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Identifying stakeholders and discussing a strategy for the participatory management of a protected area: the case of Engenho Pequeno, in Rio de Janeiro State, Brazil

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Abstract
This paper identifies the potential main social actors involved in and affected by the conservation and use of the Environmental Protection Area (EPA) of Engenho Pequeno, in Rio de Janeiro State, Brazil, and discusses how environmental education can be shaped to engage them in participatory, socially progressive and environmentally sustainable management for that area. Therefore, semi-structured interviews were conducted with individuals and entities related to the EPA. The snowball method complemented the mapping of non-official social actors. The discussion was based on the critical approach of environmental education, polycentric governance, adaptive management, environmental advocacy and case studies about education in protected areas. Results showed nine key stakeholders to be considered in a network program for the EPA's participatory management, including government, schools, local and nearby residents and religious groups. In the end, we recommend the hosting of a one day workshop, built around existing local and national environmental goals, as an entry point for trust building and the search for shared interests.

Keywords Natural resources · Sustainable use · Public policies · Participative process

1 Introduction

Protected areas are created all over the world with the same goal: to protect biodiversity and ecosystem services, considering cultural values. They are natural areas delimitated at strategic points to protect natural resources (Law No. 9.985). Around 16% of the land on Earth is protected as parks and other categories of terrestrial protected areas, in different

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countries (UNEP-WCMC & IUCN, 2021). In Brazil, protected areas are called conservation units (Brasil, 2006) and cover 29.42% of the area (Vieira et al., 2019). However, protecting, restoring and promoting sustainable terrestrial ecosystem is part of the 2030 Agenda[1] in Brazil (Article 19 Brazil & Gestos 2020).

To achieve that purpose, protected areas need effective plans of decentralized governance and adaptive management. Rhodes (1996, 2007) defines governance as a process of governing with and through self- and inter-organized networks. Those networks must be composed of all stakeholders interested in and affected by the use of the common resources. Governance also involves government as a steering actor and works in higher scale, but must be connected to local level action (Armitage et al., 2012). In the case of protected areas, Bixler (2014) highlights the relevance of polycentric governance, including a 'community-oriented, decentralized approach.' In his view, 'a strong local-scale system of social-ecological governance increases the likelihood that governance at other scales will be successful' (Bixler, 2014: 167). In that process, not only governments, but communities, enterprises, schools, and every other social groups must be part of the decision making.

Conservation units in Brazil are meant to work under participatory management, a term that also refers to adaptive management. Official guidelines and legislation (Brasil, 2016; 2015; Law No. 9795), and academic studies (Layrarges, 2000; Lopes & Ambivero, 2017; Loureiro & Cunha, 2008) regard environmental education (EE) as an important process for adaptive management in conservation units. EE is defined as the education focused on rethinking and changing the societies' behavior toward the environmental protection (Sauvé, 2002). For this study, we considered the critical approach of EE, which aims to discuss and transform environmental issues interjectionally with social and political reality (Guimarães, 2004; Freire 1996; Massoni et al., 2019). In Brazil and abroad, EE is recognized as a strategic tool to engage communities, schools, governments, enterprises, organizations and other social actors in the participatory management and sustainable use of protected areas and natural resources (Ardoin et al., 2020; Loureiro & Cunha, 2008).

Another important study area for nature and biodiversity protection is advocacy. According to Keck and Sikkink (1998), advocacy is related to actors that interact in structured terms to make significant change in higher scale decision making, such as policies, inspired by a particular cause. In the environmental area, it is also based on scientific information and alternative strategies of communication (Keck & Sikkink, 1998; Niblett, 2012). Consequently, EE can be related to advocacy on behalf of the environment as a key 'stakeholder' (Fleet, 2020; Niblett, 2012).

However, implementing EE in conservation unities, be they small urban protected areas or large-scale national parks, remains a significant challenge for managers (de Souza Pimentel et al., 2020; Brasil, 2016; Loureiro & Cunha, 2008). This is partly due to well-known phenomena such as vested interests and contrasting stakeholder values, needs and so on (Ostrom, 2015; Nayak and Berkes 2011; Armitage, 2005).

The Environmental Protection Area (EPA) of Engenho Pequeno, in São Gonçalo city, Rio de Janeiro state, is an example of that reality (See Fig. 1). The municipality has more than 1 million inhabitants and structural, social and environmental issues, such as water supply. As shown in Fig. 1, the EPA of Engenho Pequeno is a small forest (13 square kilometers) that struggles with urban pressure. It is administered by the local government,

