

Exploring the policy and institutional context of a Payment for Ecosystem Services (PES) scheme for mangroves in southwestern Madagascar

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ABSTRACT

Although Payments for Ecosystem Services schemes emerged since the 1980's to manage forest ecosystems, their application to mangrove forests is still recent, and evidence of their effectiveness is still questioned towards the complex legal status of mangroves. This study explored the context of policy and institution regarding the Payment for Ecosystem Services (PES) implemented in the mangroves of the Southwestern Madagascar. We used Policy content analysis to examine the interactions between the Madagascar sectoral policies and the PES design frameworks developed under the Reduction of Emission from Deforestation and forest Degradation (REDD+) mechanism of the United Nations Framework Convention on Climate Change. In addition, semi-structured interviews with national and local stakeholders were conducted to identify i) institutional interplay between PES and mangroves and ii) challenges faced with the implementation of PES in the mangroves. We found that environmental, fisheries and land use planning policies that concern mangrove management are coherent with the frameworks and supportive of PES implementation. Lack of clear legal frameworks and coordination between the sectoral ministries, weakness of government organisations due to political instability, and limited local governance capacity are the major challenges for the implementation of PES schemes in mangroves. These led to lower motivation to collaborate in mangrove conservation efforts among the members of local communities. We emphasized that the existence of the mangrove PES initiative like in the Baie des Assassins could be a catalyst for Madagascar to develop clear policy, legislation, and institutions to support effective implementation of the PES schemes in mangroves.

1. Introduction

Mangrove forests provide a range of valuable Ecosystem Services (ES) that are crucial for the human wellbeing, including provision of food and wood, control of flood, storm and erosion, provision of habitats for commercial fish species and biodiversity, provision of recreational services, and sequestration of atmospheric carbon that have increasing impacts on the climate changes [1,2]. Despite such a substantial role of mangroves, they are being rapidly destroyed all over the world with their global loss estimated at 1.04 million ha between 1990 and 2020 [3]. However, in the context of their unprecedented deforestation [4]

and the uncertainties linked to global climate change, the development of new conservation policy instruments that balance conflicts between human and conservation priorities has become the focus of several current studies [5]. Among them include Payment for Ecosystem Services (PES), an instrument that has attracted increased attention in recent decades around the world [6–9]. PES was defined by Wunder [10] as “a voluntary transaction where a well-defined ES (or a land use likely to secure that service) is being ‘bought’ by a (minimum one) ES buyer from a (minimum one) ES provider if and only if the ES provider secures ES provision (conditionality)”. PES represented a growing trend in conservation policy and developed rapidly in both developed and

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developing countries [11] around three groups of environmental services: watershed protection (e.g. Brazil, [12]), carbon sequestration (e.g. Kenya and Tanzania, [13]), and biodiversity conservation (e.g. Cambodia, [14]). As such, with an increasing international efforts to fight against climate change and as a result of the growing recognition of the high capacity of mangroves to either sequester or store large quantities of carbon [15,16], mangrove PES has been considered as part of the mechanisms to Reduce Emissions from Deforestation and Forest Degradation (REDD+) promoted by the United Nations Framework Convention on Climate Change (UNFCCC) [17]. *Mikoko Pamoja* mangrove carbon project of Kenya [18] is an example of successful mangrove PES in the world where local communities of the Gazi bay of Kenya (seller of ES) generate an annual income estimated at US\$12,000 through the sale of the carbon sequestered by their mangroves. This credit is earned from the conservation and restoration of their mangroves which sequester 3000 metric tons of CO₂-equivalent/year and sold to carbon buyers (e.g. governments, international investors and companies) on the Voluntary Carbon Market through Plan Vivo Certificates [19].

