Community Perceptions of a Payment for Ecosystem Services Project in Southwest Madagascar: A Preliminary Study

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Article

Abstract: Despite the popularity of Payment for Ecosystem Services (PES) schemes as a new paradigm to enhance conservation of natural resources, evidence of their benefits to people and nature is often illustrated from desk-based reviews, but rarely investigated from the local sites where they have been implemented. We investigated local perceptions of a PES scheme implemented in the Baie des Assassins’s mangroves of southwest Madagascar with particular focus on its perceived future effects. To meet our goal, we first collated socioeconomic and mangrove ecological information through extensive literature research, and key informant interviews with 35 peoples within the 10 villages surrounding the bay to be used as reference conditions. Following this, a workshop with 32 participants from local communities was conducted, using participatory scenario planning to predict the effects of the PES project, and to identify concerns surrounding its implementation. Local communities perceived the PES scheme as a potentially valuable approach for the sustainable management of their mangroves, and perceived that it would address major socioeconomic issues and mangrove management problems in the bay as a result of the carbon offsetting from their mangroves. We conclude that to achieve acceptance and good governance of a PES project by local communities, needs and concerns surrounding the implementation of the PES project need be addressed.

Keywords: mangroves; biodiversity; ecosystem services; scenario planning; Baie des Assassins

1. Introduction

Due to growing population and global economic pressures, the world is currently faced with an unprecedented decline in biodiversity [1]. This in turn impacts ecosystem services, which are essential for human survival [2]. To halt and reverse this decline, national and international policies and approaches are being promoted and implemented [3]. In particular, Payments for Ecosystem Services (PES) schemes are gaining popularity as an important mechanism to secure the protection and sustainable use of ecosystems. PES schemes also have the potential to solve other problems including biodiversity and habitat loss, global climate change [4], and poverty [5]. Forest carbon sequestration payments as part of the Reduction of Emissions from Deforestation and forest Degradation (REDD+) program are currently gaining increasing attention [6] because carbon emissions from tropical deforestation and degradation contribute to 4.8 billion tonnes of carbon dioxide per year, which has been estimated to be around 8 to 15% of annual global anthropogenic carbon emissions [7]. Countries in the coastal tropics have recently focused on the development of market-based solutions like PES [8] where remote and inhabited sites are often considered models of pristine ecosystems [9] that may attract billions of dollars of conservation funds.
above and beyond all current investments in forest conservation [10]. For example, the Paris Climate Accord, signed in December 2015, promised billions of dollars to help reduce greenhouse gas emissions with a particular emphasis on forest conservation [11].

Alongside the increasing interest in applying PES schemes in the sphere of conservation [12], there has been a growing body of literature evaluating their strengths and limitations [13,14]. These limitations raised many issues for those who propose such projects [15–17]. One of the important issues that many PES project developers (as intermediary and knowledge providers) face is getting different actors at different scales involved in project implementation. A careful consideration of broader actors is fundamental to PES scheme effectiveness as these actors’ interests, knowledge, and constraints play an important role in determining how a program is structured, how economic and institutional benefits and costs are distributed, and what conflicts may arise [18]. For the case of PES scheme implemented at the local level, consideration of the perspective of indigenous people is meaningful because a proposed project like PES could result in negative consequences for these people if they are not informed and consulted about these projects in advance [19,20]. For example, misunderstandings about the project context and its potential benefits (both positive and negative) at the beginning of implementation could affect the project’s feasibility, impacts, and legitimacy [21]. This may also risk stakeholders trust in the project, and the reputations of the organizations involved [22]. Yet, investigation of the perceptions of those who are targeted by PES projects is rarely carried out at the early stage of project implementation. As such, this investigation first needs to be done preliminarily as part of the PES project and the results need to be incorporated in the management strategies to avoid errors and bias in the monitoring, quantification, and interpretation of the future impacts of interventions [23].

To address the issue of consulting communities in PES schemes, carbon certification standards that focus on implementation and impacts monitoring of land-based carbon projects were promoted at the 16th Conference of Parties [24]. One of these is the Climate, Community and Biodiversity (CCB) standard [25–27], which is most often applied in voluntary carbon offset projects and markets [28]. The standard requires that project interventions must be designed at the local level to (i) meet local needs, (ii) guide decision-making that minimizes the risk of unnecessary failures and (iii) ensure long-term validation and effectiveness of the project [29,30]. The standard also requires the definition of counterfactual scenarios that quantify what would happen without and with project intervention from the concerned stakeholders [31]. Through these scenarios, local stakeholders are encouraged to quantify and interpret the future impacts of the proposed project interventions [23].

