

The role of Quilombola communities in endemic species conservation programs in the Atlantic Forest

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The role of *Quilombola* communities in endemic species conservation programs in the Atlantic Forest

Abstract: The Atlantic Forest in Brazil is a biodiversity hotspot and home to traditional communities, including *quilombolas*. Among its endemic and threatened species is the Juçara palm (*Euterpe edulis*), a keystone species to ecosystem resilience and community livelihoods. This study presents the first in-depth assessment of a Payment for Ecosystem Services (PES) program involving *quilombola* communities—the PES Juçara—designed to promote conservation and restoration of the Juçara palm. Through semi-structured interviews and content analysis, we examined how the program is perceived by participants, focusing on governance structures, community engagement, and socio-environmental outcomes. Our findings reveal that participants' strong connection with the Juçara palm and traditional ecological knowledge are central to their engagement in conservation activities. The program has provided resources to support environmental action, often inaccessible due to financial constraints. Reported benefits include improved water security, habitat recovery, and opportunities for sustainable income through the legal sale of Juçara seeds and pulp. Personal and social gains such as training, property improvements, and youth retention in rural areas were also cited. Trust between communities, program managers, and environmental monitors—many of whom are local—was identified as a condition for the program's success. However, participants also raised concerns about limited enforcement against illegal harvesting, indicating the need for stronger protection of species and community rights. This study underscores the importance of tailoring PES initiatives to the socio-ecological realities of traditional communities. By integrating local knowledge and cultural values, PES programs can contribute to biodiversity conservation, social justice, and long-term sustainability in culturally rich landscapes.

Key-words: Payment for Ecosystem Services; Juçara palm tree; Conservation; Traditional communities; *Quilombola*; Perception study.

1. Introduction

The Atlantic Forest has a history of occupation and landscape transformation since the pre-colonial period (Solórzano et al., 2021); however, it was with the arrival of Portuguese colonizers, that this process intensified, resulting in degradation which currently continues, even in the United Nations Decade for Ecosystem Restoration (2021-2030) (Carlucci et al., 2021; Guedes Pinto & Voivodic 2021). The reduction in forest cover, resulting from deforestation driven by the intensification of monocultures and pastures, leads to the emergence of small forest fragments, the loss of habitat, the extinction of species, and the decrease in ecosystem services provision, also compromising the traditional communities' well-being who inhabit the ecosystem (Castro et al., 2006; Silva, 2008; Ribeiro et al., 2009; Mittermeier et al., 2011; Marques & Grelle, 2021; Solórzano et al., 2021; Vancine et al., 2023). This scenario urges the adoption of sustainable land use practices, conservation, and forest restoration strategies, to ensure ecosystem resilience and social well-being.

Considered one of the planet's hotspots, the Atlantic Forest is important in biodiversity conservation and ecosystem services provision (Myers, et al., 2000; Marques & Grelle, 2021). Located predominantly in Brazil, it has high diversity and endemism (Myers, et al., 2000; Marques et al., 2021). With an original area of 1.6 million hectares and a relief that includes mountains, plateaus, plains, and depressions, the biome is home to more than 20,000 species of animals, of which approximately 6,000 are endemic (Marques et al., 2021). Among mammals, reptiles, birds and amphibians, some of them live in small fragments distributed throughout the biome. The ecosystem is also composed of different types of vegetation (e.g. *Euterpe edulis* - Bello et al., 2021), differentiated in terrain, location, age, and climate (Marques et al., 2021). Threatened with extinction, species, especially endemic ones, are crucial for the maintenance and resilience of ecosystems and are economically and culturally important for human populations (Mittermeier et al., 2011).

This biome is also culturally rich, being home to several traditional communities (Castro et al., 2006; Silva, 2008) that maintain direct contact with nature and utilize its resources for their subsistence and cultural preservation (Instituto Socioambiental & Associações Quilombolas, 2010). One of these communities are the *quilombolas*, descendants of enslaved diverse cultural groups of Africans, who in an act of resistance to slavery, sought refuge in the forests, where they grouped and formed *quilombos*, today characterized as villages and rural neighborhoods (Diegues and Arruda, 2001; Santos & Tatto, 2008; Instituto Socioambiental & Associações Quilombolas, 2010; Prado, 2022). These settlements also originated from the occupation of lands abandoned by large landowners; and even through inheritance or donated lands (Silva, 2008). In various regions of Brazil, these individuals established themselves as small-scale farmers in the forested areas of the country's interior (Instituto Socioambiental & Associações Quilombolas, 2010).

In the Ribeira Valley, Southern Brazil, after the decline of gold mining, many *quilombola* communities were formed along the Ribeira de Iguape River, between the municipalities of Iporanga and Eldorado, where they continue to exist and resist to this day, using nature resources like *Juçara* palm tree - *Euterpe edulis*, a prominent endemic species of the Brazilian Atlantic Forest, that faces the threat of extinction due to overexploitation resulting from the removal of its palm heart (CNCFlora, 2012; Fundação Florestal, 2024).

Occurring from the south of Bahia (Northern Brazil) to the north of Rio

Grande do Sul (Southern Brazil), *Juçara* palm is important in its role in the food chain of several fauna species and its contribution as an additional source of income for traditional communities (dos Reis et al., 2000; CNCFlora, 2012; Vianna et al., 2022; Fundação Florestal, 2024). The extraction of *Juçara* palm heart has become the main economic and subsistence source for the *quilombola* communities (Santos & Tatto, 2008; Barroso & Hanazaki, 2010), and the exploitation by these traditional populations has been ongoing for many years. In the 1950s, the commercialization of *Juçara* palm hearts began, leading to intense extraction that escalated in the 1960s with the arrival of new explorers, increasing pressure on natural populations (Instituto Socioambiental & Associações Quilombolas, 2010). Until 1960, *Juçara* palm was the main source of palm hearts in Brazil, but high demand and unsustainable practices caused a population decline (Galetti & Fernandez, 1998). Although forest police began monitoring illegal cutting in the 1970s, exploitation persisted due to clandestine factories (Instituto Socioambiental & Associações Quilombolas, 2010). In response, the federal government enacted Decree No. 99547 in 1990 to prohibit cutting native species in the Atlantic Forest, followed by regulations in São Paulo in 1994 and Federal Decree No. 750/98 in 2003, which allowed *Juçara* palm sustainable management. Yet, the 2006 Atlantic Forest Law reintroduced restrictions to conserve native species (Instituto Socioambiental & Associações Quilombolas, 2010).

The commercial demand of *Juçara* palm hearts and fruits drives its continued exploitation (Galetti & Fernandez, 1998; Vianna et al., 2022). Despite legal frameworks for sustainable management, illegal trade persists (Muler et al., 2014), leading to the decline of natural populations and cascading ecological impacts (Galetti & Fernandez, 1998; dos Reis et al., 2000; CNCFlora, 2012; Muler et al., 2014; Fundação Florestal, 2024). Since the *Juçara* palm is single-stemmed, harvesting the heart requires cutting down the entire plant, hindering natural regeneration (dos Reis et al., 2000; CNCFlora, 2012). Therefore, conservation and restoration efforts, often led by traditional communities, are crucial for the species's survival. Traditional communities worldwide live in harmony with nature, develop sustainable practices that conserve biodiversity and protect their natural surroundings (Maru & Haile, 2020). The traditional knowledge enhances their resilience and ability to maintain ecosystem services (Gómez-Baggethun et al., 2013; Hassen et al., 2023). Many natural elements hold cultural significance, which often results in their preservation. For instance, some indigenous groups prohibit harming sacred forests, fearing negative consequences for offenders (Maru & Haile, 2020). Incorporating this knowledge into conservation, restoration, and public policy efforts is vital for safeguarding nature.

In this study, we explore the role of *quilombola* communities in conserving *Juçara* palm populations. To mitigate overexploitation and preserve both the species and cultural traditions, these communities have initiated efforts to replant *Juçara* palm seeds in forests and degraded areas, as well as cultivate seedlings in nurseries (Instituto Socioambiental & Associações Quilombolas, 2010). A more recent initiative is the Payment for Ecosystem Services (PES) *Juçara* program, launched by Fundação Florestal (i.e. Forest Foundation - FF) in 2021. This program incentivizes *quilombola* communities in the Ribeira Valley to plant *Juçara* palm by providing financial compensation over five years, with the goal of increasing the species' population within and around protected areas (Fundação Florestal, 2024).

