

Sustainable local development and the construction of dams: the case of the community of Tanquã in the state of São Paulo, Brazil

Cláudia M. Coleoni; Ariane Silveira; Caio C. C. Rodrigues; Emília E. Tanaka; Felipe Vitti; Fernando Hideki; Ianna R. M. Dantas; Joyce Stenico; Júlia Garcia; Juliana C. F. Florencio; Matheus Kortz; Nicole F. Zandoná

University of São Paulo

1. Introduction

Globally, hydropower is considered a key source of energy with an expressive potential of supplying energy to different regions at both short and long run. According to the Dams & Development Project from the United Nations Environment Programme (UNEP, 2007), renewable energy is expected to meet 18% of the electricity demand by 2030 and more than half of it may be supplied by hydroelectricity. In addition to energy generation, the construction of dams also improves irrigation systems—40% of the food produced is cultivated in irrigated lands and 30-40% of the global irrigated lands rely on dams. It is also important to notice that about 2 billion people live in high-flood risk regions and dams are key components for strategies to store and adapt water flows (UNEP, 2007). Despite the benefits of dams, their social, environmental and economic impacts should be thoroughly considered and assessed. For instance, dam walls may prevent fish from migrating and sediments from flowing downstream, which is crucial to maintain physical processes and natural habitats. The construction of dams also involves reallocation of local people and/or indigenous communities; therefore, it

requires an active participation of the civil society in the decision-making process as well as the contribution from a wide range of scientific disciplines and stakeholders (UNEP, 2009).

Given its hydropower potential, Brazil relies heavily on hydroelectricity for energy supply as well as other demands. According to von Sperling (2012), 70% of Brazil's installed energy capacity consists of hydroelectric dams in the beginning of 2011. In total, there are already 578 plants, of which 176 are large ones. Since the construction of dams involves several socio-environmental impacts, the Brazilian government demands every dam to have an environmental license, which is composed of four stages: (i) presentation of the process; (ii) preliminary license (LP); (iii) installation license (LI); (iv) operating license (LO).

The Brazilian environmental policy, in its Resolution No. 001/1986 from the National Environmental Council (CONAMA, 1986), requires the elaboration of an Environmental Impact Assessment (EIA) and its respective Report on Environmental Impact (RIMA) about the potential environmental harms the dam may cause. The environmental licensing process must also include public audiences to ensure civil society participation in the decision-making.

Considering Brazil's water resources and environmental policy, the present project refers to the case of Tanquã, a small community located in São Paulo state which has been endangered to disappear as a result of the construction of Santa Maria da Serra dam along the Tietê-Paraná Waterway. Therefore, our main objective is to analyze the socio-ecological interrelation of different stakeholders towards this entrepreneurship and the local community, so that we can better understand varied interest groups and identify potential sustainable and economically viable activities at Tanquã.

1.1 Background on the Santa Maria da Serra dam

This entrepreneurship aims at improving the transportation of commodities which is currently made via highways and also to develop the economy of big cities nearby, counting with an investment of approximately US\$600 million. Notwithstanding, it is important to state that this problematic involves different stakeholders and interests, among them professors, lawyers, students, locals, politicians, researchers, private companies. The EIA conducted for the Santa Maria da Serra dam reports a series of incalculable social, environmental, cultural impacts; however, the document lacks a vital range of mitigation actions for the construction, which may be licensed by the Environmental Company of the State of São Paulo (CETESB). The scientific and non-scientific documents regarding the case of Tanquã and the general analysis of the Santa Maria da Serra dam meet the idea that this construction brings more negative and irreversible impacts not only to the local community and to its environment, but also to big cities nearby.

2. Material and Methods

This project was conducted in the community of Tanquã, located in the state of São Paulo, Brazil, and is composed of three stages, all of them based on an environmental education approach. The first of these consisted of the Minimum Possible Intervention tool, which is part of the “participative-action-research” methodology (Viezzler, 2005; Andrade & Sorrentino, 2013), and had the goal of interacting with the locals from the Tanquã community. Secondly, in order to better understand stakeholders’ interaction in this case, we used the social-ecological systems

(SES) framework (Ostrom, 2009). After the diagnosis stage, the International Students Forum (ISF) – Brazil made an intervention with the community and the different group of interests.