In this study, we used a scenario planning method as recommended by the CCB standard as a useful method to assess and perceive future impacts of a PES program within a complex system [32,33]. The scenario planning method emerged from military strategy and war planning during the Second World War and has been developed and used across a range of sectors including business planning [34,35], biodiversity assessment, ecosystem and protected area management [2,36–38], agricultural development [39], land use change, and climate change adaptation [40]. Scenario planning is defined by Peterson et al., 2003 as a ‘method for structured exploration of multiple hypothetical futures that provides a powerful way to explore and understand social-ecological systems while explicitly acknowledging their inherent uncertainty’. It describes futures that could plausibly happen (rather than predictable outcomes), which then help inform plans or decisions in the context of unpredictable and uncontrollable change that could alter the future state of a system [41]. Scenario planning incorporates in its early stage a starting point or a reference condition that can be used to be compared against future scenarios ‘with’ and ‘without’ the project [42]. Results from scenario planning exercises enable an exploration of the potential impacts, risks, and management opportunities stemming from a variety of plausible future conditions [43] which in turn can potentially attract buyers of carbon credits. Indeed, in practice, buyers often seek assurances, which can be provided by adhering to a verified carbon program standard. In this way, buyers are more likely to purchase credits as they
become more confident that their purchases will result in real social and environmental benefits [26] for the stakeholders rather than the project developer [44].

Mangroves are receiving increasing attention as sites for implementation of PES programs to reduce emissions of greenhouse gases (GHG) in the atmosphere [45,46]. This emphasis on mangroves as sites for PES schemes is due in part to their high capacity to either sequester or store large quantities of carbon, which is globally estimated at 937 tC/ha [47,48]. This level of sequestration is considerably higher than those of other forest ecosystems including tropical forests (109 tC/ha), temperate forests (68 tC/ha), and boreal forests (182 tC/ha) [47,49,50]. As such, the possibility of PES has rapidly gained traction in mangrove research and conservation [51]. This is especially the case in the coastal tropics, where management of these important ecosystems faces numerous challenges including a lack of baseline data, inadequate financing, poor institutional support, a lack of political will and capacity for their monitoring, management, and protection [52]. Given that efforts to protect mangrove ecosystems through PES initiatives are new at the global scale [53] and have been rarely tested in the lowest income countries, understanding the local perceptions of PES projects is crucial to ensure successful implementation and long-term viability of these projects.

In this research, we investigated community perceptions of the PES project as a preliminary study to its implementation in the mangroves of the Baie des Assassins of southwest Madagascar. Our specific objectives are to (i) identify which variables within the socio-ecological system of the bay are perceived to be affected by the PES project, (ii) predict changes in these variables, with and without PES project interventions, (iii) assess the potential of the project from the view of the community, (iv) identify community concerns about the proposed project and construct adaptive strategies to address these concerns, and (v) develop recommendations for the implementation and running of the PES mangrove project in the Baie des Assassins.

2. Materials and Methods

2.1. Study Site

Our study site Baie des Assassins is located in the rural commune of Befandefa, Morombe district of the southwest region of Madagascar (Figure 1). The bay is part of the Velondriake Locally Managed Marine Area (LMMA) which was the first LMMA established in the country, and is co-managed by the Velondriake Association and the Non-Governmental Organization (NGO) Blue Ventures. The bay is home to the fishers ethnic group called Vezo (96% of population), and is one of the most isolated areas in Madagascar. This isolation led to difficult conditions for the 3698 inhabitants living around the bay due to poor infrastructure (e.g., road, schools, health clinics, and markets) and the limited access to different services (e.g., education, health care, drinking water and electricity).

The mangrove forests surrounding the Baie des Assassins (approximately 1507 ha) are an important coastal ecosystem which supports both the fisheries and biodiversity. The forests provide habitat for important marine and coastal species found in the area and support livelihoods of thousands of coastal people. Adjacent to the Mikea forest national park, the area surrounding the bay (including mangroves) is a nationally important biodiversity site due to its species diversity and level of endemism. Despite their importance, the mangroves of the bay are part of an ecosystem that is under intense human pressure, as indicated by an accelerating rate of deforestation (estimated at 3.18% lost between 2002 and 2014 [54]). This loss is due primarily to the high levels of anthropogenic pressure in coastal areas and the natural hazards (cyclones and storms) which result in loss of biodiversity and ecosystem services. As such, these mangroves are the first in Madagascar to be incorporated into a PES scheme (using the Plan Vivo standard (Plan Vivo is an Offset Project Standard for forestry, agricultural and other land-use projects with a focus on promoting sustainable development and improving rural livelihoods and ecosystem services (https://www.offsetguide.org/understanding-carbon-offsets/carbon-offset-programs/voluntary-offset-programs/plan-vivo-system/#:~:text=Plan%20Vivo%20is%20
Figure 1. Map of the study site showing the Velondriake LMMA (A) and the Baie des Assassins with its mangrove coverage and villages (B).

2.2. Data Collection

The method used to conduct our study was developed from the Social and Biodiversity Impacts Assessment (SBIA) manual which was produced by the Climate, Community and Biodiversity Alliance (CCBA), Forest Trends, Fauna and Flora International, and the Rain Forest Alliance to help developers of land-based carbon projects. This manual comprises three parts: core guidance for project proponents [25], a toolbox for assessing social impacts [26] and a description of the biodiversity impact assessment process [27]. Referring to the manual, our data collection comprises three steps: a desk-based literature review to collate information, a field socioeconomic survey to fill information gaps, and a participatory scenario planning workshop to predict changes as a result of the PES project.