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[1] The 2030 Agenda is a plan of action, created by the United Nations, to establish and promote the 17 SDGs (Sustainable Development Goals). The SDGs are an actualized version of the Millennial Development Goals and should be globally achieved by 2030. They were published by the United Nations in 2015.
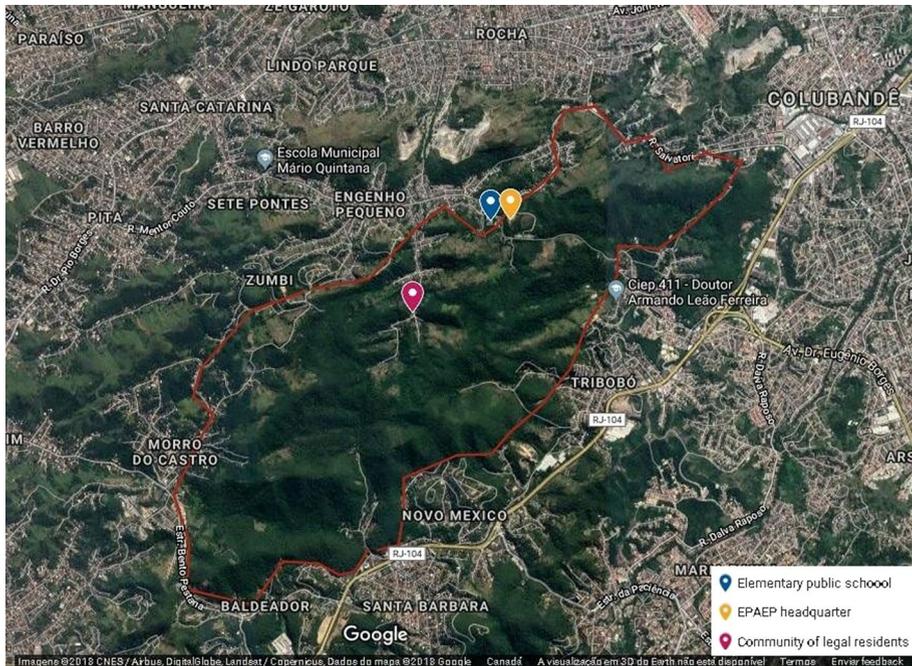
Fig. 1 Map of the EPA of Engenho Pequeno, delimited by the red line, and the geographic location of the areas headquarter, the legal residents' community and an elementary public school (*Source*: Júlia de Marins/Google Maps)

which does not have any programs of education or strategy of ecotourism for the unit. Moreover, the entity does not have any records regarding important management factors, such as number of tourist visits or size and character of the communities culturally, religiously[2] and geographically related to the EPA of Engenho Pequeno (Marins & Lopes, 2018).[3]

Given this complex array of environmental and social relations, this paper reflects on the following questions: Is it possible to create participatory forms of management based on a stakeholder network at the EPA? Could EE build better protected area governance? What is an appropriate EE approach to draw stakeholders together from across the protected area?

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[2] Three types of religious groups often visit the EPA: Catholics, Protestants and Afro-Brazilians. Catholic groups use an area popularly considered sacred. The space has a statue of Our Lady of Conception Aparecida (the patroness of Brazil). According to a popular story, the owner of the farm that used to exist at that region, prior to the establishment of the conservation unit, installed the statue because his grandson saw an apparition of the saint at that spot. Protestant groups visit another space at the area to camp. They organize tourist visits with the youth for leisure. Afro-Brazilian religious groups use a third area to leave offers of fruits and drinks to sacred entities. There is no conclusive information about a sacred value of that specific forest for those practices.

[3] The delimitation of the EPA was made based on the formal register on the website of the Ministry of Environment—that does not reflect precisely the real boundaries—and on observation during field work. The illegal residents inside the area could not be precisely mapped.

What types of discourse can foster better resource governance while building trust among highly differentiated stakeholders?

2 São Gonçalo city and the EPA of Engenho Pequeno

São Gonçalo is the second most populous city in Rio de Janeiro state, with more than 1 million inhabitants (IBGE 2021). Like many peripheral areas in Brazil, São Gonçalo has several structural precariousness, like water supply and sewage treatment (Marins & Lopes, 2018).

The EPA of Engenho Pequeno is a 13-square-kilometer-remnant of Atlantic Forest, bordered by seven neighborhoods of the municipality of São Gonçalo. It was delimited in 1991 by popular demand against the forest's proposed destruction for the creation of a dumping ground (Santos & Pinto, 2006). After 10 years, the Municipal Natural Park of São Gonçalo was created, comprising part of the EPA's territory. Both are managed by the Municipal Secretary of Environment (SEMMA, in Portuguese) of São Gonçalo city. However, the Municipal Park is not physically delimitated or used for stricter environmental protection, as it was supposed to have been, according to the category of natural parks' guidelines (Law No. 9.985).

The official register of the EPA on the Ministry of Environment website stipulates its objectives as: engaging environmental conservation, academic studies and EE programs. Yet the unit does not have any management plan, formal educational programs or academic research partnerships. Actually, the protected area struggles with urban pressure, such as irregular constructions, encroachment by marginalized citizens and fires. Officially sanctioned tourist visits are few in number. Educational visits by schools occur twice a month and activities focused on community participation happen once in every two months (Marins & Lopes, 2018).

3 Methods

This paper is placed on the relevance of identifying social actors before creating strategies for biodiversity protection. According to Bennett et al. (2016), social sciences in conservation can strongly contribute to environmental protection outcomes and to society's comprehension of the relationships between humans and nature.

This study has two objectives: first and most importantly, to identify the EPA's main stakeholders and to understand the relationship between them. Secondly, to discuss how EE can be used as a tool for future work in the participatory management of the EPA of Engenho Pequeno.

To address the first objective, a combination of methods and tools for a qualitative study (Mills & Birks, 2014) was conducted: i) search of secondary data—the EPA's registration of tourist or educational visits; ii) field research—through semi-structured interviews; iii) snowball method—for identifying respondents to the semi-structured interviews.