Other countries like Vietnam [20] and Madagascar [21,22] have also applied PES schemes to manage their mangroves. However, due to recent application of these schemes in the field of mangrove management, there is still much to learn about how the schemes function in the socio-economic, biophysical and political context of the mangrove ecosystem. Recent studies have shown that PES seems particularly difficult to operationalize in mangroves [23,24] due to the fact that this type of ecosystem is administered by multiple actors who often have contradictory political objectives [25,26] within a complex hierarchy of power [27]. Therefore, the inclusion of this ecosystem in international policy frameworks such as carbon finance mechanisms (for example, REDD+) and other mechanisms of the United Nations Framework Convention on Climate Change (UNFCCC) has led to different debates and researches at the international level [28,29]. To be included in these policy frameworks, national policy frameworks for mangrove management and governance should at least be in compliance with these international frameworks, but in reality, there is little certainty that this consistency exists in different countries. A certain number of case studies from central America (Honduras, Guatemala, Panama, [30], Kenya [19] and Malaysia [31] regarding the application of REDD+ to mangroves highlighted the institutional complexity of the mangroves (including policy and land tenure conflicts) as the main risk and obstacle for REDD+ . Policy, laws, and tenure security constitute the basic ingredients for the successful implementation of REDD+ (including PES) in the mangroves [29,32]. As such, their detailed analysis is often crucial in different geographical areas of the implementation. This can help identify new potential challenges, share lessons learned, and draw potential solutions.

This present study examines the case of a mangrove PES project (based on payment for carbon sequestration) implemented in the Baie des Assassins of southwestern Madagascar. Aware of the increasing degradation of their mangroves (loss of 3.18 % between 2002 and 2014, [33]), the local community association (Velondriake) from the Baie des Assassins began integrating their mangroves into the PES scheme in 2013, with the technical and financial support from the NGO Blue Ventures. This established PES project aims at generating carbon credits through restoration and avoiding mangrove deforestation, while contributing to climate change mitigation and local poverty reduction. As in some tropical countries where PES schemes have recently been integrated into the mangrove governance system, the adoption of this scheme in the mangroves in Madagascar faced several challenges, mainly related to the political context. The objective of our study is therefore to i) analyze existing policies, legal and institutional frameworks related to PES and mangroves, ii) identify sources of coherence and conflict between them, and iii) identify their implication for the implementation of PES in mangroves at the local context. To do so, we used the institutional approach adopted from the study of Corbera et al.

[34] and Richards et al. [35] from which, research questions and methods (Table 1) were developed, based on three analytical domains and dimensions (policy interaction between mangroves and PES, institutional interplay between mangroves and PES, and implications for the implementation of mangrove PES at the local level).

2. Materials and methods

2.1. Study site and context

Our study site, the Baie des Assassins, is located in the rural commune of Befandefa (22° 8.767'S and 43° 18.331'E), district of Morombe in southwest Madagascar (Fig. 1). The bay is surrounded by 1507 ha of mangrove forests and falls within the Velondriake Locally Managed Marine Area (LMMA). This LMMA is a Category V protected area under the International Union for Conservation of Nature (IUCN) classification, is co-managed by the Velondriake Association and the NGO Blue Ventures, and governed through the national code of protected areas (Loi n° 2015–005 portant refonte du Code de Gestion des Aires Protégées). The mangroves of the bay constitute an important resource for the local population (food, building materials and income) and an important habitat which supports marine and coastal biodiversity in the region [21]. The bay is extremely isolated and the local population live within extreme socioeconomic conditions (e.g. limited access to community infrastructure and services, high population growth and coastal migration) and biophysical conditions (e.g. farming is not productive due to aridness). These have resulted in over-exploitation of the mangrove resources such as the extraction of mangrove wood to build houses and fences and to produce lime (the burning of mollusc shells, primarily *Terebralia palustris*, to make a kind of plaster used in house construction, [36]) which are commercialised to support the needs of these people. Therefore, due to their widespread degradation (3.18% of loss between 2002 and 2014, [33]), the mangroves of the bay have been incorporated into a PES scheme since 2013. The mangrove PES project (locally named *Tahiry Hoko*) of the bay was developed and funded by the NGO Blue Ventures. Blue Ventures has

Table 1

Analytical domains and dimensions and research questions to analyze the context of the PES project implemented in the Baie des Assassins (Adopted from Corbera et al., [34] and Richards et al., [35]).