2.2.1. Collection of Socio-Economic Information

Socioeconomic data were gathered through a two-tiered approach: a desk-based study and field surveys. The desk-based study consisted of collating socioeconomic information that had been previously collected in the 10 study villages. From this, we used two categories of data collected by the NGO Blue Ventures including a census (performed in 2015) and a household survey (conducted in 2016). While the census covered the Baie des Assassins’ villages and a larger area surrounding and North of the Bay, the household survey included only four of the 10 villages surrounding the bay. Information about the population size, livelihoods, education, and literacy were collated from the census, whilst the information concerning the occupation, income generation, sanitation and hygiene were gathered from the household survey.

Further field surveys were carried out from January to February 2019 to fill in gaps in the socioeconomic dataset, and to update information previously collected from the census and the household survey. To do this, interviews with 35 key informants from the ten villages of the bay were conducted (Table 1). The subjects were purposely selected based on (i) the interaction of the sectors they belong to with the socioeconomic information gathered previously (education, health, infrastructure, management and institutions in the
village), (ii) their attribution, and (iii) their presence in the village. The interview lasted between ten and thirty minutes for each individual. To confirm the accuracy of information collected on infrastructure and basic services, the research team completed transect walks through each community, following the interviews, to collect independent observations on infrastructure such as water, sanitation, electricity, schools and health clinics.

Table 1. Key informants interviewed in the studied villages of the Baie des Assassins.

| Sector               | Attributions                          | Number of People Interviewed | Information Gathered                                                                 |
|----------------------|---------------------------------------|-----------------------------|--------------------------------------------------------------------------------------|
| Local association    | Resources management committee        | 3                           | Management of natural resources and the participation of women in the management      |
| Health               | Community health workers              | 10                          | Challenges faced in providing health services (including infrastructure, human resources, and health in general) |
| Health               | Nurse/midwife                         | 2                           | Challenges faced in providing health services (including infrastructure, human resources, and health in general) |
| Education            | Head of school                        | 10                          | Challenges faced in the provision of education services (including school infrastructure and human resources) |
| Public administration| Village chiefs                        | 10                          | Existing infrastructure, and the major constraints for development in their village    |
| Total                |                                       | 35                          |                                                                                      |

2.2.2. Documenting the Mangrove Ecosystem of the Baie des Assassins

A literature review was carried out to gather mangrove ecological data in the Baie des Assassins. Information on the characteristics of vegetation, floral and faunal diversity, and threats to the mangroves and the associated biodiversity were collated from both published and unpublished sources. The data collection approach is presented in Table 2.

Table 2. Literature used to collate mangrove ecological information for the Baie des Assassins.

| Type of Data                          | Source Type/Description                                                                 | Reference |
|---------------------------------------|----------------------------------------------------------------------------------------|-----------|
| Ecosystem and forest type             | Characteristics of mangrove vegetation and calculations of tree biomass                | [54]      |
| Faunal diversity                      | Species inventory for fauna (birds, mammals, reptiles, crustaceans, and molluscs)      | [56]      |
| Threats to mangroves and the associated biodiversity | Results of ecological monitoring and socioeconomic surveys describing the status of and threats to biodiversity in the Velondriake LMMA. Pattern of mangrove disturbance and biomass removal in the Baie des Assassins. | [57,58] |

2.2.3. Participatory Scenario Planning Workshop

A participatory workshop was held in order to explore the diversity of the community’s roles in the scenario planning workshop. The selection of participants consisted of four parts: (i) identification of the key stakeholders based on their affiliation to the sectors that could be involved in the PES project, (ii) weighing stakeholder’s knowledge based on knowledge of the village context, influential power and ability to write and read, (iii) recruiting relevant stakeholders and (iv) inviting them to a workshop. Three key stakeholder groups were identified, including local administrative authorities (villages chiefs, school heads and local health clinic representatives), local management association (Velondriake association), and representatives from the local communities in the 10 study villages. A total of 32 people from these groups from the 10 studied villages were invited to the workshop. Although we attempted to ensure balance between men and women at
the invitation stage, there was a distinct gender bias due to the dominant positions held by men in the villages.

Then, a two-day workshop was held in the village of Tampolove in September 2019. The workshop consisted of four stages. Firstly, the socioeconomic and mangrove ecological baseline data for the Baie des Assassins was presented to participants, to provide them with a context for the workshop. Next, participants were divided into three groups (Table 3) and given an overview of the participatory scenario planning exercise. The third stage involved characterizing the Baie des Assassins’ situation without and with project intervention using an open question: how do you perceive the situation within the bay without and with the PES project? Within this, each group was asked to anticipate both negative and positive changes as a result of the project. Finally, the groups also were asked to identify potential concerns (both their own and of other community members) regarding the existence of the project and to describe their likely effects on the project viability, the livelihoods of the local community, and the management of mangroves. A matrix table was utilized to characterize these effects by using a series of scores: (−1) for negative effect, (0) for no effect and (+1) for the positive effects. To address all of the concerns, participants were asked to define strategies to minimize risks that could destabilize the project and make it unsustainable.