Although PES *Juçara* program is a promising initiative, it remains underexplored. To date, only one study has examined its development, focusing on local production arrangements (Nunes et al., 2023). This paper presents a unique analysis of the conservation and restoration efforts for the *Juçara* palm, led by

quilombola communities within the PES framework. Using qualitative research, we assess the environmental and social impacts of the PES *Juçara* from the perspective of the *quilombola* communities. Specifically, we evaluated governance structures, community involvement, and the environmental, personal, and social benefits of the program.

2. Methods

2.1 Study area

The study was conducted in *quilombola* territories, located within Sustainable Development Reserves (SDR) and Environmental Protection Areas (EPA) in Ribeira Valley, state of São Paulo. These Protect Areas correspond to two categories of protected areas intended for sustainable use, and are equivalent to the International Union for Conservation of Nature (IUCN) classifications of Protected Areas with Sustainable Use of Natural Resources (category VI) and Protected Landscape or Marine (category V), respectively (CNUC, 2024). The research focused on territories within the Ribeira de Iguape and South Coast Water Resources Management Unit (Figure 1), in the State of São Paulo. This region features a drainage area of 17,068 km² and a population of 369,743 inhabitants (Andrade et al., 2013; CBH-RB, 2019). Economically, the area is notable for its agriculture, particularly banana cultivation, and mining activities, as well as trade and services sector. The basin is well-preserved, with approximately 72% of its territory covered by native Atlantic Forest vegetation and continuous forest remnants (CBH-RB, 2019; Maciel et al., 2021). A significant portion of the Ribeira Valley is designated as environmental protection areas, covering various categories of protected areas to preserve biodiversity and cultural, historical, and archaeological heritage (Brazil, 2000; Maciel et al., 2021; Martines et al., 2023). This region's unparalleled social and cultural diversity is home to most of Brazil's *quilombola* communities. Due to its extensive preserved forest, the Ribeira Valley was designated a Natural Heritage Site of Humanity by UNESCO in 1999 (Andrade et al., 2013).

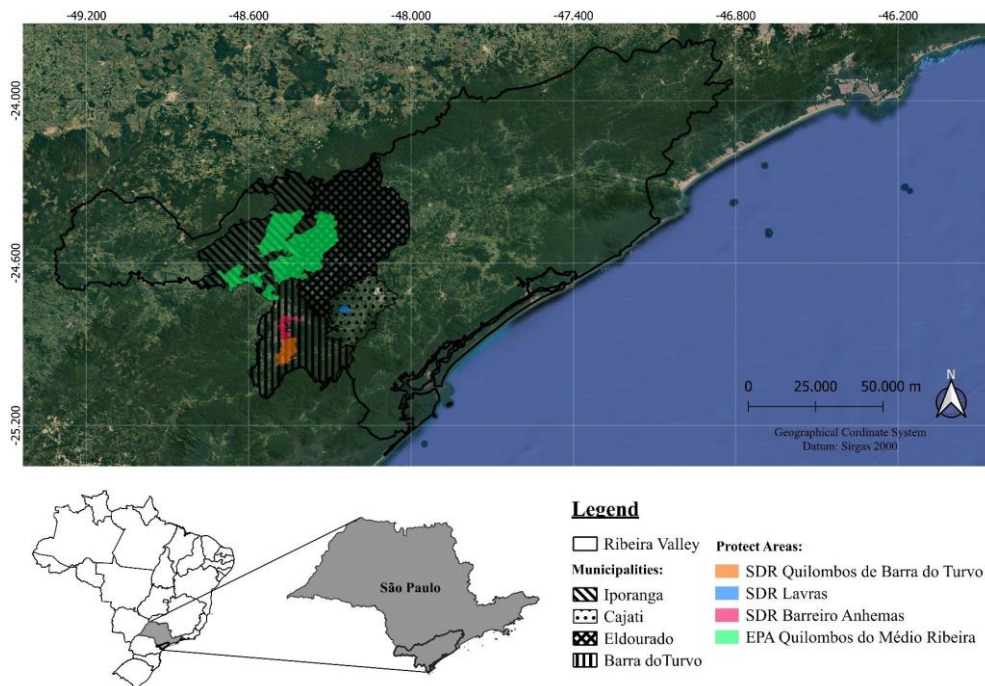


Fig.1 Map of the study Protect Areas' locations. Source. Prepared by the authors. Note: Sustainable Development Reserve (SDR) and Environmental Protection Areas (EPA). Map lines delineate study areas and do not necessarily depict accepted national boundaries

2.2 The PES *Juçara*

According to Fundação Florestal, the entity responsible for managing protected areas in the state of São Paulo, PES *Juçara* was designed to support the repopulation of the *Juçara* palm tree. The program, launched in 2021 (signing of contracts and start of planting), aims to remunerate *quilombola* communities who plant *Juçara* palm seeds or seedlings over 5 years. To participate, in addition to having properties in the selected areas (EPA *Quilombos do Médio Ribeira*, SDR *Lavras*, SDR *Barreiro-Anhemas*, SDR *Pinheirinhos*, and SDR *Quilombos de Barra do Turvo*), interested parties undertake not to cut down any palm trees to obtain palm hearts for approximately 7 years. However, during the project, it is permitted to harvest and sell seeds and fruits in the form of products such as pulp and ice cream. In addition, producers must take some low-cost and high-environmental-impact compensations, such as building boxes for native bees and receiving school visits on the property (Fundação Florestal, 2022). The program completed 2 years of implementation in September 2024.

2.3 Sample universe

Data collection with *quilombola* communities was carried out in four Protected Areas: SDR *Barreiro Anhemas* (Community named *Anhemas*), SDR *Quilombos de Barra do Turvo* (Communities named *Pedra Preta*, *Cedro* and *Ribeirão Grande*), SDR *Lavras*, and EPA *Quilombos do Médio Ribeira* (*Quilombos Piririca*, *Ivaporunduva*, *Pedro Cubas de Cima*, *Pedro Cubas* and *Nhunguara*). In total, 24 households were selected, using the simple random sampling method (Newing et al., 2011). Individuals who refused to participate were replaced through a new selection process, repeated until the desired sample size for the study was reached. Meetings were held with the councils of the Protected Areas involved, managers, and leaders of the study areas. They were willing to interact with the communities and move around the study area, consulting on residents' willingness to participate in the research. They did not accompany interviewers during interviews to minimize interference with responses; however, they were essential in first contact with the population.

2.4 Data collection

The study received approval from the ethics committee of São Paulo State University (UNESP) (Opinion 5.578.773 – Approval August 12, 2022) and from IPA - Research Registration and Management of the Secretariat of Environment, Infrastructure, and Logistics of the State of São Paulo (Document 0000029727/2023; Process No. 000000015224/2022 – Approval April, 23, 2023). Ethical measures were followed during the research. Data collection was supported by researchers and postgraduate students from the same research project, and initial contact with *quilombola* communities was facilitated by protected areas' managers and environmental monitors. To ensure the anonymity of the respondents, all of whom were of legal age, the survey did not identify their names or the location of their properties or residences. Additionally, time was allocated to administer pilot questionnaires and refine their format (Newing et al., 2011).

During pre-scheduled field visits (Newing et al., 2011; Biggs et al., 2021), information was collected through dialogues using structured face-to-face guide questionnaires applied in person. They comprised 15 open-ended questions and 24 closed-ended questions, covering various topics such as social aspects (e.g., education), economic aspects (e.g., family income), cultural dimensions (e.g., beliefs), and traditional knowledge (e.g., agricultural techniques). The initial questions aimed to outline the socioeconomic profiles of the respondents, while subsequent questions sought to explore their perceptions, opinions, involvement, and participation in the PES, as well as their environmental and social perspectives. The methodologies employed were based on established practices in anthropology, social sciences, and socio-ecological studies, with a focus on Human Ecology (Newing et al., 2011; Biggs et al., 2021).

2.5 Data analysis

The governance arrangements, *Juçara* conservation actions, and environmental, personal, and social benefits were evaluated qualitatively using resources such as notes, memos, and content analysis (Newing et al., 2011; Drisko et al., 2016; Erlingsson et al., 2017; Biggs et al., 2021). Content analysis was used as it is widely employed in qualitative research to identify viewpoints, attitudes, interests, and opinions of individuals and diverse groups (Drisko et al., 2016). Considering that data based on human experiences are complex and carry multiple meanings, the frequency of words or excerpts from the interviews was used to understand the importance of specific content, aiming to condense and summarize relevant insights (Drisko et al., 2016; Erlingsson et al., 2017). Adapted from Erlingsson et al (2017), the steps followed in the analysis were: (i) transcription of the interviews; (ii) division of the texts into smaller parts, or meaning units; (iii) condensation of the meaning units; (iv) development of descriptive codes for the meaning units; and (v) creation of categories (Figure 2).