To start the identification of the stakeholders, we tried to consult the EPA's data (secondary data) of tourist visits, education actions or any other activities, but the management office does not have detailed records of visits. During literature review about the EPA of Engenho Pequeno, only an academic publication about natural conservation

and EE activities restricted to teenage students was found (Santos, 2014). Therefore, the objectives of this work were maintained and fieldword were the next method used.

So, fieldwork was carried out, in order to collect primary data directly from people that live, work or often visit the area (Sheppard, 2020). The instrument utilized was semi-structured interviews, with previous elaborated questions, but no established options of response (McInthosh and Morse, 2015). The interview guide had four questions: What is your professional occupation? What is your relationship with the EPA? Are you aware of other individuals or groups frequently related to the EPA that should be relevant to this research? Do you have any relationship with other individuals or groups that have a close relationship with the EPA? In all the interviews, the participants were also asked to add comments or topics to be covered in the conversation.

As the fieldwork was conducted before the covid-19 pandemic, the interviews were in person. The first and the second respondents (Respondents 1 and 2) were selected during fieldwork, considering their professional activities at the EPA. In addition, the following participants were identified through the exponential non-discriminative approach of the snowball method, in which every respondent in the research is asked to indicate other respondents (Etikan et al., 2016). The strategies complemented each other, so the study could reach both governmental and community actors.

The snowball indication followed the sequence: Respondent 1 indicated an elementary public school (Respondent 6). On the other hand, Respondent 2 suggested a person at the SEMMA (Respondent 3) and a frequent visitor of the EPA (Respondent 7). Respondent 3 indicated a coordinator at the the Municipal Secretary of Education (SEMED, in Portuguese) which is Respondent 4. Finally, Respondent 4 suggested the participation of a supervisor at the SEMED (Respondent 5).

Considering that this study had time and logistic limitations, Respondents 5, 6 and 7 were interviewed, but were not asked to indicate other participants. For them, the third question of the interview guide was as follows: Are you aware of other individuals or groups frequently related to the EPA? In the same way, the other social actors indicated by Respondents 1, 2, 3 and 4 were not interviewed at this stage of the research. Nevertheless, this study is a first investigation and does not aim to address all the EPA stakeholders at this point. Future work is considered to expand the data collection and analysis about more social actors and to apply the recommendations built in the conclusion section of this study.

For the final goal of this study—which is to discuss EE as an advocacy tool for participatory management—the discussion in Sects. 5 and 6 considers literature review about the critical approach of EE, polycentric governance, adaptive management and environmental advocacy. Case studies about education in protected areas were also considered. They were selected during the second data search, on general databases. The selection criteria were papers and articles focused on EE programs and adaptive management of natural resources with successful results.

It is interesting to highlight that none of the respondents suggested a different topic to be covered on the interviews. Nevertheless, the method allowed the participants to freely speak about social conflicts and management limitations about the area.

4 Results of the data collection

This section presents the results of the interviews conducted during fieldwork. Data is organized by the respondent's profile.

4.1 Official management of the conservation unit: local administration and SEMMA

The management of the EPA of Engenho Pequeno is organized in two levels: local management, at the protected area, and the governmental management, at the SEMMA.

4.1.1 Local management

Respondent 1 is the bushman of the conservation unit. The person is responsible for hosting tourist visits, guiding visitations on trails, taking care of the seedlings nursery, conducting workshops about medicinal plants and supporting activities of forest recovery. These last activities are sporadically organized by the SEMMA. The respondent identified two social actors to be interviewed for this study. Both are responsible for constant tourist visits in the EPA of Engenho Pequeno: religious groups and one public elementary school. The religious groups are from three orientations: Catholic, Protestant and Afro-Brazilian. According to the respondent, the groups do not have a formal partnership with the municipal government. However, each group has a specific area inside the EPA to conduct their activities. The three spaces are watched and maintained by the bushman.

The school is located very close to the EPA's headquarters and most of the students are residents of the Engenho Pequeno neighborhood. The Science teachers constantly organize tourist visits with the students, but the school does not have a formal partnership with the EPA's local administration or the SEMMA. Respondent 1 also mentioned illegal residents inside the conservation unit as well. They are families that were already indemnified to leave their lands, located in the middle of the forest, returned to the old houses. They often have conflicts with the local management of the conservation unit because of illegal logging, livestock rearing, and irregular construction.

Respondent 2 is the local manager of the EPA of Engenho Pequeno, who is responsible for booking the tourist visits, organizing educational activities and conducting workshops about medicinal plants. The tourist visits are not registered in official documents and the educational activities are all locally planned, without the participation of the SEMMA. To be interviewed for this study, the manager suggested the State University of Rio de Janeiro, which is a former close partner of the unit. The institution used to have an official agreement for academic research at the EPA, for field research of undergraduate students of Pedagogy. However, the partnership ended a few years ago. Respondent 2 also indicated a citizen of the Engenho Pequeno neighborhood, who visits the area to practice mountain bike, and the SEMMA. The interviews with the two respondents from the area's local management are summarized in Table 1.