Table 3. Distribution of participants within the groups.

| Attribution                                  | Group | Men  | Women | Total |
|----------------------------------------------|-------|------|-------|-------|
| Village chiefs                               | A     | 10   | 0     | 10    |
| Community representatives (Elders)           | A     | 8    | 2     | 10    |
| Resources management committees in the local association | B     | 5    | 0     | 5     |
| Teachers                                     | C     | 5    | 0     | 5     |
| Community health workers                     | C     | 0    | 2     | 2     |
| **Total**                                    |       | 32   |       |       |

The scenario planning exercise was facilitated in the local dialect of Malagasy, and participants were guided towards the expected objectives by two undergraduate university students. Alongside the scenario planning exercise, a video of each group’s work was recorded to facilitate retrieving all information provided by the participants.

2.3. Data Analysis

Most of the data gathered on both socioeconomic and mangrove ecosystems were qualitative. Descriptive statistical methods of means and percentages were used to present each type of socioeconomic variable (population size and age structure, education and literacy, health and sanitation, and livelihoods) while only numbers were used to present the variables collated from the mangrove ecosystem documentation. From the scenario planning exercise, we got two types of data: physical notes and video records from the work of each group. Due to the non-numerical and non-structured nature of responses from the participants, qualitative data analysis was run using narratives (stories that the members of each group told during the exercise). Videos recorded from each group were listened to and codes were assigned to words and phrases that represent important and recurring themes. From the stories, we identified 24 codes (which we nominated as variables) and then narrowed these down to 18 according to the strength of their relationships. To know which sectors are perceived to be affected by the PES project, the 18 variables identified were categorized into sectors and the number of variables in each sector was counted to generate a graph (Figure 2). To identify which variables under these sectors are most affected by the project, the frequency of each variable in the group stories was calculated (Figure 3). The same process was used to assess each group’s perceptions of the project (Figure 4). The changes that participants perceived as the results of the absence and the presence of the project were characterized using (+) as positive and (−) as negative, and a summary table was created. To assess the potential of the project from the view of the
participants, the perceived positive (+) and negative (−) changes as the results of project were quantified (Figure 5). Finally, to identify participant’s concerns regarding the project, the frequency of each concern in group stories was calculated (Figure 6).

**Figure 2.** Sectors perceived to be affected by the PES project and their importance according to the quotes of the participants.

**Figure 3.** Variables perceived to be affected by the PES project and their importance according to quotes of participants.

**Figure 4.** Group perceptions of the PES project including: A: village chiefs and community representatives, B: Resources management committees in the local association, C: teachers and community health workers.
Figure 5. Proportion of variables negatively and positively affected by the PES project.

Figure 6. Concerns associated with the presence of PES project and their importance according to the participants.

3. Results

3.1. Socio-Ecological Conditions of the Baie des Assassins

Table 4 presents the statistics of social and mangrove ecosystem conditions of the Baie des Assassins. The social framework, remoteness, limited infrastructure, and low levels of education (literacy rates 48%) contribute to the high dependency on marine resources (58.5% of the population are fishers) and to the weak capacity to manage their important natural ecosystems (e.g., mangroves). The potential of the Baie des Assassin’s mangrove to sequester carbon (454.92 tons of carbon per hectare) and to shelter important biodiversity merits conservation.
Table 4. Description of socioeconomic and mangrove ecosystem conditions of the Baie des Assassins.

| Socioeconomic Settings | Description | Source |
|------------------------|-------------|--------|
| Livelihoods dependent on marine resources | The majority of people practice fishing as their primary activity (58.5%), while others are involved in other activities such as agriculture (15.6%), aquaculture (8.8%), retail and hospitality (6%), public services (1.4%), and other domestic jobs (9.6%) which may lead to some inconsistency in job categorization. Aquaculture (5.6 USD/person/day) and Fishing (1USD/day/person) are the main sources of income. | Household survey 2016 |
| Low literacy rate and poor school infrastructures | The majority of the studied villages (9) only have a primary school education. Only one has a secondary and high school education. This situation results in a low literacy rate (48%) because 90.5% of the population stopped at the primary school. | Census 2015 |
| Poor health infrastructure and service | Only 2 basic health centers are available in the ten villages. 3 medical personnel work for 3698 inhabitants in the ten villages. | Field survey 2019 |
| Problem of water | 53 wells recorded in the ten villages are constructed locally and 74% of them are not subjected to water sanitation. 97% of population have no sanitation facilities. | Field survey 2019 |
| Weak capacity to use home sanitation | Only one village has electricity provision from a company. Majority of people use firewood and charcoal extracted from the forest. | Household survey 2016 |
| Energy sourced from forest products | Most of the villages have male elders as heads of villages. DINA: rules/norms/social conventions are used to govern society. Taboo is used to limit certain use of natural resources. Natural resources are managed by the local association called Velondriake. Decision making is made by the elders but often in consultation with community members. | Field survey 2019 |
| Institution and customary rules based on tradition and beliefs | 3.2. Responses from the Participatory Scenario Planning Workshop

Categorization of participant responses from the participatory scenario planning workshops allowed us to identify six sectors that were perceived to be affected by the PES project (Figure 2). The most impactful variables, according to the participants, were socioeconomic factors and forest management and environment, while institutional, cultural and the capacity to withstand natural hazards were of lesser importance.