2.1. Study area

The study area was the Tanquã community, a neighborhood located in the city of Piracicaba (22° 42' 30" S, 47° 38' 00" W), state of São Paulo, Brazil (Figures 1 and 2). The project began in January of 2014, followed by three technical visits in the months of March, May, and July, as well as one public meeting at the Piracicaba City Hall. According to the Technical Report from the Public Ministry of the State of São Paulo (MPSP, 2013), there are approximately 19 dwellers in the eastern margin, and 53 dwellers in the western margin of the Piracicaba River portion of the Tanquã region, composing a total of 72 dwellers and 17 families. Additionally, there are approximately 40 ranchers, a proof that the neighborhood attracts several tourists year-round. Known as the “mini-pantanal” of Piracicaba¹ and with an area of approximately 1,800 hectares, Tanquã is a wetland home to 54 fish species (such as *Leporinus piavussu*, *Salminus brasiliensis* and *Prochilodus lineatus*) and 218 bird species (such as *Dendrogygna* spp., *Jabiru mycteria* and *Platalea ajaja*), of which some are migratory birds that come from other regions of the state of São Paulo, Brazil, and even from farther regions of the world (RIMA, 2013).

This wetland is also a sedimentation zone, subject to flooding most of the year due to the raining period, which allows the formation of islands for a few months. Although Tanquã provides vital ecosystem services, there are several anthropic interferences in

¹ “Mini-pantanal” is a reference to “pantanal”, a Brazilian biome that is considered one of the most extensive and continuous wetlands in the planet (MMA, 2014).

the watershed (such as vegetation suppression, grazing and hunting, and sugarcane crops), which directly compromise water quality by increasing the rate of organic matter in the water bodies.



Fig. 1 Study site. The satellite image shows a portion of the planned reservoir located in the Tanquã neighborhood, city of Piracicaba ($22^{\circ} 42' 30''$ S, $47^{\circ} 38' 00''$ W), state of São Paulo, Brazil. The landscape is mostly composed of ponds and lowlands in a transitioning environment. (Google Maps, 2014, adapted by the authors)



Fig. 2 Tanquã community and its biodiversity. As shown in the pictures, Tanquã is predominantly a fishery community composed of 72 locals and nearly 40 ranchers. Although it is home to 54 fish species and 218 bird species, it lacks an adequate infrastructure to increase ecotourism in the region. (Photos taken by Cláudia Coleoni in March, May, and July of 2014)

2.2. *Minimum Possible Intervention*

In order to perform this study, it is crucial to understand the community we are working with in such a way that we can build a relationship of trust. This will prevent us from turning the community into a “laboratory”; rather, with the participative-action-research methodology, the community becomes an integrant part of the research process (Viezzer, 2005). This allows the dialogue between the scientific and non-scientific knowledge, which leads the present study to results that will empower the Tanquã community.

Therefore, our approach is the Minimum Possible Intervention, which is taking action in a community with the resources we have, doing the most out of the minimum we could do as students and citizens. From the environmental education perspective, our project focused on the following five concepts, which are suitable to reach subjective and intersubjective realities (Andrade & Sorrentino, 2013):

- i. *Identity*: Firstly, it is needed to understand the locals’ principles and ways of interacting with their surrounding environment as well as with one another. Therefore, the researchers need to spend time with the community periodically.
- ii. *Community*: Once the researcher understands the locals’ identity, the next phase is to observe the community’s way of living as well as their local economy. This concept is beyond the geographic boundaries, and shows the cohesion and security individuals have in dialoguing with each other.
- iii. *Happiness*: Environmental education presents “happiness” as the “fulfillment” of a community’s rights and objectives, which are made possible once spaces of participation and solidarity are strengthened.

- iv. *Dialogue*: This concept does not resume only to the means of communication, but it also refers to how the community recognizes and deals with diversity of opinions and personalities, which could be related to the different land uses in a region. In order to identify these characteristics in Tanquã, we had the goal to participate in local meetings and interview locals to better understand their perspective on the construction of the Santa Maria da Serra dam.
- v. *Power of acting*: In this final stage, the community should be able to better understand its own reality and potentialities, so that the individuals feel engaged and empowered to act by themselves towards a common goal. Moreover, we identified external interests in the Tanquã community and tried to understand how they converged.

2.3. *Social-ecological systems*

In order to verify sustainability in the Tanquã community, this study uses the social-ecological systems (SES) framework. Ostrom (2009) emphasizes that all humanly used resources are part of complex SES, which are composed of multiple subsystems and internal variables that consider different spatial and temporal scales. The SES framework has as its core the identification and analysis of relationships among multiple levels, which are linked socially, economically, and politically in an ecosystem context. Therefore, the studied subsystems for the Tanquã community were the following: (i) resource systems (i.e. water resources); (ii) resource units (i.e. wildlife, water flow, vegetation); (iii) governance systems (i.e. environmental departments, the state, among others); (iv) users (locals, tourists, civil society, industry, interest groups).

2.4. Students taking action

After the diagnosis stage, ISF–Brazil made an intervention focusing on (i) increasing the visibility of the community; (ii) incentivizing debates in our university campus (Luiz de Queiroz College of Agriculture/University of São Paulo – ESALQ/USP) with the community and stakeholders involved; (iii) distributing petitions as an attempt to cancel the entrepreneurship.