Analytical domain and dimensions	Guiding research questions	Methods used
Policy interplay between mangrove and PES	What cross-sectoral policies and legal frameworks affect mangroves in the country? What are the interactions between these policies and the global PES design rules? What policies and legal frameworks are sources of challenges for the implementation of the PES scheme in mangroves? What are the policy gaps between mangroves and PES?	Policy document review
Institutional interplay between mangrove and PES	How is mangrove management coordination structured in the country? Is the structure conducive to the achievement of PES objectives?	Key informant interview and document analysis
Implication for the implementation of mangrove PES at the local level	Do national political and institutional challenges affect PES performance at the local level? What local capacity is lacking and needed to implement successful PES?	Interview using Natural Resources Governance Tool (NRGT)

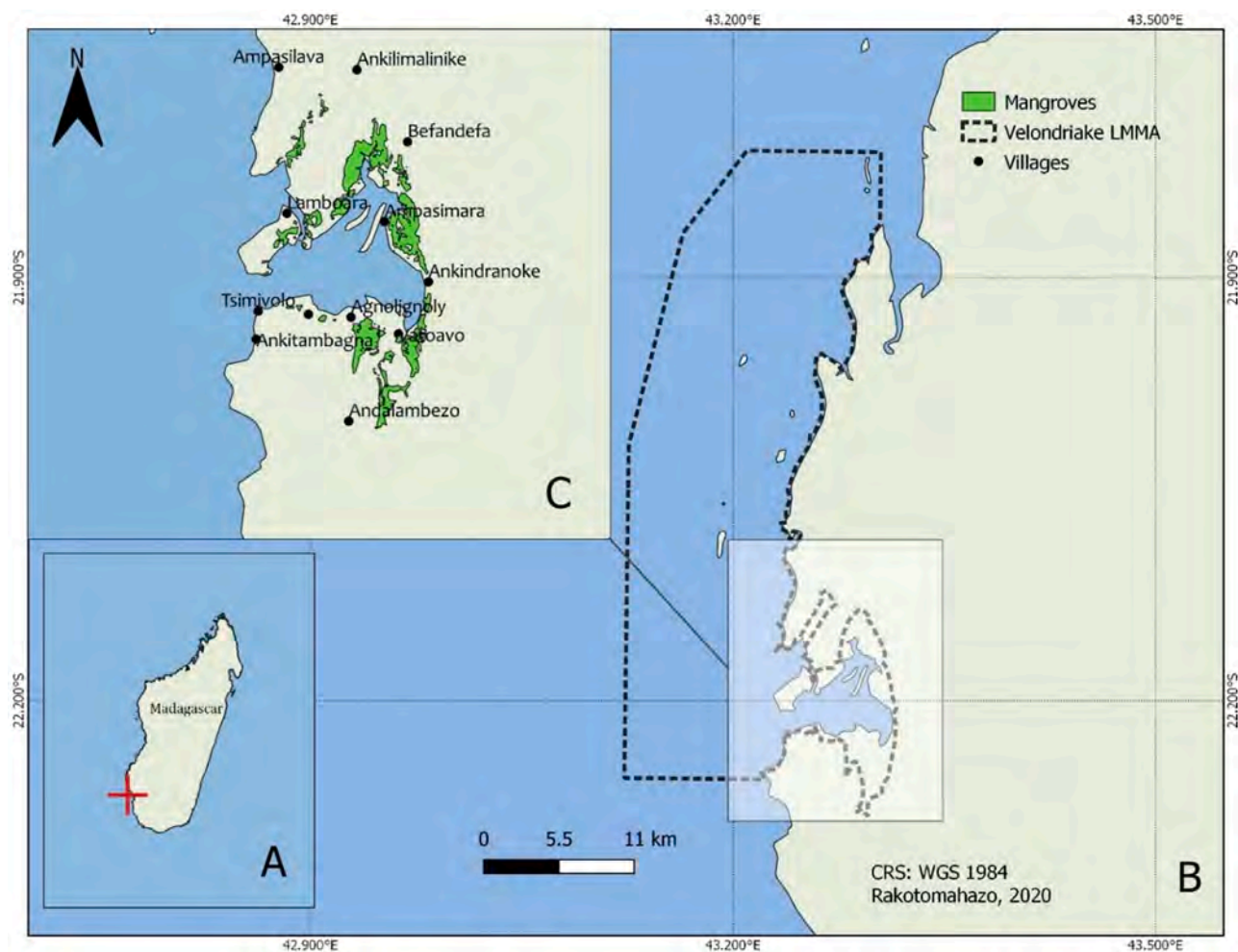


Fig. 1. Location of study site in Madagascar (A), Velondriake LMMA (B) and Baie des Assassins (C) with its mangroves and surrounding villages.

worked in the area since 2003 with specific interests in rebuilding tropical fisheries with the local communities. The project is coordinated by the Velondriake Association and engages the local population from the ten villages surrounding the bay in conservation and restoration activities. The *Tahiry Honko* project is underpinned by a community-designed mangrove management plan which comprises 257 ha of strict conservation, 973 ha of sustainable use, and 163 ha of degraded area to be restored [21]. Two of those mangrove management areas are governed by a set of rules which exclude use of mangrove wood by the local communities. For example, night fishing and the cutting or collection of dead or living mangrove wood is strictly prohibited in the strict conservation zones. Cutting/collection of sub-adult mangrove trees is also prohibited in the mangrove reforestation areas. This conservation initiative is expected to prevent the emission of 1371 tCO₂ per year, certified under the Plan Vivo standard. The carbon credits obtained from the emission prevention are then used to encourage the 895 households in the ten villages surrounding the bay to sustainably manage their mangroves, and reduce poverty in the area, thereby contributing to the fight against climate change.