3.2.2. Perceived Variables Affected by the Project

Within the 18 variables retrieved education, forest protection, and livelihoods of people were frequently quoted to be more affected by the project. Certain participants within the groups also took into consideration of the variables like infrastructure, natural habitats, health of people, carbon stocks, and law to be affected. Variables such as employment, tourism, resilience to natural hazards, participation in management, knowledge sharing, local capacity, local leadership, community cohesion, beliefs, and gender equity were fewly quoted (Figure 3).

3.2.3. Perception of the PES Project from Different Groups

Group A (village chiefs and community representatives) and C (teachers and community health workers) have the same perceptions while group B (resources management
committees) differs from them regarding the PES project. All the groups mentioned that establishment of protected areas, and local regulations under the implementation of the project will result in restriction of activities in the mangrove forests. This in turn, will impact people dependant on the mangrove forest (presented in Table 5). Group B added two additional variables that could negatively be impacted by the project: destruction of the environment due to improved living standards, and loss of traditional beliefs (detailed in the Section 3.2.4 and presented in the Table 5).

Table 5. Perceived changes in the Baie des Assassin’s conditions with and without the PES project. (+) represents positive changes and (−) for negative changes.

|                              | Without Project                                              | With Project                                               | Causes of Changes Anticipated with the Project               |
|------------------------------|--------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|
| Environment                  |                                                              |                                                            |                                                             |
| Greater pressures on the mangrove habitats and biodiversity (−) | Secure mangrove habitats and biodiversity (+)               | Protection of intact mangroves and restoration of degraded areas |
| Decrease in carbon stocks in the mangroves (−)                   | Increase in carbon stocks in the mangroves (+)              | Well protected mangroves serve as barriers to protect against cyclones and erosion; money from carbon credits can be used as emergency assistance fund |
| **Capacity of resilience to natural hazards**                     |                                                              |                                                            |                                                             |
| Vulnerable to natural disasters (−)                                | More resilience to natural disasters (+)                    |                                                            |                                                             |
| Socioeconomic               |                                                              |                                                            |                                                             |
| Poor community infrastructure (−)                                  | Better community infrastructure (+)                        | Conservation of mangroves, sale of mangrove carbon credits, building of new infrastructures, and development of new alternative livelihoods to mangroves |
| Low fisheries productivity (−)                                     | Better fisheries productivity (+)                           |                                                            |                                                             |
| Fewer livelihood options (−)                                       | More livelihood options (+)                                 |                                                            |                                                             |
| Fewer employment opportunities (−)                                 | More employment opportunities (+)                           |                                                            |                                                             |
| Poor education, health and clean water services (−)               | Improved access to education, health and clean water services (+) |                                                            |                                                             |
| Less access to credit and savings (−)                             | More access to credit and savings (+)                       |                                                            |                                                             |
| Less touristic attraction (−)                                      | More touristic attraction (+)                               |                                                            |                                                             |
| Business as usual (+)                                             |                                                            |                                                            |                                                             |
| Forest management and governance                                   |                                                              |                                                            |                                                             |
| Continued mangrove forest clearance (−)                            | Increase of forest size and protected area extent, decrease in deforestation (+) | Creation of management areas, forest restoration, creation of local regulation and management committees, and provision of awareness raising from the project developers |
| Less participation in decision making (−)                           | More participation in decision making (+)                   |                                                            |                                                             |
| Free access to mangrove forest use (+)                             | Limitation of mangrove forest use (−)                       |                                                            |                                                             |
| No forest management (−)                                            | Strong forest management (+)                                |                                                            |                                                             |
| Low understanding of mangrove importance (−)                       | Improved understanding of mangrove importance (+)           |                                                            |                                                             |
| Lower knowledge of mangrove protective legislation and policy (−)  | Greater knowledge of mangrove protective legislation and policy (+) |                                                            |                                                             |
| Institution                                                           |                                                              |                                                            |                                                             |
| Weak institutional capacity (−)                                     | Strong institutional capacity (+)                           | Capacity building and provision of training by the project developers |
| Less community cohesion (−)                                         | More community cohesion (+)                                 |                                                            |                                                             |
| Bad quality of leadership (−)                                       | Good quality of leadership (+)                              |                                                            |                                                             |
| Culture                                                                |                                                              |                                                            |                                                             |
| Traditional beliefs are still practiced in the use of resources (+) | Loss of traditional beliefs in the use of resources (−)     | Innovation brought by the project                          |
| Less women participation in (meeting decision making) (−)           | Increased women participation in (meeting decision making) (+) | Training and initiatives to support women’s involvement in governance |
be no change to their current situation, or things would become more challenging. The presence of the project was expected to reinforce the protection of natural habitats, fauna and vegetation, and to avoid carbon emission through carbon sequestration and storage performed by well-protected mangroves. Well-protected mangroves also were considered to be vital for protecting the rest of the marine ecosystems including seagrasses and coral reefs with the mangroves serving as protective barriers from inland pollution (e.g., rubbish and insecticides). In terms of resilience to natural hazards, the presence of a mangrove PES project was assumed by the participants to increase their chance of being protected from cyclones, storms and erosion. Money from the sale of carbon credits was also envisaged as useful in case of natural disasters.