4.1.2 SEMMA

Respondent 3 works at the SEMMA (Table 2) and was indicated by Respondent 2. The person is a coordinator, who is responsible for accompanying the process of hiring

Table 1 Summary of the interviews with respondents 1 and 2

Question	Respondent 1	Respondent 2
What is your professional occupation?	Bushman of the EPA	Local manager of the EPA
What is your relationship with the EPA?	Trail Guide; host visitors; manage the seedling nursery; support activities of forest recovery	Office administration, manage visits; organize educational activities; conduct medicinal plants workshops
Are you aware of other individuals or groups frequently related to the EPA that should be relevant to this research?	Religious groups—Catholic; Protestant and Afro-Brazilians; families inside the EPA; school nearby the headquarter; illegal residents	Citizen of the Engenho Pequeno neighborhood, who visits the EPA to train mountain bike; University; SEMMA
Do you have any relationship with other individuals or groups that have a close relationship with the EPA?	Informal contact with the religious groups' leaderships; good relationship with the school; not a good relationship with legal or illegal residents inside the EPA. All relationships are not official	Informal, but close relationship with sports people; past partnership with the university, but no formal relationship now

Table 2 Summary of the interviews with respondent 3

Question	Respondent 3
What is your professional occupation?	Program coordinator
What is your relationship with the EPA?	Management of the unit: hiring employees; providing materials; authorizing big activities; supervision of any activities that may cause environmental threats
Are you aware of other individuals or groups frequently related to the EPA that should be relevant to this research?	Residents inside the EPA and religious groups. The coordinator of educational initiatives at the SEMED
Do you have any relationship with other individuals or groups that have a close relationship with the EPA?	Constant conflicts with resident families because of irregular constructions and environmental risky activities. No formal registration about the families living inside the EPAEP and the constant visits of religious groups

employees; authorizing big activities; and supervising any activities that may cause environmental harm in the protected area. About other relevant social actors to participate of this research, the person mentioned a coordinator at the SEMED (Respondent 4), legal residents inside the EPA of Engenho Pequeno and religious groups and. These groups are not formally registered at the Secretary. On the other hand, the legal residents are identified by the SEMMA, but only have a bureaucratic relationship with the Secretary. SEMMA is responsible for approving or not any structural alteration at the legal residents' houses, which often cause conflicts between the community and the entity. Moreover, the respondent affirmed that sometimes those legal residents start fires to burn garbage and it is the responsibility of SEMMA to prevent or combat those kinds of environmentally threatening practices.

4.2 SEMED

Respondent 4 is a program coordinator at the SEMED and is responsible for creating and approving education programs in São Gonçalo city. In relation to the EPA, the coordinator is only responsible for providing the SEMED bus to transport students. The social groups indicated by the respondent in the third question were the school, also mentioned by the bushman, and a colleague from the SEMED (Respondent 5). The Secretary does not have a partnership with the school or any educational institution for projects at the EPA.

Respondent 5 is a supervisor, who supervises EE initiatives of the SEMED in field, such as visits by the school to a municipal seedling nursery. The supervisor also visits schools to ensure maintenance of vegetable gardens, under EE projects. The person does not work with any specific activity at the EPA (Table 3).

4.3 School

The manager of a public elementary school (Respondent 6) was indicated as a key stakeholder by the bushman (Respondent 1) and one of the employees of the SEMED (Respondent 5), who explained that the proximity of that institution to the conservation unit is a facilitator for the organization of leisure and educational activities (Table 4). Most of the tourist visits for field class are focused on observing animals and learning about medicinal

Table 3 Summary of the interviews with respondents 4 and 5

Question	Respondent 4	Respondent 5
What is your professional occupation?	Coordinator of programs	Supervisor of programs
What is your relationship with the EPA?	Approves the use of the SEMED bus to transport student for educational visitations	Does not work or participate of activities at or about the EPA
Are you aware of other individuals or groups frequently related to the EPA that should be relevant to this research?	The school and the program supervisor at the SEMED	Question not included in Respondent 5 interview
Do you have any relationship with other individuals or groups that have a close relationship with the EPA?	Any partnership with universities or formal programs of education with schools about the EPA. Thinks participation of universities is important	Personal connection with one of the Catholic religious group

Table 4 Summary of the interview with respondent 6

Question	Respondent 6
What is your professional occupation?	Manager
What is your relationship with the EPA?	The proximity facilitates the use of the EPA for leisure and educational activities. Most of the visits are about Science classes to talk about animals and medicinal plants
	There are tourist visits with students to the area every month with different groups. Good and close relationship with the EAP administration, only. The school is available for educational activities related to the EPA. It is often used as a place of reunion or class for groups before they go for a trail at the area
Do you have any relationship with other individuals or groups that have a close relationship with the EPA?	Did not precisely replied. Only mentioned the school community

Table 5 Summary of the interviews with respondent 7

Question	Respondent 7
What is your professional occupation?	Car mechanic
What is your relationship with the EPA?	Visits the area every day to practice mountain bike
	The EPA means 'everything.' It is a place to practice sports and to be in contact with nature
	Always participates of the activities offered to the community in the EPA. Helps in propagating the activities within community. Informal and close relationship with the EPA administration, only. The EPA has personal value as a space to enjoy nature and leisure with family. Always communicates when goes to the EPA to exercise and helps to maintain the trails clean and safe. Also communicates any suspicious or risky practices from other visitors at the area
Do you have any relationship with other individuals or groups that have a close relationship with the EPA?	The association of residents of the Engenho Pequeno's neighborhood

plants. The school has a good relationship with the unit's local administration, but not an official partnership. The school is often used for hosting speeches and meetings of visiting groups before heading out on guided trails at the EPA.