2.2. Data collection

To assess how effective is the PES scheme to promote sustainable management of mangroves and to identify the state of the small-scale mangrove PES project in the Baie des Assassins regarding the Madagascar's REDD+ initiatives, a diagnostic analysis of mangrove and PES policies, legal and institutional frameworks was conducted. Data

collection approaches then ranged from documents review (policies and legal texts) to interviews.

2.2.1. Analysing political interplay between mangroves and PES

This analysis was carried out through documentary review. Policy documents were gathered from two levels: international and national. At the international level, the documents of the United Nations Framework Convention on Climate Change (UNFCCC) were gathered, in particular the decisions of the COP (COP 13, 15, 16, 17, 19, see, Appendix A). At the national level, existing policies in relation to PES and mangroves were gathered from the three ministries' departments (Ministry of Environment, Ministry of Fisheries, and Ministry of Land Management). To proceed to the analysis, we first reviewed the COP decisions in order to learn about the rules for the global design of PES schemes (including REDD+). To identify the interplay between the national mangrove policies and the global design rules of PES, we used content analysis [37, 38]. This consisted of carrying out a systematic analysis of the text. The relevant words/sentences from the national policies (e.g. promotion of PES, forest landscape restoration and fight against deforestation and forest degradation) were categorized and coded manually according to their relationship with the PES global design rules (e.g. S=safeguard, A=Additionality, F=Finance, P=Permanence and LA= Leakage Avoidance). A total of 11 policy documents were reviewed (Table 2).

2.2.2. Analysing institutional interplay between mangroves and PES

To identify institutional interplay between mangroves and PES, semi-structured interviews were therefore conducted with the staff of

Table 2
List and source of policy documents analyzed.