Concerning the socioeconomic aspects, details of the revenue that could be earned from the sale of carbon credits was succinctly described by the project proponent, which allowed the workshop participants to perceive the existence of the project as an opportunity to improve their community infrastructure such as schools, health clinics, and wells. This improvement could be achieved if the money was used for building health clinics, wells and schools, and to subside primary school children’s fees. A better infrastructure would improve the children’s access to education, and access to health clinics and clean water. In addition, the project was expected to provide an opportunity for new employment and new alternative livelihoods (e.g., ecotourism, beekeeping and others). Hence, householders will be able to save money and earn additional income.

In terms of management and governance of forest resources, the presence of the project aims to increase forest size and protected areas, slow mangrove forest clearance, enable local participation in decision making in the management and governance of natural resources, improve local forest management, reinforce respect for local regulations governing the use of resources and underline the importance of mangroves, and the significance of national legislation and policy. This will be accomplished by raising people’s awareness to the local problems, forest restoration, creation of management committees, and patrolling systems by the project developer.

Participants stated that the presence of the project would improve local institutional capacity and the quality of leadership in terms of management and the governance of resources. Existence of the project is also expected to increase social cohesion both in terms of management and daily social life (e.g., creation of community groups supported by the NGO). Lastly, empowerment of women was expected to increase as a result of a mangrove PES project due to greater participation of women in meetings, decision making, and activities related to mangrove management.

Despite the mangrove PES project being considered as very important for addressing the majority of local problems in the Baie des Assassins, there were some areas that were identified by the participants that could be negatively affected by the project. These included degradation of the environment as a result of improved living standards from the project, as well as negative impacts due to curtailment of the traditional use of mangrove resources and their traditional beliefs. Although the participants foresaw that development in the smaller villages could be promoted by the existence of the project (e.g., building of basic infrastructure using the carbon revenue and improved income from the promoted alternative livelihoods and employment), they were concerned that development would lead to destruction of the environment, because the members of the community might build more houses using wood from the mangroves and other forests as an indication of higher family income and success. Participants also assumed that members of the community would buy more nets which would increase pressure on marine habitats and biodiversity. Apart from that, national laws governing the use of natural resources such as mangroves are not well-known in most coastal communities probably due to the remote geographical location, issues of access and limited contact with and support from the government. This situation often creates conflict between the rights to use resources as defined by the national government, and the rights perceived by the local community which may also lead to conflict between the project developer and the members of the community. Lastly,
due to infrequent interactions with external agencies (government/NGOs), communities often perceive propositions of projects/activities as a threat to their right to access and use natural resources, and to their traditional attitudes and beliefs.

3.2.5. Potential of PES Project from the View the Participants

The consensus of the participants was that the proposed PES project could potentially provide guidance for the management of the Baie des Assassins’ mangroves. Participants in the scenario planning perceived the project to bring more positive impacts (87%) than negatives (13%) in the socio-ecological system of the Baie des Assassins (Figure 5).

3.2.6. Concerns Associated with the Presence of the PES Project and the Likelihoods of Impacts

Workshop participants noted three main concerns with implementation of the project: a long interval before any carbon credits, changes in the membership of the project, and a lack of transparency in the management of the project (Figure 6). The interval before the payment ranked as highly important as this could have considerable negative impacts on community livelihoods (scored as −1) and thus on the way in which the project is regarded by communities (−1), with this impacting successful mangrove management (−1). Delay in receiving the first payment could lead to a loss of patience of the members of the community involved in the project, with this resulting in loss of respect for the agreements (e.g., local regulations and conservation agreements) concerning the management of their mangroves and the PES project. It was thought that negative impacts on the project’s viability could be caused by changes in the project’s structure, staff or management of the mangroves, and participants were concerned that this could threaten project continuity since newcomers would not know the previous context, and therefore would be unable to manage it. A PES project is complex by nature, especially when implemented in a local context. Participants were also concerned about how transparency would be managed in the project. The absence of transparency could create conflict between the project managers and the local communities which will harm the viability of the project (−1). A fourth consideration was that community livelihoods would not be impacted by the lack of transparency and the changes in membership of the project (score 0).

