						
	Skills, knowledge and learning*						
	Social networks*						
	Engaged governance*						
	Diverse and innovative economy*						
	Community infrastructure*						
	Leadership*						
	Positive outlook (including readiness to accept change)*						

Appendix 3. Standardized description of the six case studies containing the basic mechanisms proposed by Heylighen (2013), as well as information on the type and period of the disturbance; relevant historical, cultural, socioeconomic and environmental traits; formal and informal institutional arrangements; stakeholders involved.

Case I – Capivara fishing accord (Ummus 2017)

The lake system referred to as Capivara sector (Middle Solimões River region, AM) provides several fishing resources, especially “pirarucu” (*Arapaima* sp.). The area is inhabited and used by around 80 families of riverine people divided into five localities. This case refers to the self-organized constitution of the Capivara Fishing Accord, which in 2015 comprised 120 small-scale fishers. Fishing accords are formal institutional arrangements between resource users and environmental agencies to organize small-scale fishing of certain species or in specific areas (de Castro 2000). The alignment process to design the agreement started in 2007, triggered by conflicts with large-scale fishing operations over the use of the lakes, added to decreasing fish stocks and restrictions on the use of other lakes in the region. The group of participating fishers grew, enabling division of labor involving surveillance and monitoring of the lakes in 2011. The four-year workflow of surveillance and monitoring was followed by fish harvesting. The result was an increase in fish stocks and income from pirarucu fishing and greater control of the lakes by the community (aggregation).

Case II – Reconstruction of São Luiz do Paraitinga (Farinaci 2012)

São Luiz do Paraitinga, in São Paulo State, is considered one of the last strongholds of traditional cultural manifestations in the region and boasts architectural heritage sites. Its natural heritage is also relevant, as a Protected Area covers part of the municipality with many patches of native Atlantic Forest. In early January 2010, the river that cuts through its urban area rose 11 meters above the normal level, isolating the city for three days and destroying historical buildings. More than 5,000 of the approximately 10,000 inhabitants were displaced. This unprecedented flood was favored by the history of land use in the rural area, which caused soil compaction and erosion, and silting of water courses. Despite the magnitude of the disaster and the great material losses, there was alignment and the local community responded to the crisis effectively, avoiding human losses and quickly restoring normal living conditions. There was division of labor resulting from great mobilization among civil society and the private and public sectors to clean the town, rescue residents and ensure the provision of utilities. Workflow was also established, with the resolution of emergency situations followed by initiatives to rebuild the town and resume normal life (aggregation), demonstrating high capacity for self-organization in response to the crisis.

Case III – REDESUAPA stakeholder network (Moraes 2019)

Soon after the great flood described above, several working groups were formed to rebuild the town. A group formed by professionals from different state agencies, representatives of the municipal government and local and regional third sector institutions self-organized and showed alignment from the outset, defining concrete strategies to prevent similar disasters. Based on division of labor, this network concentrated its initial efforts on specific projects and initiatives for soil recovery and conservation in the town’s rural area. The established workflow then led to conservation actions combined with income generation for smallholders, mainly through alternative production systems (such as pasture rotation and agroforestry) adapted to the local socioeconomic, geographical and environmental reality (aggregation). Five years later,

the group identified the need to further align values and define common goals among its members as guidelines for future work. An organization was created: “Rede para o Desenvolvimento Sustentável do Alto Paraíba” (Upper Paraíba River Sustainable Development Network – REDESUAPA). This group has experienced several crises since its inception, which so far have been faced and overcome collectively. REDESUAPA meetings support the construction and expansion of knowledge and favor continuous alignment and learning among its members. Its dynamics strengthens cooperation among members and favors the agency of individuals and of the actual network (Moraes and Islas 2020). Currently the network is on “standby mode”; members are connected through virtual platforms and social media. Face-to-face interactions paused after São Paulo State government merged the Secretary of the Environment into the newly formed Secretary of Infrastructure and the Environment, in early 2019 (Moraes and Islas 2020).

Case IV - Reaction to protected areas in Trindade (Araujo 2014)

The community of Trindade (about 1000 inhabitants), on the south coast of Paraty, RJ, has undergone major economic, social and environmental changes since the 1970s. This process was marked by the expansion of tourism and the real estate sector, the development of energy and road infrastructure, and the creation of Protected Areas (PAs). From the 2000s, the Serra da Bocaina National Park (a no-take PA that includes parts of Trindade) started implementing initiatives in the community, triggering several conflicts between part of the community and the PA’s managers (de Freitas and de Araujo 2020). With the increased tourism and the initial restrictions to the access and use of areas and natural resources of the PA, there was alignment between two local community associations. Drawing on division of labor and workflow, they carried out a number of long-term initiatives, such as: representation in PA Steering Committees, participation in reviewing the management plan of two PAs; negotiation with the PA to exploit tourism services; hiring of qualified advisory services; revival of a traditional local culture festival; and strengthening of partnerships in local and regional networks. These actions changed the institutional structure of the associations and their operating methods, which resulted in at least two important events from 2016 (aggregation): the building of a headquarters for local associations and Escola do Mar (School of the Sea), the latter as a community organization of education and traditional culture (Araujo et al. 2020).

Case V - Artisanal fishing monitoring program in Tarituba (Dias 2015)

The community of Tarituba, on the north coast of Paraty, RJ, has about 500 residents, most of whom living off tourism and fishing. In 2006, a marine area where important traditional small-scale fisheries overlapped with parts of a no-take PA (Tamoios Marine Protected Area) was subject to regular inspection. This led to the banning of traditional fishing, creating a serious crisis. In order to mitigate conflicts between fishers and the Tamoios MPA management office, in 2012 there was alignment within the PA Steering Committee to establish an agreement, allowing traditional fishing in certain areas with specific gears and vessels. This agreement was institutionalized as a Statement of Commitment in 2017, establishing that fishing should be monitored. This led to the development of a participatory monitoring program for artisanal fishing. During this process there was division of labor, since the different stakeholders involved – fishers, environmental managers, representatives of state and municipal agencies, and a university – contributed to the collective construction of a monitoring program from the individual perspective of each stakeholder. The workflow involved the Tamoios PA Steering Committee, which includes representatives from various sectors of government and

civil society, in decision-making regarding the monitoring program. A directive with goals and indicators was established (aggregation) aiming to guide managers and fishers in generating relevant information to reconcile the needs of coastal and marine environment conservation and the well-being of fishers.

Case VI – Reorganization of community-based tourism at Aventureiro (Prado 2013)

Inserted in a no-take PA since 1981, the community of Praia do Aventureiro (around 100 inhabitants), in Ilha Grande, RJ, started engaging in community-based tourism activities in the mid-1990s. Following a number of clashes with the competent environmental agency, tourist activities (especially campgrounds) were banned for 8 months in 2006. This was a critical and disturbing period for the way of life of local families, who depended on the income from local tourism. The ban on tourism triggered a process of self-organization in the community as a whole. Alignment arose from the need for greater political organization to claim the community's land rights as well as adapt and foster other activities, such as fishing. There was division of labor and workflow among the leadership of the local community organization, external partners (tourists, universities, NGOs) and other local residents looking for alternative livelihoods. After a number of legal negotiations, tourism was admitted and regulated by a deferred prosecution agreement that set a maximum number of tourists, configuring the aggregation of the self-organization process. This conflict also generated a drawn-out process to reclassify part of the no-take PA as a sustainable use protected area, which happened in 2014.