Scale	Type	Source des documents	Number
International	Policy	United Nations Framework Convention on Climate Change (UNFCCC)	1
National	Policy	Ministry of Environment	7
National	Policy	Ministry of Fisheries	2
National	Policy	Ministry of Land Management	1
Total			11

the Ministries concerned. Interviewees were drawn from the Ministry of Environment, Ministry of Fisheries, and Ministry of Land Management. Those ministries were targeted because of their cross-cutting role in the coordination of mangroves and PES. To conduct these interviews, an authorization letter from the university where we conducted this research was sent to those three ministries' departments to obtain validation and schedule for the interviews. Unfortunately, we could not interview staff from the Ministry of Land Management due to their unavailability during our interview period. As such, perspective from this institution may not be reflected in the results. Our interview targets included 2 policy makers: one from the Ministry of Environment and one from the Ministry of Fisheries. The interviews focused on how mangrove governance is structured at the national level, what are the roles and the representation of stakeholders in the adoption of law/decrees regarding the mangroves, and how the PES schemes are instituted in the context of mangrove management?

2.2.3. Identify challenges for the implementation of PES schemes in mangroves

Challenges faced with the implementation of the PES schemes in mangroves were identified based on i) the review of the legal texts governing mangroves and the experimental design of the PES from national to local context. To do this, existing legal texts regarding mangroves were retrieved from the website of the Ministry of Environment, Ministry of fisheries, and Ministry of Land Management and reviewed. In total, 7 legal texts (5 from Ministry of Environment, one from Ministry of Fisheries, and one from Ministry of Land Management) were reviewed. Those legal texts were analysed based on two themes: legal status and protection status of mangroves. Those two themes were purposely considered as they have interaction with the tenure security and the property rights which are crucial for the successful implementation of the PES project. Contents of the legal texts were then noted according to their relationship to these two themes and the challenges were defined based on the contradiction and consistency of the contents noted.

To triangulate the information gathered from the legal texts review, semi-structured interviews were conducted with the stakeholders in charge of the technical implementation of the PES including the Ministry of Environment (responsible for the REDD+ program implementation, n = 1) and NGO Blue Ventures (n = 2). Information gathered focused on the historical background for the implementation of the PES schemes in Madagascar, the overall challenges faced with the implementation in mangroves including policy constraints (gaps) and coordination with multiple stakeholders, and their effect on the implementation of the project activities.

2.2.4. Assessing the effects of the national political and institutional challenges on the site implementation of the PES schemes: case of Tahiry Honko project

To develop an understanding of how the national political and institutional challenges affect the site level implementation of the PES scheme, we assessed the governance capacity of the Tahiry Honko project manager (which is Velondriake Association, Fig. 2). The project was selected as a case study as the only PES project implemented in the mangroves of Madagascar and has also been implemented over a

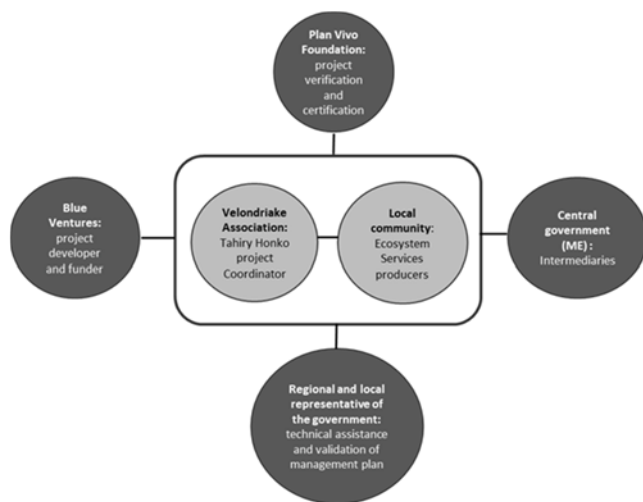


Fig. 2. Role and representation of stakeholders involved in the management of the Tahiry Honko project of the Bay of Assassins (Source: Blue Ventures, modified by the authors).

relatively longer period (8 years). In addition, it is exposed to different socioeconomic, ecological, and institutional contexts. Stakeholders involved in the project are constituted by the Plan Vivo foundation, Madagascar government (including national, regional and local representatives), Blue Ventures, Velondriake association, and the local communities from the ten villages of the Baie des Assassins (Fig. 2).