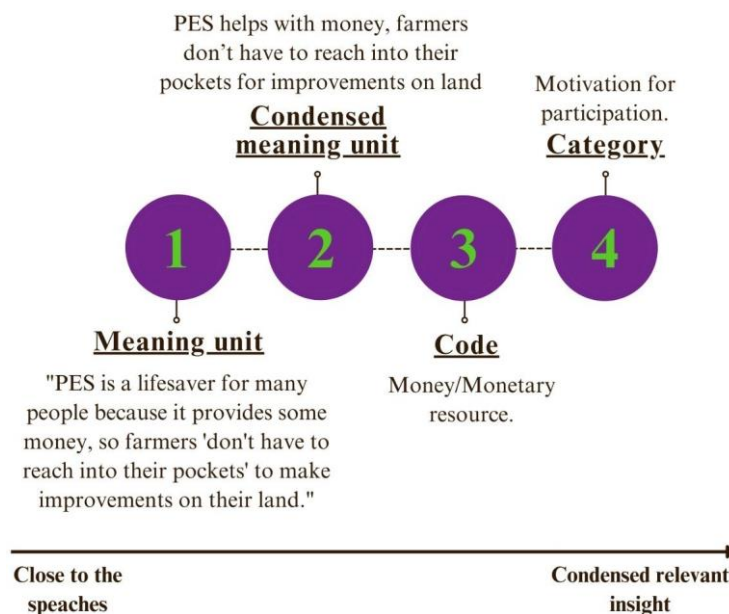


Fig.2 Example of the steps for analyzing speeches using content analysis (Adapted from Erlingsson et al., 2017). In the lower left corner is the dialogue as stated by the interviewee, and in the lower right corner is the condensed relevant theme extracted from the dialogue

3. Results

3.1 *Juçara* palm conservation efforts

The beneficiaries were actively engaged in various conservation and restoration activities to preserve the *Juçara* palm, which aligned with the program's objectives. The community was empowered to choose whether to plant seedlings, seeds, or both, taking responsibility for the planting, maintenance, and replanting as necessary. Planting and reforestation sites varied, with most located in Permanent Preservation Areas (PPAs). This initiative sought not only to protect the soil but also to enhance water supply and flow in the region. Planting also occurred in areas identified as *capoeirões* (abandoned pastures or agricultural lands undergoing native vegetation regeneration), as well as in unutilized open spaces within the forest and on slopes near the participants' homes. Additional activities included erecting fences around *Juçara* palm plantations, donating seedlings, and processing seeds for commercialization, with most directed to the state and a portion of the pulp sold at local markets. Furthermore, participants attended PES-sponsored courses (e.g., native bee cultivation) and installed bee boxes near their homes and/or *Juçara* palm

plantations to promote pollination (Angelo, Personal Communication).

Most of the beneficiaries interviewed were already engaged in *Juçara* palm conservation activities independently. Some had *Juçara* palms in their backyards for reasons such as personal interest, participation in similar programs, intrinsic value, aesthetic appeal, subsistence, traditional cultivation practices passed down through generations, providing shade, and even serving as windbreaks. Others began planting and conserving *Juçara* palms due to incentives from other environmental programs, such as Cooperafloresta, which focuses on agroforestry and, like PES, offers financial compensation for participants' efforts, as well as the ITESP (i.e. Institute of Lands Foundation), which promotes reforestation without financial rewards. Only one individual reported having had no prior engagement with the *Juçara* palm—stating, "I never worked with it" — but was motivated to participate by the desire to reforest the area and the financial compensation received for the effort. The person anticipated that, in the future, they would benefit from the opportunity to commercialize the *Juçara* palm pulp and seeds.

3.2 Perspectives on *Juçara* extraction

Many beneficiaries discussed their knowledge of issues related to *Juçara* palm extraction, emphasizing their awareness that the practice is prohibited and understanding the reasons behind this prohibition. However, they also noted that, despite existing environmental legislation, illegal extraction continues to occur.

"Most of the time it's illegal, it's risky to go to jail, but not in the nursery." "The fear is from outsiders; they come and cut it down."

"But whether we like it or not, they steal it. Up there, some areas were cleared without anyone seeing. When it's time to harvest, whether we like it or not, they steal it anyway."

Several interviewees mentioned using the *Juçara* palm for subsistence and shared their experiences. In the past, they or their families worked as palm heart gatherers for survival. They criticized excessive extraction, stressing that, unlike many illegal hunters, they had never sold *Juçara* palm hearts outside the region. While they had harvested *Juçara* palms in the past, they now recognize the harm caused by overexploitation and emphasize the importance of sustainable management to conserve natural populations. Despite their desire to comply with regulations, they found the legal process to be overly bureaucratic. In this context, the PES initiative supports those who wish to work with *Juçara* palm products while also promoting the conservation of the species.

"The region here has always been preserved; at least the traditional peoples have never deforested."

"We're putting all this effort in to see if it can be removed from the extinction list. Once it's off the list, we want to use it, but legally."

"I tell my colleagues that this is the legalized way they found for us to work, and we need to take advantage of it."

"...because it was a farm and it was left alone, so palm heart gatherers and hunters would go there, and it was a headache. Now, with this project, it's better; there's more space to monitor and more outside help to aid in preservation. Currently, there are very few palm heart gatherers."

"Before, when my father worked with it, he would cut those large palm hearts, but today they are cutting down the seedlings that haven't even produced palm hearts yet. So, we are interested in this because if we don't do something, our grandchildren won't even get to know them, as they are

being destroyed quite a lot."

The participants expressed their belief that uncontrolled extraction of the *Juçara* palm has decreased due to legal restrictions. They acknowledged the importance of these laws in conserving and restoring *Juçara* palm populations. Additionally, they highlighted the species' role in providing essential ecosystem services, such as regulating water flow, offering food and habitat for wildlife, and serving as a regional heritage. Their statements underscored the critical importance of preserving the *Juçara* palm for the proper functioning of the ecosystem.

"I believe it has decreased significantly due to the difficulties now involved, because in the past, it was very common for people to take a load from any roadside."

Despite these positive observations, concerns remain regarding the lack of enforcement. Some expressed worries about insufficient personnel to protect the *Juçara* palms they have planted, with no assurance that these palms will not be cut down. Additionally, those who attempt to follow the law by reporting illegal hunters fear potential retaliation, which adds to their hesitation in taking action.

"I think some people didn't want to participate – in the program - because of the problem of deforestation, hunting, and cutting down Juçara palm. There are people who don't like it when others are involved with these things."

"Our people work with some doubt, wondering if I will plant it and someone else won't cut it down."

3.3 Governance arrangements in the territory

The Fundação Florestal has implemented the PES *Juçara* program in the territory, involving various governance arrangements that include managers and environmental monitors. The program is led by the *quilombola* community, most of whose members already have experience in managing the *Juçara* palm. While the Fundação Florestal oversees administrative and bureaucratic responsibilities, the *quilombola* community actively participates in the program's development and implementation, as outlined in section 3.1. Environmental monitors from the *quilombola* community are particularly noteworthy, as they help build trust and facilitate community engagement with the PES. These monitors, who often live in the communities where the program is implemented, maintain relationships with community members, bridging the gap between the government and traditional communities. Their understanding of the community's needs and realities allows them to contribute meaningfully to the program and gain recognition for their efforts.

"I am part of the SDR council as a coordinator." "I am a monitor of the Caverna do Diabo State Park."

"The Fundação Florestal approached me, and I decided to join the project because there was an area I wasn't going to use."

"Before Joel¹ approached me about the project, there was a limited spot available, right? I mentioned that I already worked with the Juçara, and offered to give my spot to someone else to encourage those who didn't have it. However, Joel insisted that I join, so they included me as well."

1 It does not correspond to the real name.

The managers of the protected areas, although often not part of the *quilombola* community, maintain close relationships with community members, facilitating dialogue. The presence of residents' associations in each community throughout the studied territory, along with the involvement of various individuals in decision-making, also contributes to the program's development. This collaboration, while sometimes subject to minor conflicts, remains significant. Beneficiaries have reported learning about the PES through these actors

—managers and environmental monitors. The close relationships among participants are also a key factor in encouraging others to engage in PES programs, influencing them to participate.

"It was through the association that we became aware of the PES Juçara."