4.4 Resident

Respondent 7 is a resident of the Engenho Pequeno neighborhood and the most regular visitor of the EPA of Engenho Pequeno. The reason f is the daily practice of mountain biking. In the interview, summarized in Table 5, EPA means everything to the person, primarily, because it is a place to practice sports and to be close to nature. Respondent 7 reflected on the fact that they used to visit the area, before the creation of the EPA, with family for fishing at the waterfall, now totally dried. The resident has a good relationship with the unit's local administration and is always participating in public activities. The person also helps promoting those programs within the local communities. The social actor indicated by the respondent was the association of residents of the Engenho Pequeno neighborhood. It does not have constant or formal relation with the EPA of Engenho Pequeno, but it is probably open to a partnership.

4.5 Total of stakeholders identified

In summary, the total number of social groups identified as stakeholders through the interview process is nine: EPA's local management; SEMMA; SEMED; a public elementary school; a public university; the resident's association of the Engenho Pequeno neighborhood; the community of residents legally inside the EPA; the illegal residents inside the area and religious groups. In data collection, seven respondents were interviewed, representing five stakeholders (Respondents 1 and 2 represent one stakeholder—EPA administration—and Respondents 4 and 5 represent one stakeholder—SEMMA). Not all of the social actors indicated in the first interviews could be contacted due to logistic limitations, in particular and importantly, one or more representatives from the community living inside the unit, and one or more representatives from the three identified religious groups.

5 Discussion: EPA of engenho pequeno management stakeholders: who are they?

According to the Brazilian law that establishes the National System of Protected Areas Management—SNUC, conservation units are created to improve environmental conservation, but also to benefit society and local and/or traditional communities (Law No. 9.985). For that, the participatory management must be adopted by managers, to include communities, populations and social groups in the process of decision making (Brasil, 2016). That concern is connected with the international goal of engaging society in global biodiversity protection efforts (UNEP-WCMC & IUCN, 2021).

For the case of the EPA, the religious groups and the residents inside the area are fundamental in the participatory management process. The religious groups visit the area for traditional practices, which gives the EPA of Engenho Pequeno a cultural meaning. The fact that they have specific spaces for their meetings and activities, maintained by the conservation unit's administration, reveals that they already have a connection with the management office.

In the same way, the status and condition of the conservation unit directly impact local residents' living conditions. According to the SEMMA's respondent (Respondent 3), every improvement or service implementation that the community needs has to be evaluated and

approved by the Secretary. Also, Respondent 3 mentioned incidents with fire in the area and the 'lack of knowledge' by the families about environmental protection rules. These situations highlight that the relationship between SEMMA and residents can be a complicating factor in building a participatory management network.

The role and impact of local communities in decentralized management is a point of debate within the literature. Bixler (2014), for example, argues that, most times, government is the actor that gives the final approval about the network's decision. According to Dietz et al. (2003), while opinions of social groups are collected, the real power of planning and decision making and plan belongs to the government or to any powerful stakeholders. Thereby, the process ends up repeating the social imbalance that exists in traditional practices of governing. Despite this fact, the literature overwhelmingly agrees across a wide array of resource governance and management issues and contexts—from forests to parks to watersheds—that while government is an important actor in the governance network, it should not be the determiner of all decisions. Its role can be steering, directing the decision making according to major plans, such as public policies, but ultimately it is those closest to and most dependent upon the resource who should have the final say in plans, policies, decisions and actions (Bierman et al., 2010; Rhodes, 2007).

However, social groups can organize themselves to get their voices heard by government and other entities of strength in environmental governance. In Peru, for example, Pavelka (2012) shows how the Huari family and its community are an example of effective local social mobilization. Living at one of the most famous trails to Machu Picchu, the Huari are farmers that offer simple, guided tours and accommodation for tourists in their community. They engaged their neighbors on a network of small providers of touristic services to fight big international tourism companies. The association could organize income activities for every family and avoid a legal restriction that would forbid the job of the traditional tour guides in advantage of the foreign companies (Pavelka, 2012). EPA's residents could learn from the Peruvian case, uniting their currently fragmented approaches to deal with the SEMMA about regulations and activities.

The population living adjacent to the protected area is almost not mentioned in the interviews but it is represented by Respondent 7. As a neighbor of the EPA of Engenho Pequeno, the person describes a personal connection with the area, which means an intrinsic value of nature. In addition, the community respondent also mentioned the association of residents of the Engenho Pequeno neighborhood. It is the closest community nearby the EPA's headquarters, yet it has no formal relationship with the unit's local administration or with the SEMMA.

The guidelines for conservation units in Brazil recognize traditional and nontraditional communities, living inside and around the protected areas, as main actors, more than audience, in participatory management (Brasil, 2016; Layrargues, 2000). Considering the existence of an organized entity to represent the residents nearby the EPA's headquarters, the SEMMA and the area's local administration already know where to start a relationship with that population. In the same way, the association knows about the conservation unit's existence and could take the initiative to stimulate the population in occupying that space as tourist visitors and as community historically related to the area.