4. Discussion

Payment for Ecosystem Services schemes have constituted one of the most important incentives-based conservation policies worldwide in recent years [59–61]. In countries in the coastal tropics, PES schemes appear to offer a great opportunity to enhance forest and biodiversity conservation [4,29], and to address certain social problems [62]. Our study, building on the work of the Blue Venturer’s NGO in the Baie des Assassins, highlights the importance of assessing community perceptions and expectations; knowledge of these is essential to ensure the long-term success of any project [63,64].

4.1. Potential of PES Schemes to Manage the Mangroves of the Baie des Assassins

Scientific data from the documentation of the mangrove ecosystem of the Baie des Assassins also highlighted the potential of mangroves for a PES scheme [54]. This was based on the fact that, apart from the wide range of ecosystem goods and services that mangroves provide (such as food, wood, biodiversity habitats and coastal protection), the closed-canopy mangroves in the area were estimated to store 454.92 (±26.58) t ha$^{-1}$ of carbon. Although lower than the amount of carbon stored by the mangroves at the global scale (937 t ha$^{-1}$ of carbon), the carbon that these mangroves store (and which theoretically could otherwise be emitted if burnt for fuelwood) can be sold on the international carbon market, and the credits used as a conservation incentive. If integrated into conservation, the 1507 ha of mangroves surrounding the bay have the potential to fund the local needs highlighted by the participants of the workshop. Without taking into consideration how carbon offsets are calculated, and which activities/interventions could be compensated under the PES schemes, our simple calculation gives an estimated 685,564.4 carbon credits.
(1507 ha × 454.92 t·ha\(^{-1}\)) which can be valued as 3,427,822 USD per year (using the lower cost 5 USD) and as 6,855,644 USD over the 20 years of Plan Vivo’s duration. If the state’s benefit sharing legal framework (which is still in the stage of implementation) considers that a share of the revenue from the carbon credits can be given to the local community as the owner of the PES initiative, it is expected that it will be possible to address the majority of social and environmental problems in the area. Among the social problems that could be addressed with the money are the building of schools, health clinics, wells, meeting rooms, and small markets. The money also could be used to incentivize the management of mangroves [65] by funding management activities such as the restoration of degraded mangrove areas, capacity building of the local association, forest patrolling, and management meetings. A PES project might also deliver additional benefits such as the protection of biodiversity and natural habitats, increased fisheries productivity, and income generating opportunities including access to new alternative livelihoods, employment, credits and savings, for natural resource stewards [66]), who are isolated from markets and have few other livelihood options. Securing mangrove forest resources through the PES scheme will constitute a win-win mechanism for both environmental protection and social development in the area [16,67]. Use of carbon funding is expected to encourage local residents to engage in the PES program [68] resulting in increased program legitimacy, local buy-in, and compliance with the rules and regulations put in place [69]. Furthermore, PES projects are conditional upon the buyer being able to benefit from the service, either directly (e.g., recreation for wildlife watching or research), or indirectly (e.g., through the protection of habitat or reduction of carbon emissions). Although the potential of the Baie des Assassins’ mangroves to deliver an important ecosystem service (carbon sequestration) might be considered enough to promote PES project implementation, local perceptions of this project are also crucial to assess how the project fits the local context and to ensure how it can be fair and transparent in the view of community.

4.2. Solutions to Address Negative Impacts and Concerns

To ensure that the project interventions result in better social and environmental outcomes, it is necessary to address the risk of negative impacts and the concerns of those targeted by the interventions is necessary [25]. Access to mangrove resource use is expected to be restricted in the presence of the project due to the increased extent of management areas and adoption of local regulations. This will impact those who use mangroves as a source of food and income. A potential strategy proposed to mitigate the problem is the provision of adequate alternative livelihoods that mainly target the mangrove resource dependents [66]. To avoid social mistrust of external agencies (NGO/Government institutions) who may propose projects/activities for the local people, most workshop participants suggested the involvement of elder people from their villages in consultations, meetings and decision making. Elder people act as intermediaries to facilitate the interaction of all villagers with the external agencies. Their intervention (including having a seat at the table and having a voice) is therefore meaningful for the people [70,71]. Failure to communicate with the elders is likely to result in non-acceptance of the project proponents in the field by locals. Although not regularly cited as obstacles, these issues can make field work unsafe or impede it completely. Moreover, given that the taboos and customs limit certain aspects of the use of natural resources in the area, they can also be incorporated in development of socially acceptable rules or regulations for resource management [72].