"I am a member and the first alternate on the association's board, and my nephew is a director."

"Joel (environmental monitor) and Carla² (manager of the SDR) informed me about the program." "Everyone in the community contributed to the formation of the association."

"So I encouraged them, saying, 'Do it because this will benefit you for five years, and you will be taking care of the forest to ensure our protection. This way, people won't be hunting.'"

3.4 Perceived environmental, personal, and social benefits from the PES Juçara

The environmental, personal, and social benefits mentioned by the interviewed beneficiaries were organized into identifiable themes. Similar statements were grouped together under each theme (Erlingsson et al., 2017) (Table 1).

Table 1. Themes of benefits identified through the content analysis of the interviews. The themes are divided into environmental, personal, and social categories. Within each one, there are themes of benefits mentioned by the interviewees

BENEFITS			
THEMES	<u>ENVIRONMENTAL</u>	<u>PERSONAL</u>	<u>SOCIAL</u>
	Water resource	Monetary resource	Monetary resource
	Reforestation	Market opportunity	Market opportunity
	Soil	Tourism	Tourism
	Fauna (food and habitat)	Capacitation	Field fixation
	Dispersion	Well-being	Scenic beauty
	Polinization	-	Legal management
	Scenic beauty	-	-
	Juçara palm repopulation	-	-
	Combating extinction (<i>Juçara</i> . bees, and birds)	-	-
	Nature	-	-

We identified various environmental, personal, and social benefits recognized by the

2 It does not correspond to the real name.

interviewed beneficiaries as resulting from the PES (Figure 3, 4, 5 and 6).

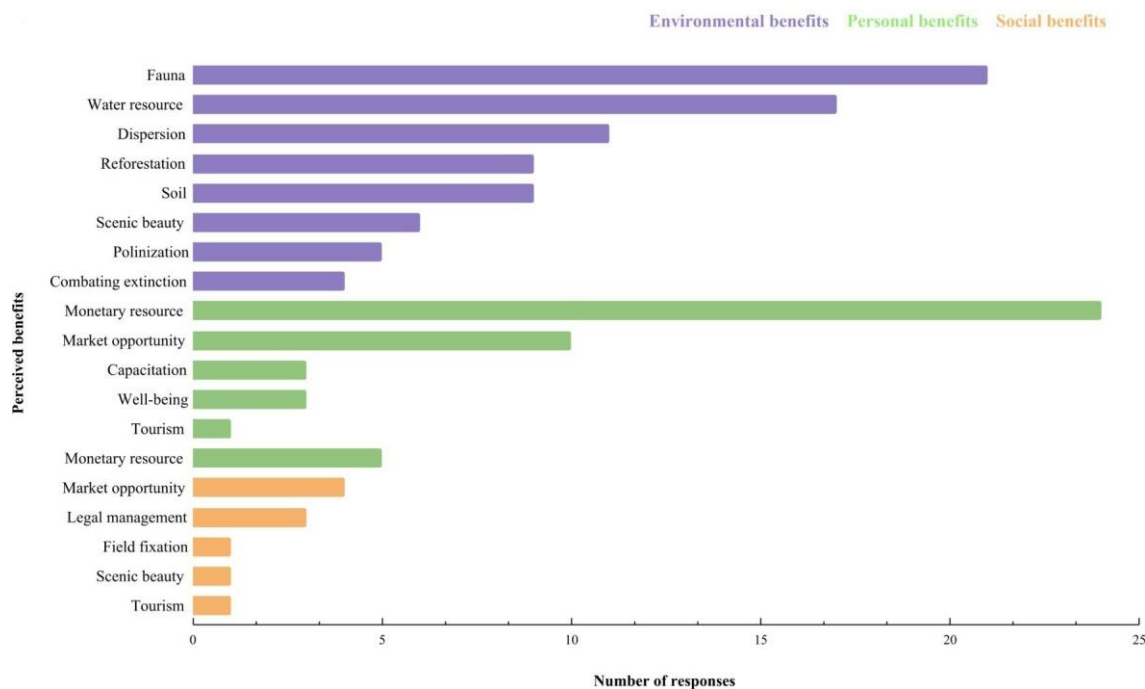


Fig.3 Benefits mentioned by the interviewed community in terms of environmental, personal, and social aspects. The X-axis represents the number of participants who mentioned each benefit, and the Y-axis represents the benefits identified in the interviews. Purple bars indicate environmental benefits, green bars indicate personal benefits and orange bars indicate social benefits

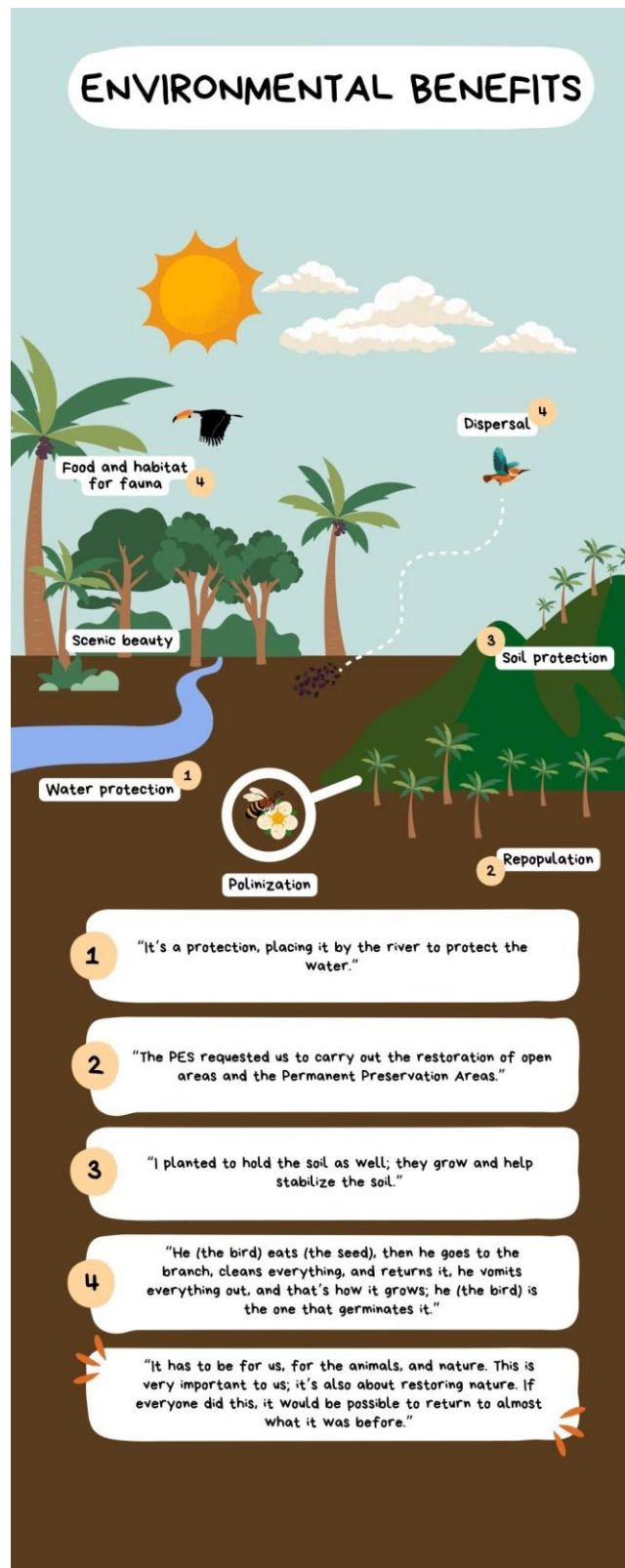


Fig.4 Illustration of the environmental benefits mentioned and examples of related discourses. Produced by the author using Canva.com Free