Elsby (2012) illustrates how enjoying natural areas nearby our homes is not only making tourism but supporting local economy and business. In Canada, many options exist to 'go local': parks and green areas, local food tours, participating in small-scale agriculture as part of WWOOF—the World Wide Opportunities on Organic Farms (Elsby, 2012: 22). Elsby also describes an increasing interest among Canadians in participating with First Nations communities in a variety of activities, so helping to build social capital in divided

societies. Seeing local areas as accessible and affordable raises possibilities for building an ecosystem sensibility across degraded and urbanized landscapes through networks of small-scale parks and green areas. In São Gonçalo, the EPA of Engenho Pequeno could be an interesting option for ecotourism, promoting EE (Pavelka, 2012), improving local economy and, especially, connecting the population with its own territory and history.

6 Discussion: how to make participatory management work in the EPA of engenho pequeno?

After all, why is not participatory management working in the EPA of Engenho Pequeno yet? Probably, because the government is not engaged in that cause. Beyond the argument of a low budget for environmental conservation, as it appears in the results of this study, the government of São Gonçalo is not really committed with the sustainable management of the only conservation unit of that municipality. However, management and governance have to walk together (Lemos & Agrawal, 2006). The first one on a local level and the last one in higher scale, connected with national and international decision making. So, how to make the local government of São Gonçalo care about the EPA? As previously mentioned, EE is a recommended strategy to build participatory management in conservation units in Brazil. In other parts of the world, it has also been implemented to discuss the sustainable use of natural resources with communities inside and nearby protected areas (Leisher et al., 2012; Matsvange 2016). It is important to highlight that the approach for EE considered in this study is the critical currency, which integrates and contextualizes ecological debates with social structure and issues (Sauvé, 2005).

The discussion here is not about the structure of a program in EE. For that kind of structure, Brazil has a variety of guidelines (Brasil, 2016), legislation (Law No. 9.985), national plans (Law No. 9795) and academic studies (Lopes & Ambivero, 2017; Loureiro & Cunha, 2008; Loureiro, 2004; Layrargues 2000). The topic here is how EE can be shaped to defend the participatory management of a protected area. In participatory management, EE is used to also connect stakeholders, especially communities, to biodiversity protection and, consequently, sustainable development. For example, in Indonesia, a program conducted in marine protected areas of an archipelago by an international NGO was centered in education and outreach activities. Leisher et al. (2012), argue that the initiative helped improve the relationship between the community and the MPA's management by discussing regulations about protected areas and natural resources usage with the population. In Zimbabwe, Matsvange et al. (2016) studied an EE program about forestry conservation with a community of farmers in protected forests. In both cases, the most positive outcomes described by the authors were the change of opinion, and, more importantly, the change of behavior of those populations.

Improving actions for social and environmental transformation is one of the principles of EE (Guimarães, 2016), and also environmental advocacy (Keck & Sikkink, 1998). In the Leisher et al. (2012) and the Matsvange et al. (2016) case studies, education advocated for biodiversity conservation among communities. Scholars relate education and advocacy in the environmental case as distinct from each other but clearly in alliance (Fleet, 2020; Niblett, 2012). Both the Indonesia and Zimbabwe cases illustrate the positive aspects of this alliance, showing that advocates of environmental sustainability find success through education and training.

There are clear lessons to be learned from Indonesia and Zimbabwe for the case of São Gonçalo's EPA. For example, all stakeholders may be brought together in an educational forum to discuss the future of the conservation unit. In this way, those residing within the EPA, those living adjacent to it, as well as the more dispersed religious groups, could participate meaningfully in debates about the relationship they have with the Engenho Pequeno's natural area. To facilitate such an exercise, partnerships with two other stakeholder (Law No. 9795) are essential: the public elementary school and the public university. The school is very close to the EAP headquarters and most of the children and teenagers study there. The university, on the other hand, could be a key actor to the governance of the conservation unit, contributing to the consolidation of appropriate methodology and materials for the EE program (Brasil, 2016; Guimarães, 2016). The overall exercise must be overseen by the SEMED, which is already involved, albeit not in an intense level, with the educational activities at the EPA of Engenho Pequeno.

However, more than constructing and sharing knowledge about biodiversity protection, the main goal of EE must be empowering the social groups related to the EPA to make their voices heard by the government. That is what EE would advocate for toward that conservation unit's management and governance. Beyond changing the community's practices about the environment and the relationship they have with the area, it would expect to change decision-making processes and practices on municipal and national levels. To properly work, management and governance arrangements must reflect the facts that stakeholders have different interests (Lemos & Agrawal, 2006), and are affected in different ways by the management and governance process and result in the protected area (Bixler, 2014). Given such complexities, a win–win plan is not enough to ensure good governance (Wells and McShane, 2004). The best strategy is to address and to negotiate the difference of interest between stakeholders. The community already has the argument about the local relevance of the EPA, considering cultural, environmental and educational purposes. But why is that conservation unit relevant to Brazil and to the globe? How would EE make the São Gonçalo government care about it?