We recognize that the success of a carbon sequestration PES project such as that in the Baie des Assassins depends not only on the local socio-cultural context but also on the national political and institutional context. State intervention is necessary to provide a legal framework since a PES scheme involves a contract between ecosystem service providers and buyers, land ownership rights, and transaction costs [73]. National policy, law, institutions, and organizations play an important role for the establishment of a PES project [74–76]. In Madagascar, frequent change in the government institution in charge of PES slows the production of documents to validate and register projects under
the carbon certification standard, and the absence of clear law and policy regarding the carbon ownership rights, carbon marketing, and benefit sharing, complicate the process for the sale of carbon credits on the international market. Recognizing the weak legal framework surrounding PES, and the susceptibility to political pressures in a country in which NGOs and local institutions often have little control, participants in this study emphasized their concerns over the delay of money from the first sale of carbon credits. A solution suggested by participants to address this delay was to lobby the government. Members of the community would prefer to take action on this with marine conservation platforms or networks. Such networks can ensure that community voices are raised and considered by the government and then are incorporated during the processes of policy development and reform. Moreover, the authors consider that a possible solution to clarify rights to use natural resources like mangroves by the local community is raising awareness of the existing national regulations which should not only be the responsibility of the members of the government themselves but also the responsibility of private sectors (NGOs/Associations). Another solution to allow communities to maintain their full rights in the use and management of natural resources is to request the management transfer of natural resources to them, a mechanism that has been written into national law since 1996 [77].

Additional to the solutions suggested by the workshop participants, we propose the following solutions to address concerns that community development would lead to an increase in house building using mangrove wood and overfishing: promotion of stone buildings (because they do not require timber and are more sustainable), provision of training on legal fishing techniques including the use of large-mesh nets, extensive legislation training and enforcement [78], and the promotion of higher-efficiency cooking stoves (which thus require less fuel, [79]). Lastly, a handover and exit plan could be prepared by the supporting NGO through transfer of benefit sharing responsibilities to the local association to make sure that the association is robust, inclusive, transparent, and independent [80]. This will address any concerns of the local people about the equity and transparency of benefit sharing as well as any changes in the structure and membership of the project management.

4.3. Strengths and Limitations of the Study

Our study set out to bridge the gap between theory and practical implementation of PES projects [81]. In a developing country like Madagascar, implementation of conservation projects is often challenged by the lack of a baseline for socio-ecological data against which the impacts of any conservation action can be assessed [82]. This included local perceptions concerning the installation of the PES projects in a mangrove ecosystem.

We presented baseline socioeconomic and mangrove data in our workshop to give the participants a knowledge and understanding of their current social and ecological conditions. These data also set a frame of reference that can be used for evaluation of the project interventions at later stages [83]. Our participatory scenario planning exercise supported by these baseline data allowed us to investigate the perspectives of representatives of stakeholders to gain some local perceptions of the proposed PES project. Use of this particular approach to incorporate the context and perspective of local stakeholders is crucial [12] because their meaningful engagement is critical to effectively implement a PES scheme [82–85]. Interaction, discussion, and presentation of pre-collected socioeconomic and mangrove ecosystem data during the scenario planning exercise helped participants to gain knowledge of their strong relationship with nature. This knowledge, in turn, allowed them to identify plausible changes, concerns, and expectations as the outcome of the project [38,86], and to construct proactive strategies to maintain socially and environmentally desirable system states [34,87–90].

Participant configuration critically determines the outcomes of many scenario planning exercises [91]. In our study, the diversity of participants’ level of knowledge (ranging from illiterate to those with a university education) led to some misunderstandings over the
results of project implementation. For example, although certain situations (e.g., existing national law, depletion of resources) would not be the result of project implementation, participants believed this would be the case. Validity and reliability of the responses need to be checked to more adequately reflect the nature and objectives of the research [92]. In addition, although the use of small groups during the scenario planning exercise was considered cost-effective to achieve the desired outcomes of the PES project, the perceptions of these small groups regarding the proposed project may not reflect those of all the Baie des Assassins’ communities. To ensure full coverage of local perspectives, a larger number of participants is strongly recommended. Finally, a PES scheme should be implemented in five major steps with these usually carried out in sequence: proposition and preliminary study, design, execution, and monitoring [59,93,94]. Our study describes only the early stages of this process (proposition). Our data were generated using a rapid rural appraisal method to generate our data which may not be applicable to a large-scale PES project. Gaining peoples’ trust is not a single process but critically needs ongoing communication and the provision of continuous feedback. This requires a core team with good communication and facilitation skills, and a thorough knowledge of the area. Finally, although feedback from our workshops is sufficiently positive to warrant implementation of the project, support from external agencies (e.g., central government, experts) is crucial for the project’s success.

Further studies investigating design, execution and impact monitoring are recommended to better understand how to ensure the success of a PES project over time, and whether the same approaches are applicable in coastal and terrestrial contexts as well as larger PES projects.

5. Conclusions

Our study is the first to investigate local perceptions towards the implementation of a PES scheme in the mangroves of Madagascar. Local communities believed that with carbon marketing, the PES scheme has the potential to lead to sustainable management of the mangroves surrounding the Baie des Assassins. Workshop participants hope to use their carbon profits to address major social problems (such as schools, health clinics, markets and wells), and to support management of mangroves (monitoring of protected areas and restoration of degraded mangroves). If the predicted negative impacts and concerns associated with the project are addressed, there is a high chance that the proposed PES project will be accepted by the local communities, and it will be possible to successfully manage the entire mangrove area in the Baie des Assassins. The method used proved efficient to assess stakeholder perceptions and concerns relating to a PES project and to identify adaptive strategies to ensure long-term viability of the project.

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