To assess the governance capacity of the Velondriake Association, we used the method adopted from the 'Natural Resources Governance Tool' (NRGT) of Wilkie et al. [39]. This approach consists of assessing the authority, capacity and power of the governance structure that manages natural resources in a given geographic area. The assessment consists of conducting interviews with the members of the stakeholder groups that collaborate (directly/indirectly) with the governance structure for the management of the given resources, based on the sub-attributes of authority, capacity and power. Indeed, to assess authority, sub-attributes such as legitimacy, accountability, transparency, participation, fairness, and diversity within the governance structure must be taken into account. In addition, to assess capacity, sub-attributes such as knowledge, competence, resources (human, material and financial), institutional framework, and motivation must be considered. Lastly, to assess power, questions about the level of independence of the structure in terms of decision-making and enforcement of rules and regulations must be taken into account.

We started with listing the main stakeholder groups that work directly and indirectly with the association. This list was created based on the information gathered from interviews with the Blue Ventures staff (as the project developer) and the Velondriake association president (as the project coordinator). Four governance groups were intentionally chosen which included the Blue Ventures staff, the Velondriake association, the local community associations from the ten villages of the bay, and the regional and local representative of the government. We excluded Plan Vivo foundation and the central government from the list as they are not familiar with the local context of the project management and governance. Following this, interviews were conducted with members of each stakeholder group. The questions asked were related to the sub-attributes that make up authority, capacity, and power (See Appendix B). We had a total of 11 sub-attributes (legitimacy, accountability, transparency, participation, equity, knowledge, resources motivation, power and diversity) from which a set of closed questions were generated and asked of each individual (Fig. 3). A series of scores from - 2 (completely disagree) to + 2 (completely agree) was used for each response modality.

Although the Natural Resources Governance Tool suggested 8 people

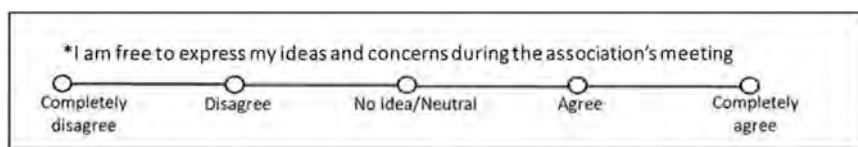


Fig. 3. Modality of response for each sub-attribute question.

to be interviewed for a set of 3–4 stakeholder groups, in this study, we interviewed 22 people (Table 3) to ensure that the diversity of people who live in and around the natural resource (mangroves) managed through the PES scheme were represented. With our 4 stakeholder groups, we only used one questionnaire (see Appendix C) but the questions were asked differently for the members of each group interviewed.

2.3. Data analysis

To analyse data from the documentary review, specific policy measures emphasised in the policy documents from the three sectoral ministries were retrieved and analysed against each of the REDD+ design rules: safeguard, additionality, finance, permanence and leakage avoidance. Theme coding was applied to extract specific policy measures from documents [40] by categorising content into policy aim, policy objectives and activities into matrix table (Excel). Those policy measures were then matched against the specific REDD+ rules and their frequency was quantified to generate number/percentage. The same process was applied for the data retrieved from the legal texts review. Concerning the semi-structured interview performed during the study, given the relatively low number of interviewees for the national and local level interactions of the institutional frameworks for mangroves and PES, only summary descriptive analysis was performed via textual summaries and graphs, and results should be treated with caution. Lastly, to assess the governance capacity at the local level implementation of the PES, the averages of scores assigned to each question corresponding to the sub-attributes of governance were calculated using Excel. A radar chart was generated to present the governance capacity of the local association.

3. Results

3.1. Cross-sectoral policies that affect mangroves and their interplay with global PES design rules

Madagascar has several policies that promote the management of natural resources but does not have specific policy frameworks for the management of mangroves. The strategic guidance frameworks for the management of this ecosystem overlap with certain sectoral policies of the country, such as policies relating to the environment, fisheries and land use planning (Table 4). Although adopted in a global manner to manage the entire natural resources of the country, the policy initiatives for these three sectors offer several opportunities to govern and manage mangroves. Political initiatives such as the fight against deforestation and forest degradation, strengthening of monitoring and evaluation

system, promotion and integration of PES and REDD + approaches in forest resources management, restoration of forest landscapes, integrated land use planning, promotion of local participation and development of protected areas provide opportunities for mangroves to be managed in an effective and sustainable manner.