One of the greatest challenges for conservation is getting disinterested but powerful actors to function as effective and committed stakeholders (Swatuk, 1997, 2005, 2008). What is needed is a particular discursive framing that will bring local and national government together with civil society in common cause. As described above, the appropriate context at local level is oftentimes no less complicated. Yet, the fact that stakeholders inhabit the same physical space makes particular methodologies more relevant, such as the proposed stakeholder forum. On a national level, we suggest that centering the conservation and sustainable management of small (and therefore seemingly unimportant) green areas within the climate change discourse may be an effective advocacy and EE strategy. Beyond the intrinsic value of nature, the conservation of all protected areas in Brazil, small or large ones, is relevant for climate change adaptation (e.g., watershed protection; cooling effects on urban heat islands; flood abatement) and mitigation (e.g., carbon sequestration) strategies. In other words, the small and seemingly insignificant protected areas, when related to the international debate about current and future impacts of climate change, may imbue these units with relevance and broader purpose. The Brazilian National Plan for Climate Change (PNMC in Portuguese) has a specific section for biodiversity and ecosystems. It includes the goal of creating new conservation units and consolidating the existing ones.

The speech of Al Gore in the movie An Inconvenient Truth (Bender et. al. 2006) about his research on climate change goes from the physical explanation about global warming to the international political agreements about adaptation and mitigation. When speaking about the USA, Gore presents an interesting example of bottom-up environmental action.

Table 6 Summary of literature review: discursive frames and benefits

Frame	Benefits
Decentralized decision making for good governance and management of natural resources (including ideas such as collaborative governance, polycentric governance, and CBNRM)	Appropriate and more resilient decisions were taken, because all relevant stakeholders had a hand in the decision
	Legitimacy of decision due to collective decision making
	Building of social capital
	Cultivation of social capital between state and civil society
	Municipality included in national plans and policies
	Access to financial incentives
	Accomplishment of national plans—reduction in deforestation, biodiversity protection
	Connection with global efforts for sustainable development—SDGs; Kyoto and Paris Agreements
EE as an advocacy tool for governance of natural resources	Access and collective construction of knowledge
	Empowerment to deal with government
	Opportunity to solve conflicts with social groups
	Participation in global network focused on biodiversity protection for climate change adaptation/mitigation
EE as a strategy for participative management in protected areas	Shared and collectively constructed knowledge
	Connection between social groups
	Accomplishment of EE and conservation units management legislation (PNEA, SNUC)
	Accomplishment of national plans and programs for climate change (PNMC)
	Connection with international efforts—Paris Agreement

As commonly known, the USA did not sign the Kyoto Protocol, an international document focused on setting internationally binding emission reduction targets (see https://unfccc.int/process/the-kyoto-protocol) However, cities across the country started local programs of adaptation and mitigation. Such actions resulted in a network of municipalities and states committed to a meaningful climate change action that extends itself around the world through organizations such as ICLEI, commonly known as Local Governments for Sustainability (https://iclei.org/en/Home.html). It is a very interesting example of the difference and the power that small efforts can have when connected to small initiatives.

EE can then, in our view, use climate change point of view for adaptive management and decentralized governance about protected areas. Monroe et al. (2017) present a systematic analysis about programs of education for climate change all over the world. They studied almost 50 cases (Monroe et al., 2017) and concluded that many strategies for teaching and learning about climate change may be used with different types of contributors or audiences. Many of the EE programs considered presenting a question for discussion among the participants before giving explanations. It converges with the principles of critical EE and of the autonomy pedagogy (Freire, 1996): to consider traditional knowledge, empathy with the topic and appropriation of scientific knowledge. The authors also argue that all successful strategies followed the idea of relating the content about climate change with the audience's reality. They also engaged participants in learning from each other.

Both practices are very close to critical EE for adaptive management in conservation units in Brazil, such as the EPA of Engenho Pequeno.

The table below (Table 6) summarizes the arguments of the literature review cited in this study. The complete table, with all the references, can be found in Appendix 1. In there, we organized the benefits of education and participatory management for the governance of a small protected area. We considered the local, national and global levels of outcomes for the community, the municipal government and the national government.

7 Conclusions and recommendations

This paper identifies the potential main social actors involved in and affected by the conservation and use of the EPA of Engenho Pequeno, in São Gonçalo city, Rio de Janeiro state, Brazil, and discusses how EE can be shaped to engage them in participatory, socially progressive and environmentally sustainable management for that area. It should be noted that the results here are not definitive, but rather, they are indicative of the array of stakeholders involved. By examining the interests and formal and informal roles played by key stakeholders, we can then hypothesize—based on comparative findings from secondary studies—as to the challenges and opportunities for EE to act as an advocate on behalf of not only the EPA but of all those interested in its sustainability. In the end, we recommend the hosting of a one or more-day long workshop that is built around existing Municipal and State environmental goals utilizing the complementary discursive framings of collaborative governance (appealing particularly to the local and state level) and climate action (appealing particularly to the national level).

Our results show nine key stakeholders. In the official management of EPA, there are as follows: (i) the Municipal Secretary of Environment (SEMMA, in Portuguese) and (ii) the conservation unit's local administration. In the community, the results are as follows: (iii) religious groups, (iv) legal residents inside the area, (v) illegal residents also inside the area, and (vi) population nearby the EPA. Finally, among education entities, there are as follows: (vii) the Municipal Secretary of Education (SEMED, in Portuguese), (viii) one public university and (ix) one elementary public school. The management has no data about tourist visits to the unit, neither how often nor how many people visit the area; nor does it have any formal partnership with the school, the community, or with other government entities. In the same way, visitors from the local community are not connected to each other and have no formal relationship with the area's administration. This suggests that any form of participatory, collective or collaborative management will require a method to draw stakeholders together in common cause and in the absence of a catalyst of some kind, is likely to be a drawn out process (Mihalic, 2012; Weiler et al., 2012).