3. Results and Discussion

3.1. Technical visits and the Tanquã community's point of view

ISF-Brazil visited the Tanquã neighborhood in the months of March, May and July of 2014. Throughout these months, we got a better sense of the shared goals of the community as well as the conflicts that arise with the Santa Maria da Serra dam construction, which turned out splitting the locals' opinions into two sides: those who favor the dam and those who oppose.

In March, ISF-Brazil participated of a “Bird-watching Event”, where several actors were gathered with the goal of divulgating the Tanquã community in the state of São Paulo. Among the actors, we could identify environmental Non-Governmental Organization (NGO) groups, social movements groups, bird-watchers, professors, undergraduate and graduate students, researchers, the media (i.e. television, newspapers, radio), tourists, civil society and the locals themselves. The goal of the event was not to protest against the dam construction itself, but to awaken the tourism potential of the region as well as its rich biodiversity. During our observations, we realized that most often external actors were more worried about the environmental preservation than with the social well-being of the locals. For instance, almost no visitors were fully aware that

Tanquã dwellers did not have a specified place to be relocated in case the dam is constructed. We interviewed all the representative people from each interest group, and it was clear that there was a knowledge gap, which prevented all actors from dialoguing with one another in order to reach common ground. The tourism potential was evident, but we realized that the community lacks adequate infrastructure—safe roads and access to the neighborhood, health care units, nearby schools, retailing development and investment, legalized housing, sanitation. When talking to the locals, it is clear that their identity is embedded with their fishing practices. The major point during conversations was that only a few people knew for sure how the environmental licensing process works, and did not take advantage of the public audiences to voice different opinions. In addition, several locals seemed skeptic about the construction of the dam, since it is a project that began to be discussed in the year of 1960.

In May and July, ISF-Brazil visited the Tanquã community once more, but this time focusing solely on the locals' perspectives. Table 1 shows that the community of Tanquã has not been as active as it could be in order to voice their opinion in public and political events. In addition, their perspectives have led or will probably lead to several negative outcomes, which will decrease their own local sustainability and will favor opposite groups. Hence, the community needs to promote local meetings with frequency in order to strengthen their shared goals and incentivize all individuals to be active in the decision-making process.

Table 1. Tanquã community’s perspectives on the construction of the Santa Maria da Serra dam. Interactions are based on how the community dialogues with its members and stakeholders. Therefore, the Outcomes show if the community’s ideals act towards its own sustainability (O+ sign) or not (O- sign).

Action Situations: Interactions (I) → Outcomes (O)	
Perspectives and facts	Externalities
(I) Although there is a neighborhood association, it is not active, and locals talk only informally	(O-) Weakened community identity, which will be more subject to external inputs; difficulty in voicing their opinion
(I) The majority of the locals disagree with the construction of the dam	(O+) Strengthened sense of community and continuity of locals’ way of life
(I) The community receives information about the dam construction from two main sources: prosecutor of justice and local newspaper	(O-) Lessen the community’s participation in the decision-making process; fewer opportunities to engage in political meetings and internal debates
(I) Nearly all locals are skeptic about the construction of the dam and none of them knows where they will be relocated if the dam is approved	(O-) The project is already under evaluation by CETESB; if approved, the locals will be unprepared to fight for their property rights
(I) All locals believe tourism is a very important complement to their income (i.e. fishing) and can eventually improve the neighborhood’s infrastructure	(O+) Tanquã’s visibility has increased since its existence became threatened by the construction of the dam; if tourism increases, so does the local economy
(I) Ranchers tend to be more conservative and resistant to dialogue with the locals	(O-) Different land uses may result in different opinions; if divergence occurs within the community, individual interests may arise and hamper negotiations
(I) Some locals believe moving from Tanquã means possessing legalized lands; other locals believe Tanquã lands are rightfully theirs	(O±) By acquisitive prescription, locals possess the lands of Tanquã; however, by the national forest code, their current land use is incorrect, since that site is a “permanent preservation area”

3.2. Stakeholders' interaction

On May 14th 2014, ISF-Brazil participated of an open public event at the Piracicaba City Hall, named “Evaluating the impact of the Santa Maria da Serra Dam”. In this opportunity, the main actors and interest groups who oppose the dam were present—Public Ministry of the State of São Paulo, professors, jurists, NGOs, bird-watchers. Each one of them gave a talk of about 15 minutes, exposing their points of views. Without exception, all the lecturers were emphatic: if the dam represents social, economic and environmental risks, then it should not be built. There were approximately 150 people in the event. Figure 3 shows how these different stakeholders interact with Tanquã’s natural resources.