Analysis of the COP decisions (COP 13, 15, 16, 17, 19) under the UNFCCC indicated that these policy initiatives interact with five REDD+ global rules (which include PES): safeguard, monitoring-reporting-verification (MRV), additionality, finance and avoiding leakage. REDD+ safeguards include all the initiatives that address sensitive issues such as the rights of indigenous peoples, social participation, and the preservation of natural ecosystems. MRV includes the measurement, reporting, and verification of the country's forest cover and associated greenhouse gas (GHG) emissions and removals, including their changes over time. Additionality comprises all of the activities that increase carbon storage above the level that would not have happened without those activities. Finance includes the activities related to forest conservation that can generate funding and lastly, avoiding leakage consists of avoiding shifting drivers of deforestation to other areas. Of the analysed policies, 60% (i.e. 6/10) have initiatives that interact with the safeguarding component of the REDD+ program. These initiatives include the improvement of forest governance, the promotion of local participation, integrated land use planning, the development of marine and coastal protected areas, and inclusive land use planning. Ten percent of the policies had initiatives that interact with MRV (e.g. strengthening of monitoring and evaluation systems) and 20% with leakage avoidance (e.g. development of alternatives to wood energy and diffusion of agroforestry). Seventy percent of the policies had initiatives that interplay with additionality (e.g. fight against deforestation and forest degradation, reduction of timber removal from forests, and blue growth and integrated coastal zone management) and finance (e.g. promotion of PES, integration of the REDD+ mechanism, promotion of projects under the Clean Development Mechanism and the voluntary carbon market) of REDD+ rules.

3.2. Institutional interplay between mangroves and PES

The institutional framework for the governance of mangroves in Madagascar is characterised by fragmented authority. Many organizations and structures (public and private) are involved directly and indirectly in the management of mangroves (Fig. 4 A). As per their location at the interface between the land and the sea, mangrove management direction falls under the Ministry of Environment and the Ministry of Fisheries. Ministry of Environment coordinates management strategies related to mangroves, grants management delegation contracts, supervises and assesses compliance with the national laws, and conducts technical and socio-environmental audits. Ministry of Fisheries establishes procedures and requirements for fishing activities (e.g. establishes fishing seasons for some species), exercises controls, and imposes fines. Both of them define the national policy and legal framework related to mangroves, and ensure their implementation and integration in the overall economic development of Madagascar. They also have regional offices that act at the field level. Other institutions involved in the mangroves include international NGOs (acting as technical and financial partners for implementation of management), civil society organisations (ensure advocacy, surveillance and monitoring), local communities represented by their associations (manage protected

Table 3

Distribution of respondents for each stakeholder groups.

Stakeholder groups	Number
Blue Ventures NGO staff	5
Members of the Velondriake Association	8
Non members of the Velondriake Association (community members from the 10 villages of the project)	6
Government (Decentralized Territorial Collectivities and Deconcentrated Technical Services)	3
Total	22

Table 4
Interplay between cross-sectoral policies relevant to mangroves and PES global design rules.