EE can be a process to approach those social actors as stakeholders on a network for management and governance of the EPA. The association of residents nearby the area, the religious groups, the residents inside the EPA of Engenho Pequeno and the closest elementary school are social actors representing the population, the totality of which constitutes the key stakeholders most directly affected by the condition of the area. They must, therefore, be the main actors in building the sustainable management of the protected area. At the same time, sustainability must meaningfully engage government actors. The SEMMA is the entity to be strategically touched by the community's voice and by the relevance of the conservation unit to the municipality and the country. There are many options of methods and materials to be used in that work, suggested by Brazil's environmental legislation

and academic publications. The cooperation of the local university, or other academic institutions, and the SEMED must be responsible for finding the best structure for the program.

How to bring these diverse stakeholders and actors together? In our view, climate change point of view may serve as the most effective means to engage government and other stakeholders about the relevance of connecting the local management with a higher scale process of governance. That topic is considered in the most important public policies and plans of Brazil and of the environmental international agreements.

We recommend the mounting of a workshop of one or more days to bring together all the stakeholders (Brasil, 2015, 2016) with the common theme of working for accomplishing the municipal Policy Management of Green Areas (see https://goo.gl/V26wr6) and the Master Plan of São Gonçalo city (see https://leismunicipais.com.br/a/rj/s/sao-goncalo/lei-complementar/2009/1/1/lei-complementar-n-1-2009-plano-diretor-do-municipio-de-sao-goncalo). Both documents highlight, besides the creation of new protected areas, the improvement of conservation and tourist visits in the current green areas of the city. The elementary public school can host the workshop. It is very close to the EPA headquarters and has been used before by the conservation unit's management for meetings.

Facilitation and/or mediation is required to ensure the participation of all stakeholders (Loureiro & Cunha, 2008). That is a role for external consultants or the academy (Brasil, 2015, 2016), though it is important to remember that the local state university is also a stakeholder. Such a workshop can be structured around the mutually reinforcing discourses of local, collective and collaborative resource management and national approaches to achieving climate change goals.

Future studies can work on the definition or suggestions of methods and materials for the EE program for management and governance. Case studies mentioned in this paper can be a starting point. Also, a further mapping of the social actors, including the ones not interviewed for this study because of logistic limitations, is important for the final program approach definition.

Resource governance and management are two sides of the same coin. Devising appropriate rules and procedures satisfactory to all is difficult at best and oftentimes impossible altogether. There continues to be an abiding belief in the progressive possibilities of participatory governance (e.g., Armitage, 2005), yet power and other social, political and economic disparities create an uneven playing field (Nayak & Berkes, 2011; Swatuk, 2005). In the context of Engenho Pequeno, it is our belief that establishing collaborative spaces, such as workshops, framed around widely agreed to goals and ideals, is a possible and necessary starting point.

Appendix 1

See Table 7.

Table 7 The literature review of the study: discursive frames and benefits

Frame	Authors	Audience	Level	Benefits
Decentralized decision making for good governance and management of natural resources (including ideas such as collaborative governance, poly-centric governance, and CBNRM)	Rhodes (1996, 2007) Bixler (2014) Dietz et al. (2003) Bierman et al. (2010) Armitage et al. (2012) Lemos and Agrawal (2006) Brasil (2016) Swatuk (2005)	Communities/population	Local	Appropriate and more resilient decisions were taken, because all relevant stakeholders had a hand in the decision Legitimacy of decision due to collective decision making Building of social capital
		Municipal government	Local	Cultivation of social capital between state and civil society
			National	Municipality included in national plans and policies Access to financial incentives
		National government	National	Accomplishment of national plans—reduction in deforestation, biodiversity protection
			Global	Connection with global efforts for sustainable development—SDGs; Kyoto and Paris Agreements
EE as an advocacy tool for governance of natural resources	Fleet (2020) Niblet (2012) Keck and Sikkink (1998)	Communities/population	Local	Access and collective construction of knowledge Empowerment to deal with government
		Municipal government	Local	Opportunity to solve conflicts with social groups
		National government	Global	Participation in global network focused on biodiversity protection for climate change adaptation/mitigation
EE as a strategy for participative management in protected areas	Layrargues (2000) Lopes and Ambivero (2017) Loureiro and Cunha (2008) Ardoin et al., 2020 Loureiro (2004) Brasil (2016) Matsvange et. al. (2016) Leisher et. al (2012)	Communities/population	Local	Shared and collectively constructed knowledge Connection between social groups
		Municipal government	National	Accomplishment of EE and conservation units management legislation (PNEA, SNUC)

Table 7 (continued)

Frame	Authors	Audience	Level	Benefits
Climate action	Wells and McShane (2004), Al Gore (in Bender et. al., 2006), Monroe et al. (2017)	National government	National	Accomplishment of national plans and programs for climate change (PNMC)
			Global	Connection with international efforts—Paris Agreement

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