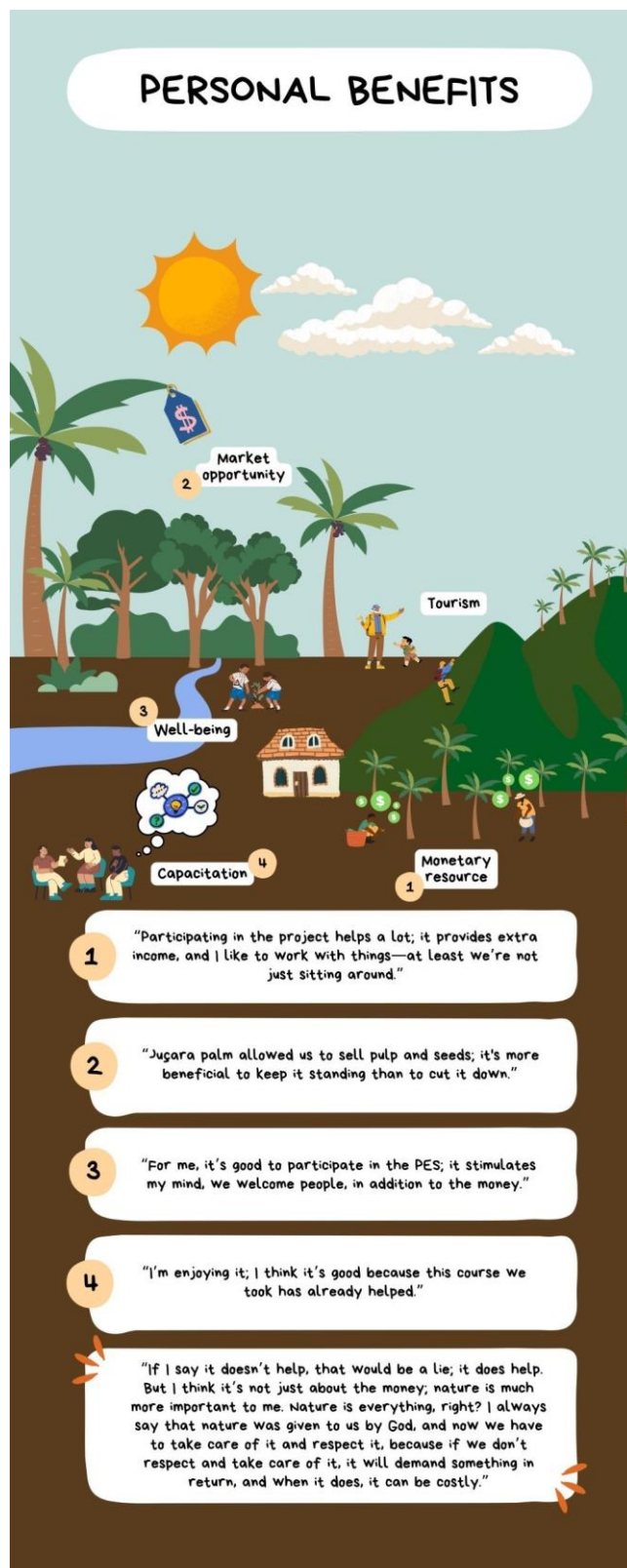


Fig.5 Illustration of the personal benefits mentioned and examples of related discourses. Produced by theauthor using Canva.com Free

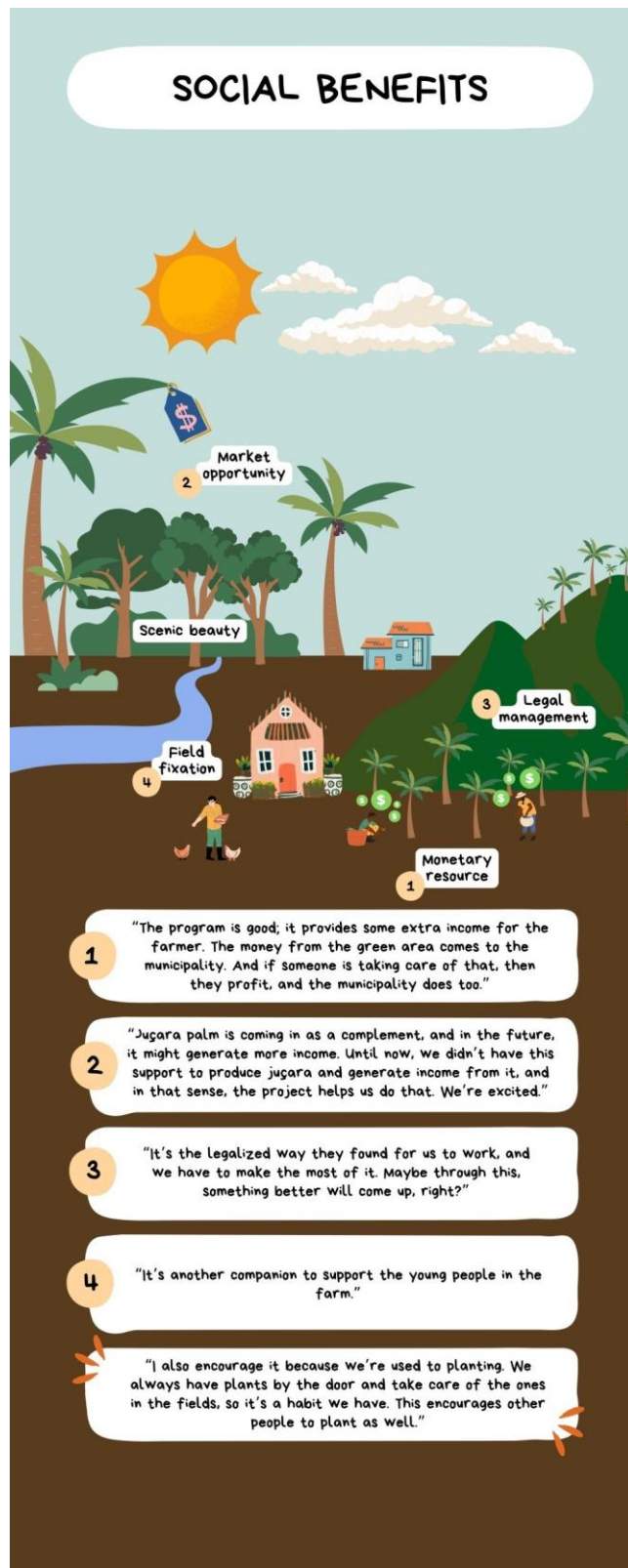


Fig.6 Illustration of the social benefits mentioned and examples of related discourses. Produced by the author using Canva.com Free

Water resources were frequently highlighted in discussions about ecosystem services and nature conservation, with many expressing that planting *Juçara* palm would help preserve this vital resource. Beneficiaries acknowledged the importance of Permanent Preservation Areas (PPAs) in protecting water and demonstrated awareness of the legislation prohibiting degradation in these areas. Moreover, reforestation emerged as a key theme, with interviewees considering the PES *Juçara* program an excellent initiative for restoring both degraded areas and PPAs. Indirectly related to these themes, soil was recognized as another beneficiary of *Juçara* palm planting, with statements emphasizing that the growth of *Juçara* palms aids in stabilizing the soil and preventing erosion.

Discussions also highlighted the significance of *Juçara* palm planting in providing food and habitat for various animals. Participants frequently noted that the fruits of the *Juçara* palm, consumed by species such as peccaries (*Pecari tajacu*), agoutis (*Dasyprocta*), black-fronted piping guans (*Aburria jacutinga*), toucans (*Ramphastos toco*), white-lipped peccaries (*Tayassu pecari*), and bellbirds, play a vital role in sustaining animal populations. Seed dispersal emerged as a key theme, with interviewees demonstrating a detailed understanding of this process, reporting that birds consuming *Juçara* palm pulp help disseminate the seeds. Additionally, while not a primary focus of the program, pollination by bees was mentioned, underscoring another environmental benefit facilitated by the *Juçara* palm, particularly through the installation of bee boxes.

Finally, the declining population of the *Juçara* palm was acknowledged, with the PES seen as a vital initiative for its conservation and recovery in the Atlantic Forest. Many expressed concerns for future generations, fearing they might not see the *Juçara* palm if its decline continues. Discussions emphasized that planting *Juçara* palms not only enhances the environment but is also crucial for the species' preservation, underscoring the recognition of the *Juçara* palm as a fundamental native species essential to the Atlantic Forest ecosystem.

The PES was regarded as significant for personal benefits, providing monetary resources, future market opportunities, and intrinsic value. Although the financial incentive is modest, beneficiaries highlighted its importance for improving their properties, such as installing fences and purchasing supplies. Many noted that the monthly benefit supplements their income from retirement or work. Additionally, participants emphasized the productive use of land that cannot be altered (PPAs) for *Juçara* palm cultivation, which serves a purpose and provides compensation that would not be available if the area were left unused.

This program also presents important market opportunities, with nearly all participants recognizing the potential for selling *Juçara* palm pulp and seeds as a pathway to profitability. The economic significance of standing *Juçara* palms was highlighted, reflecting an understanding of the species' value. Furthermore, the PES supports legal *Juçara* palm production, where previously there was no incentive, and promotes the adoption of beehives, facilitating honey sales, which many find appealing.