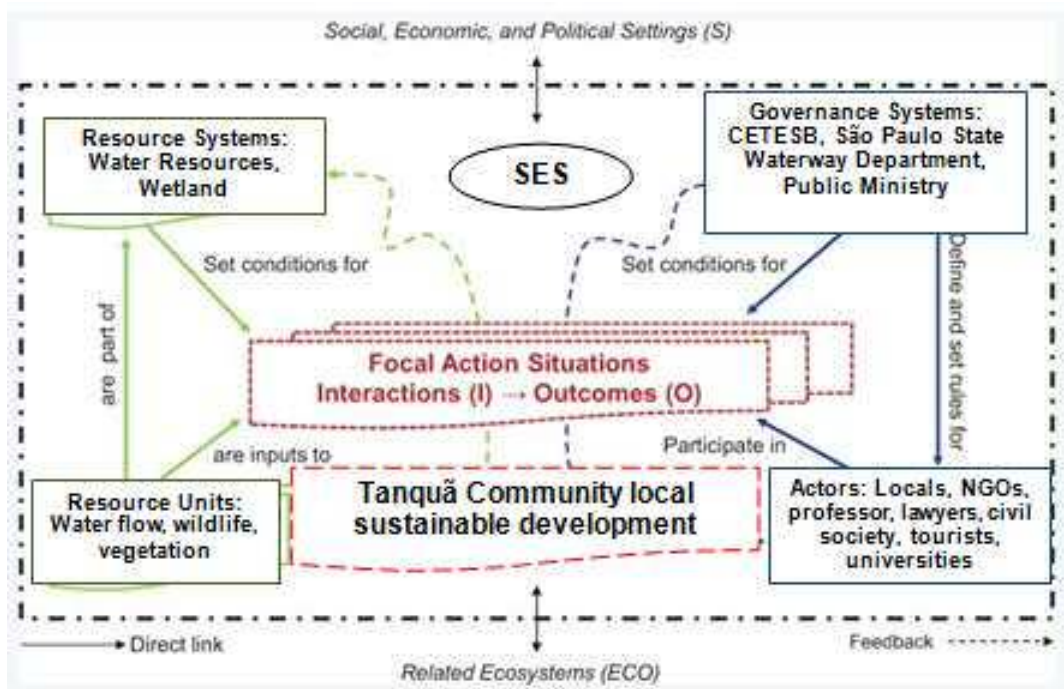


Fig. 3 Social-ecological systems (SES) framework for the Tanquã community. Based on the four subsystems (resource, governance, units and actors), SES allow a better understanding of different stakeholders interaction towards a common resource. (Adapted from Epstein et al., 2013)

3.3. Actions developed

ISF-Brazil acted in a joint effort with different majors of the ESALQ/USP campus (i.e. Environmental Management, Agronomic Engineering, Economics, and Business) to promote the cause of Tanquã via social media and personal debates. The main action is the round-table at the “Seminar on Environmental Management” (SIGA), an event we are organizing at ESALQ-USP on August 16 and 17, 2014 (Figure 4a). At this event, diverging points of view will be debated, and the Tanquã locals will be invited to participate. Lecturers invited are the São Paulo State Waterway Department, the Public Ministry of the State of São Paulo, the author of the dam project (Congressman Mr. Thame), a University of São Paulo professor and the Movement of People Affected by Dams (MAB). In addition, ISF-Brazil elaborated an online petition as an attempt to cancel the project (Figure 4b).



Fig. 4 Students taking action on behalf of the Tanquã community. “A” refers to the “Seminar on Environmental Management” (SIGA), an event that counts on a round-table about the Santa Maria da Serra dam. “B” shows the online petition elaborated as an attempt to save Tanquã.

4. Conclusion

The local sustainable development should respect cultural identity, consider environmental impacts and signalize viable alternatives both socially and economically. Tanquã community has a great potential for tourism, which directly contributes to the locals' source of income, which is solely composed of fishing activities. Furthermore, the construction of the Santa Maria da Serra dam will put into risk all the biodiversity of the wetland, including endemic bird species. The dam also imposes flooding risks to the nearby municipalities, which brings on huge economic losses.

This project has shown that information about the dam construction is not widely spread in the Tanquã community, and locals do not dialogue with other interest groups, even if the issue is the community's right to own Tanquã's lands. This is a direct result of the community's inactive neighborhood association, which needs to be strengthened specially during the current environmental licensing stage. In this sense, the local culture should be valued and united, since tourism has proved to be beneficial to the region. It was also identified a generalized skepticism in the local population, who should be focused on shared goals instead. We have also realized that the environmental concern is not central to the locals, although they depend upon fish resources for their family income.

Lastly, it is exceedingly important to maintain the attention and the work to this community after the International Student Summit (ISS) project since environmental education is a long-run process. It means that our action is built with the community and has a beginning but not necessarily an ending. Our driving force as students is to develop an enhancing environment for Tanquã to develop itself, seek sustainable activities and provide a worldwide example of water resources management.

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