Training offered by the program was considered crucial, particularly the course on bees, underscoring its relevance for participants. Additionally, PES activities contribute to well-being by promoting mental health, preventing idleness, and fostering social interaction

—key factors for overall wellness. The intrinsic value of nature resonates deeply with many beneficiaries, who appreciate the program's commitment to preservation. These conservation efforts align with their values, providing both personal and environmental benefits.

Societal benefits were categorized into monetary resources, market opportunities, settlement in rural areas, landscape, legal management, and intrinsic value. The mention of monetary resources aligned with previously discussed personal benefits, as beneficiaries recognized the opportunity for others to earn income through participation in the PES

program. They value this incentive for compensating their efforts in planting and reforesting with *Juçara* palm, providing financial support while benefiting the environment and allowing others to share in these advantages. The opportunity for legal management of *Juçara* palm is also significant, with participants acknowledging the PES's role in enabling work with the species through indirect actions facilitated by the program. Given the difficulty of accessing formal employment in the region and the ongoing rural exodus in search of better living conditions, the PES's ability to encourage people to remain in rural areas is considered crucial. Some beneficiaries believe the financial incentive could motivate young people to stay and maintain their families' rural properties.

Market opportunities further enhance these discussions, emphasizing the potential for future profit through the sale of seedlings, seeds, and pulp, which participants believe can benefit farmers broadly. Additionally, tourism emerged as a promising market opportunity; once reforested, the area could offer scenic beauty that attracts visitors.

Lastly, the intrinsic value of cultivating *Juçara* palm is noteworthy, as both beneficiaries and non-beneficiaries have a tradition of planting and are actively engaged in environmental issues. The PES strengthens these ties and contributes to the perpetuation of these important practices.

4. Discussion

The high level of engagement by beneficiaries in the conservation activities for *Juçara* palm is critical for the success of the PES program (Brownson et al., 2019). A key factor behind this engagement is the beneficiaries' prior knowledge and long-standing connection with *Juçara* palm. Only one interviewee had no prior experience with the species, and their participation was motivated by both the monetary benefits and the desire to conserve their land (Bremer et al., 2014; Authelet et al., 2021). This suggests that the absence of environmental actions is often due to a lack of opportunities and resources. People are often focused on daily demands to provide income for the family and don't have the necessary means to engage in environmental activities (Gifford, 2011). Financial limitations faced by communities further complicate their involvement in pro-environmental actions (Amoah & Addoah, 2021). Therefore, a program like PES that facilitates the implementation of environmental actions while simultaneously offering tangible benefits to participants seems important (Robinson & Whitehead, 2016; Angelo, 2024). For such programs to succeed, they must align with the needs and daily realities of participants (Zbinden & Lee, 2005; Rodríguez-Robayo & Merino-Perez, 2017).

The opportunity of engaging in alternative activities, like the sale of *Juçara* palm seeds and pulp, is particularly promising for these communities. While the market for these products is still developing and needs region-specific regulations, efforts to integrate these activities into local economies, in line with environmental guidelines, are essential (Chagas, 2015; Ball & Brancalion, 2016; Franco & Rosa, 2017; Nunes et al., 2023).

Our results showed that *quilombola* communities have long been aware of the negative impacts of excessive *Juçara* palm extraction, and their traditional practices aimed to ensure the sustainability of the species and its ecosystem, and their cultural relationships with the environment, a process that continues today (Barroso & Hanazaki, 2010; Petheram & Campbell, 2010; da Silva & Pasinato, 2021). However, the legislation over the years aimed at curbing illegal *Juçara* palm cutting has hindered *quilombola* communities' access to the plant, compromising their survival and sustenance and leading them to seek alternative means of livelihood (Santo & Tatto, 2008). In this context, PES has become a critical tool, allowing *quilombola* communities to legally manage and conserve *Juçara* palm while maintaining their cultural practice related to the use of the palm trees (Dawson et al., 2021; de Freitas Chagas et al., 2021).

According to the participants, despite legal protections, there are no guarantees that *Juçara* palms will be safe from illegal harvest by third parties. This underscores the need for stronger enforcement to protect both the species and the communities who fear retaliation for

reporting illegal activities. The lack of oversight in forest areas and the persistence of illegal industries represent major challenges that need urgent attention (Ball & Brancalion, 2016).

Regarding governance arrangements, the trust established between managers, environmental monitors, and the *quilombola* community are crucial for maintaining trust. This trust seems to favor the community's is vital for continued engagement in the PES program (Bremer et al., 2014; Brownson et al., 2019; Davis & Goldman, 2019). Additionally, the close relationship among community members also significantly impacts their participation (Athelet et al., 2021). The involvement of community members as environmental monitors further strengthens this trust, as it ensures that communities' perspectives are considered. Involving local representatives in the design and development of PES is essential for understanding the socio-ecological context and ensuring the program benefits align with community needs, promoting both ecosystem services and socio-economic well-being (Rawlins & Westby, 2013; Brownson et al., 2019).

The benefits associated with PES frequently include discussions on fauna, habitat, nutrition, and water resources, often linked to Permanent Preservation Areas and reforestation. The role of birds in seed dispersion and soil conservation were also recurring themes. Participants exhibited a deep concern for these elements, reflecting their connection to the land, which is essential for the livelihoods and cultural identity of *quilombola* communities (Gonçalves et al., 2018; Maru & Haile, 2020). When integrated into restoration and conservation strategies, this broad traditional understanding becomes crucial for achieving mitigation and adaptation goals in the face of environmental disturbances (Conde et al., 2017). It also facilitates the promotion of sustainable management of plant species, such as the *Juçarapalm*, allowing for the coexistence of environmental conservation efforts with the subsistence needs of these communities (Conde et al., 2017; de Morais Sato & Brandão, 2023). Recognizing these benefits can also assist in designing PES programs, making restoration and conservation efforts more targeted and effective (Athelet et al., 2021).

The personal and social benefits reported by participants primarily include the financial assistance received, future market opportunities, legal management of the *Juçara* palm, and training. The financial support was viewed as a supplement to income, given that most respondents work in agriculture and/or receive pensions. This assistance allowed for improvements on their properties, such as fence installation, and was seen as a way to reconcile conservation with income generation (Zbinden e Lee, 2005; Bremer et al., 2014; Yasué e Kirkpatrick, 2020). Many participants highlighted the lack of job opportunities in the region, which leads young people to leave rural areas. Thus, PES can serve as an incentive for these youths to return and continue the activities of their parents and grandparents. The legal management of the *Juçara* palm promoted by PES was also significant, providing the community with the opportunity for future sales of pulp and seeds, which would contribute to the income of the participants and to conservation actions (Kanele and Castro, 2021). Furthermore, we observed that the training offered by the program, such as in the cultivation of native bees, sparked interest in working with honey, which also benefits pollination, essential for the *Juçara* palm. To ensure that the program aligns with environmental, participant, and societal needs, it is crucial to pay attention to the demands and align with the realities of the communities. This approach can maximize environmental effectiveness and promote socialwell-being (Wunder et al., 2018).

5. Conclusion

This study shows that active beneficiary engagement is a critical pillar for the success of PES programs. Low participation is often linked not to a lack of interest, but to limited access to resources and opportunities. Future research should further investigate the structural and contextual barriers to meaningful participation in PES initiatives.

Our findings highlight the importance of trust and collaboration between program managers, environmental monitors, and local communities. The inclusion of community members

in program design and institutional arrangements is essential for incorporating local knowledge and priorities, thereby enhancing the effectiveness and legitimacy of these initiatives. Institutional frameworks should reflect this need for participatory governance.

Quilombola communities demonstrate a profound relationship with nature, particularly with the Juçara palm, underpinned by traditional management practices that support both conservation and cultural continuity. Integrating this knowledge into PES programs is vital for ensuring their relevance and sustainability. The multiple environmental, personal, and social benefits associated with the PES Juçara program reinforce the value of community-led conservation.

Finally, changes in legislation have reshaped *quilombola* communities' relationship with the Juçara palm, fostering new, legal avenues for sustainable use — such as seed and pulp commercialization. Incorporating these alternative practices into PES design offers promising pathways for aligning biodiversity conservation with local well-being and sustainable development.

Clinical trial number: Not applicable.

Ethics statements: This project was submitted and approved by the ethics committee of São Paulo State University (Opinion 5,578,773) and Registration and Research Management of the Secretariat of Environment, Infrastructure and Logistics (Document 0000029727/2023; Process nº 000000015224/2022), and the measures of ethics were followed in conducting this research.

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References

Amoah, A., & Addoah, T. (2021). Does environmental knowledge drive pro-environmental behaviour in developing countries? Evidence from households in Ghana. *Environment, Development and Sustainability*, 23(2), 2719-2738, <https://doi.org/10.1007/s10668-020-00698-x>.

Andrade, A. M.; Tatto, N. (2013). *Inventário cultural de quilombos do Vale do Ribeira* (Ed.). São Paulo. Instituto Socioambiental.

Angelo, J. (2024). Percepção de comunidades tradicionais sobre programas de Pagamento por Serviços Ambientais no Vale do Ribeira-SP.

Authet, M., Subervie, J., Meyfroidt, P., Asquith, N., & Ezzine-de-Blas, D. (2021). Economic, pro-social and pro-environmental factors influencing participation in an incentive-based conservation program in Bolivia. *World Development*, Article 105487, <https://doi.org/10.1016/j.worlddev.2021.105487>.

Ball, A. A., & Brancalion, P. H. (2016). Governance challenges for commercial exploitation of a non-timber forest product by marginalized rural communities. *Environmental Conservation*, 43(3), 208-220. <https://doi.org/10.1017/S0376892916000072>.

Barroso, R. M., Reis, A., & Hanazaki, N. (2010). Etnoecologia e etnobotânica da palmeira juçara (*Euterpe edulis* Martius) em comunidades quilombolas do Vale do Ribeira, São Paulo. *Acta botanica brasílica*, 24, 518-528. <https://doi.org/10.1590/S0102-33062010000200022>.

Bello, C., Cintra, A. L. P., Barreto, E., Vancine, M. H., Sobral-Souza, T., Graham, C. H., & Galetti, M. (2021). Environmental niche and functional role similarity between invasive and native

palms in the Atlantic Forest. *Biological invasions*, 23(3), 741-754. <https://doi.org/10.1007/s10530-020-02400-8>.

Biggs, R., De Vos, A., Preiser, R., Clements, H., Maciejewski, K., & Schlüter, M. (2021). *The Routledge handbook of research methods for social-ecological systems*. Taylor & Francis.

Brasil (2000). Ministério do Meio Ambiente. SNUC – Sistema Nacional de Unidades de Conservação da Natureza: Lei nº 9.985, de 18 de julho de 2000. https://www.planalto.gov.br/ccivil_03/leis/19985.htm.

Bremer, L. L., Farley, K. A., & Lopez-Carr, D. (2014). What factors influence participation in payment for ecosystem services programs? An evaluation of Ecuador's SocioPáramo program. *Land Use Policy*, 36, 122–133. doi:10.1016/j.landusepol.2013.08.

Brownson, K., Guinessey, E., Carranza, M., Esquivel, M., Hesselbach, H., Ramirez, L. M., & Villa, L. (2019). Community-Based Payments for Ecosystem Services (CB-PES): Implications of community involvement for program outcomes. *Ecosystem Services*, 39, Article 100974. <https://doi.org/10.1016/j.ecoser.2019.100974>.

Carlucci, M. B., Marcilio-Silva, V., & Torezan, J. M. (2021). The southern Atlantic Forest: use, degradation, and perspectives for conservation. *The Atlantic Forest: History, Biodiversity, Threats and Opportunities of the Mega-Diverse Forest*, (pp. 91-111).

Castro, F. D., Siqueira, A. D., Brondízio, E. S., & Ferreira, L. C. (2006). Use and misuse of the concepts of tradition and property rights in the conservation of natural resources in the Atlantic Forest (Brazil). *Ambiente & sociedade*, 9, 23-39. <https://doi.org/10.1590/S1414-753X2006000100002>.

CBH-RB (2019). Relatório de situação dos recursos hídricos da UGRHI 11. Bacia Hidrográfica 18 do Ribeira de Iguape e Litoral Sul – Ano Base 2018. <https://sigrh.sp.gov.br/public/uploads/documents/CBH-RB/17551/relatorio-desituacao-2019-versao-final-27-09-19.pdf>

Chagas, G. D. F. (2015). Manejo florestal comunitário de frutos como estratégia de conservação da palmeira juçara (*Euterpe edulis* Mart.) (Doctoral dissertation, Universidade de São Paulo).

CNCFlora. *Euterpe edulis* in *Lista Vermelha da flora brasileira versão 2012.2* (2012). Centro Nacional de Conservação da Flora. Retrieved from [http://cncflora.jbrj.gov.br/portal/pt-br/profile/Euterpe edulis](http://cncflora.jbrj.gov.br/portal/pt-br/profile/Euterpe%20edulis). Accessed June, 2024.

CNUC (2024). Curso à distância sobre o Cadastro Nacional de Unidades de Conservação. Módulo 1. Retrieved from <https://www.gov.br/mma/pt-br/assuntos/biodiversidade-e-ecossistemas/areasprotegidas/plataforma-cnuc-1/GuiaSNUCCNUCmdulo1.pdf>. Accessed June, 2024.

Conde, B. E., Ticktin, T., Fonseca, A. S., Macedo, A. L., Orsi, T. O., Chedier, L. M., ... & Pimenta, D. S. (2017). Local ecological knowledge and its relationship with biodiversity conservation among two Quilombola groups living in the Atlantic Rainforest, Brazil. *PLoS One*, 12(11), Article e0187599. <https://doi.org/10.1371/journal.pone.0187599>.

Davis, A., & Goldman, M. J. (2019). Beyond payments for ecosystem services: considerations of trust, livelihoods and tenure security in community-based conservation projects. *Oryx*, 53(3), 491-

496. <https://doi.org/10.1017/S0030605317000898>.

da Silva, L. M., & Pasinato, R. (2021). PATRIMÔNIO CULTURAL IMATERIAL, CONSERVAÇÃO E DESENVOLVIMENTO SUSTENTÁVEL EM TERRITÓRIOS QUILOMBOLAS DO VALE DO RIBEIRA–SP. *Revista do Centro de Pesquisa e Formação*. sescsp. org. br/revistacpf. (pp. 98-112).

Dawson, N. M., Coolsaet, B., Sterling, E. J., Loveridge, R., Gross-Camp, N. D., Wongbusarakum, S., ... & Rosado-May, F. J. (2021). The role of Indigenous peoples and local communities in effective and equitable conservation. *Ecology and Society* 26(3), Article 19. <https://doi.org/10.5751/ES-12625-260319>.

de Freitas Chagas, G., Salk, C. F., Vidal, E. J., de Souza, S. E., & Brancalion, P. H. (2021). Exploiting fruits of a threatened palm to trigger restoration of Brazil's Atlantic Forest. *Restoration Ecology*, 29(1), Article e13294. <https://doi.org/10.1111/rec.13294>.

de Moraes Sato, P., & Brandão, L. (2023). Lessons on planetary health from traditional Quilombola communities of the Brazilian Amazon. *bmj*, 383. <https://doi.org/10.1136/bmj.p2188>.

Diegues ACS, Arruda RSV (2001). Saberes tradicionais e biodiversidade no Brasil. (Eds.). Vol 4. MMA. Série Biodiversidade, Brasília. Retrieved from <https://livroaberto.ibict.br/bitstream/1/750/2/Biodiversidade%20e%20comunidades%20tradicionais%20no%20Brasil.pdf;Saberes>. Accessed May 2024.

dos Reis, M. S., Fantini, A. C., Nodari, R. O., Reis, A., Guerra, M. P., & Mantovani, A. (2000). Management and conservation of natural populations in Atlantic rain forest: The case study of Palm Heart (*Euterpe edulis* Martius). *Biotropica*, 32(4b), 894-902. <https://doi.org/10.1111/j.1744-7429.2000.tb00627.x>.

Drisko, J. W., & Maschi, T. (2016). *Content analysis. Pocket Guide to Social Work* Re. (1st ed.).

Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African journal of emergency medicine*, 7(3), 93-99. <https://doi.org/10.1016/j.afjem.2017.08.001>.

Franco, F. S., Alvares, S. M., & Rosa, S. C. (2017). Sistemas agroflorestais com juçara. Sorocaba, SP: UFSCAR: 2017a. Retrieved from <https://www.ecoagri.com.br/web/wp-content/uploads/Cartilha-SAF-Jucara-2.pdf>. Accessed May, 2024.

Fundação Florestal (2024). Pagamento por serviços ambientais (PSA) Juçara. Retrieved from <https://www.infraestruturameioambiente.sp.gov.br/fundacaoflorestal/psa-jucara/>. Accessed May, 2024.

Galetti, M., & Fernandez, J. C. (1998). Palm heart harvesting in the Brazilian Atlantic forest: changes in industry structure and the illegal trade. *Journal of Applied Ecology*, 35(2), 294- 301. <https://doi.org/10.1046/j.1365-2664.1998.00295.x>.

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, 66(4), 290–302. <https://doi.org/10.1037/a0023566>.

- Gómez-Baggethun, E., Corbera, E., & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: research findings and policy implications. *Ecology and society: a journal of integrative science for resilience and sustainability. Ecol Soc.* 2013 December 1; 18(4). doi:10.5751/ES-06288-180472.
- Gonçalves, Z. L. T., Cabral, M. I. A., Neves, T. M., dos Santos, C. A. B., & de Souza Nogueira, E. M. (2018). Sociedades tradicionais e conservação da natureza. *Revista Brasileira de Educação Ambiental (RevBEA)*, 13(4), 79-86.
- Guedes Pinto, L. F., & Voivodic, M. (2021). Reverse the tipping point of the Atlantic Forest for mitigation. *Nature Climate Change*, 11(5), 364-365. <https://doi.org/10.1038/s41558-021-01035-4>.
- Hassen, A., Zander, K. K., Manes, S., & Meragiaw, M. (2023). Local People's perception of forest ecosystem services, traditional conservation, and management approaches in North Wollo, Ethiopia. *Journal of Environmental Management*, 330, Article 117118. <https://doi.org/10.1016/j.jenvman.2022.117118>.
- Instituto Socioambiental & Associações Quilombolas. (2010). *Semeando sustentabilidade: A juçara e as comunidades quilobolas no Vale do Ribeira*. ISA. Retrieved from <https://acervo.socioambiental.org/sites/default/files/maps/2020-05/Publicacao%20Poster- Manejo- Jucara.pdf>. Accessed June, 2024.
- Kanele, A., Castro, C. P. P., Mikkola, H (2021). Quilombo Communities and Opportunities for Market-Driven Mechanisms for the Protection of the Amazon Forest. *Ecosystem and Biodiversity of Amazonia* (pp. 219-239). BoD – Books on Demand.
- Maciel, A. L., Alves, D. ., & Sant'Anna, S. (2021). Análise dos Processos de Desmatamento e Regeneração nas Unidades de Conservação Pertencentes no Vale do Ribeira (SP/PR) por Meio de Classificações de Imagens de Sensoriamento Remoto. *Revista Brasileira De Cartografia*, 73(1), 261–277. <https://doi.org/10.14393/rbcv73n1-55435>.
- Marques, M. C., & Grelle, C. E. (2021). The Atlantic Forest. *History, Biodiversity, Threats and Opportunities of the Mega-diverse Forest*. Springer International Publishing.
- Marques, Marcia & Trindade, Weverton & Bohn, Amabily & Grelle, Carlos. (2021). The Atlantic Forest: An Introduction to the Megadiverse Forest of South America. In *The Atlantic Forest History, Biodiversity, Threats and Opportunities of the Mega-diverse Forest*. (pp. 3- 23).
- Martines, M. R., de Souza, A. M., Arena, M. V. N., Prado, H. M., & Toppa, R. H. (2023). Spatial signatures of traditional and protected areas under different overlap degrees in the Brazilian Atlantic Forest. *Remote Sensing Applications: Society and Environment*, 29, Article 100916. <https://doi.org/10.1016/j.rsase.2022.100916>.
- Maru, Y., Gebrekirstos, A., & Haile, G. (2020). Indigenous ways of environmental protection in Gedeo community, Southern Ethiopia: A socio-ecological perspective. *Cogent Food & Agriculture*, 6(1), 1766732. <https://doi.org/10.1080/23311932.2020.1766732>.
- Mittermeier, R. A., Turner, W. R., Larsen, F. W., Brooks, T. M., & Gascon, C. (2011). Global biodiversity conservation: the critical role of hotspots. In *Biodiversity hotspots: distribution and protection of conservation priority areas* (pp. 3-22). Berlin, Heidelberg: Springer Berlin Heidelberg.

Muler, A. E., Rother, D. C., Brancalion, P. S., Naves, R. P., Rodrigues, R. R., & Pizo, M. A. (2014). Can overharvesting of a non-timber-forest-product change the regeneration dynamics of a tropical rainforest? The case study of *Euterpe edulis*. *Forest Ecology and Management*, 324, 117-125. <https://doi.org/10.1016/j.foreco.2013.09.001>.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., Da Fonseca, G. A., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403(6772), 853-858.

Newing, Hellen et al. (2011). *Conducting research in conservation*. Oxfordshire: Routledge.

Nunes, N. L., Campanhão, L. M. B., Rodrigues, R. R., & Brando, F. (2023, November). Pagamentos por Serviços Ambientais na Mata Atlântica e o desenvolvimento de um Arranjo Produtivo Local da Juçara no Vale do Ribeira, São Paulo. Session presentation at Economia da Sociobiodiversidade na Amazônia, at UFOPA, Santarém, PA.

Petheram, L., & Campbell, B. M. (2010). Listening to locals on payments for environmental services. *Journal of environmental management*, 91(5), 1139-1149. <https://doi.org/10.1016/j.jenvman.2010.01.002>.

Prado, H. M. (2022). *Etnoecologias quilombolas e ribeirinhas: práxis na paisagem e saberes ambientais na Mata Atlântica e Amazônia*. Editora Appris.

Rawlins, M. A., & Westby, L. (2013). Community participation in payment for ecosystem services design and implementation: An example from Trinidad. *Ecosystem Services*, 6, 117- 121. <https://doi.org/10.1016/j.ecoser.2013.09.004>.

Ribeiro, M. C., Metzger, J. P., Martensen, A. C., Ponzoni, F. J., & Hirota, M. M. (2009). The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation*, 142(6), 1141–1153. <https://doi.org/10.1016/j.biocon.2009.02.021>.

Robinson, C. J., James, G., & Whitehead, P. J. (2016). Negotiating Indigenous benefits from payment for ecosystem service (PES) schemes. *Global Environmental Change*, 38, 21-29. <https://doi.org/10.1016/j.gloenvcha.2016.02.004>.

Rodríguez-Robayo, K. J., & Merino-Perez, L. (2017). Contextualizing context in the analysis of payment for ecosystem services. *Ecosystem services*, 23, 259-267. <https://doi.org/10.1016/j.ecoser.2016.12.006>.

Santos, K. M. P., & Tatto, N. (2008). *Agenda socioambiental de comunidades quilombolas do Vale do Ribeira*.

Silva, S. R. D. (2008). Negros na Mata Atlântica, territórios quilombolas e a conservação da natureza (Doctoral dissertation, Universidade de São Paulo).

Solórzano, A., Brasil, L. S. C. D. A., & de Oliveira, R. R. (2021). The Atlantic Forest ecological history: From pre-colonial times to the Anthropocene. *The Atlantic Forest: history, biodiversity, threats and opportunities of the mega-diverse forest*, 25-44.

Vancine, M. H., Muylaert, R. L., Niebuhr, B. B., Oshima, J. E. D. F., Tonetti, V., Bernardo, R., ... & Ribeiro, M. C. (2023). The Atlantic Forest of South America: spatiotemporal dynamics of

remaining vegetation and implications for conservation. *BioRxiv*, 2023-09. <https://doi.org/10.1016/j.biocon.2024.110499>.

Vianna, L. F., Zambonim, F., & Pandolfo, C. (2022). Potential cultivation areas of *Euterpe edulis* (Martius) for rainforest recovery, repopulation and açai production in Santa Catarina, Brazil. <https://doi.org/10.21203/rs.3.rs-1746639/v2>.

Wunder, S., Brouwer, R., Engel, S., Ezzine-de-Blas, D., Muradian, R., Pascual, U., & Pinto, R. (2018). From principles to practice in paying for nature's services. *Nature sustainability*, 1(3), 145-150. <https://doi.org/10.1038/s41893-018-0036-x>.

Yasué, M., & Kirkpatrick, J. B. (2020). Do financial incentives motivate conservation on private land? *Oryx*, 54(4), 499–510. <https://doi.org/10.1017/S0030605318000194>.

Zbinden, S., & Lee, D. R. (2005). Paying for environmental services: an analysis of participation in Costa Rica's PSA program. *World development*, 33(2), 255-272. <https://doi.org/10.1016/j.worlddev.2004.07.012>.

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