Policies	Sectors	Relevant policy initiatives	Benefits to mangroves	Interplay with the REDD+ (including PES) global design rules
Madagascar Forest Policy (2016–2030)	Environment	Improvement of the governance of forest resources	Improved governance of mangroves	Safeguard
		Strengthening of monitoring and evaluation system	Secured mangrove areas	Monitoring Report and Verification
		Fight against deforestation and forest degradation	Avoided mangrove deforestation	Additionality
		Development of Payments for Ecosystem Services (PES) approaches as drivers of forest landscape restoration	Ecosystem Services provided by the mangroves valued	Finance
National Environment Policy for Sustainable Development (2015)	Environment	Sustainable management of forest resources	Well-managed mangroves	Additionality
		Promotion of projects under the Clean Development Mechanism and the voluntary carbon market	Ecosystem Services provided by the mangroves valued	Finance
		Promote the participation of local communities	Local mangrove management promoted	Safeguard
National REDD + Strategy (2018)	Environment	Sustainable management of forest resources	Well-managed mangroves	Additionality
		Forest Landscape Restoration	Restoration of the degraded mangrove areas	Additionality
		Fight against deforestation and forest degradation	Avoided mangrove deforestation	Additionality
		Integrated land use planning	Tenure security for mangrove promoted	Safeguard
		Promotion of REDD + activities on mangroves	Integration of mangroves into the REDD + mechanism	Finance
Madagascar Anticipated National Determined Contribution (2015)	Environment	Development of alternatives to wood energy	Avoided mangrove deforestation	Leakage avoidance
		Effective integration of the REDD + mechanism	Integration of mangroves into the REDD + mechanism	Finance
		Restoration of natural habitats (forests and mangroves: 45,000 ha)	Restoration of the degraded mangrove areas	Additionality
		Reduction of timber removal from forests	Avoided mangrove deforestation	Additionality
National Strategy for the Restoration of Forest Landscapes and Green Infrastructure in Madagascar (2016)	Environment	Diffusion of agroforestry	Avoided mangrove deforestation	Leakage avoidance
		Promotion of PES	Ecosystem Services provided by the mangroves valued	Finance
		Promote the participation of local communities	Local mangrove management promoted	Safeguard
National Biodiversity Strategy and Action Plans (2015–2020)	Environment	Integrated land use planning	Tenure security for mangrove promoted	Safeguard
		Development of positive incentives (PES) for biodiversity management	Ecosystem Services provided by the mangroves valued	Finance
		Restoration of degraded ecosystems (marine and coastal, wetlands) to help fight the effects of climate change	Restoration of the degraded mangrove areas	Additionality
National Climate Change Policy (2015)	Environment	Promotion of projects under the Clean Development Mechanism and the voluntary carbon market	Ecosystem Services provided by the mangroves valued	Finance
		Reduction of greenhouse gas emissions	Integration of mangroves into the REDD + mechanism	Finance
Blue policy letter (2014)	Fisheries	Restoration of degraded ecosystems (marine and coastal, wetlands) to help fight the effects of climate change	Restoration of the degraded mangrove areas	Additionality
		Preservation and restoration of sensitive aquatic ecosystems	Restoration of the degraded mangrove areas	Additionality
Regional Fisheries and Aquaculture Strategy of Indian Ocean Commission (2015–2025)	Fisheries	Development of marine and coastal protected areas	Mangroves integrated into the marine and coastal management	Safeguard
		Blue growth and integrated coastal zone management	Mangroves integrated into the marine and coastal management	Additionality
Land Policy Letter (2015 – 2030)	Land management	Inclusive planning of the use of spaces	Tenure security for mangrove promoted	Safeguard

areas), municipalities (plan land use and receive taxes from resource exploitation) and research institutions (data collection and research).

Operationalisation of REDD+ (including PES) falls also under the Ministry of Environment through the National office REDD+ coordination (BNCREDD+). BNCREDD+ insures the coordination of the whole activities related to REDD+ and implements the national REDD+ strategies through development of policies, consultations, establishment of institutional and technical frameworks, and establishment of national and regional platforms with different stakeholders (Fig. 4 B).

Institutional interplay between mangroves and PES exists in Madagascar and manifests itself in two aspects: coordination and stakeholder's involvement. Both mangroves and PES are coordinated by the Ministry of Environment and most of the stakeholders involved in the mangrove management and governance are part of the framework for the operationalisation of REDD+ (box with dotted lines, Fig. 4 B). Existence of those stakeholders including civil society organisations, research institutions, and NGOs that connect the two institutional frameworks constitutes the key enablers for the integration of mangroves into the PES schemes.

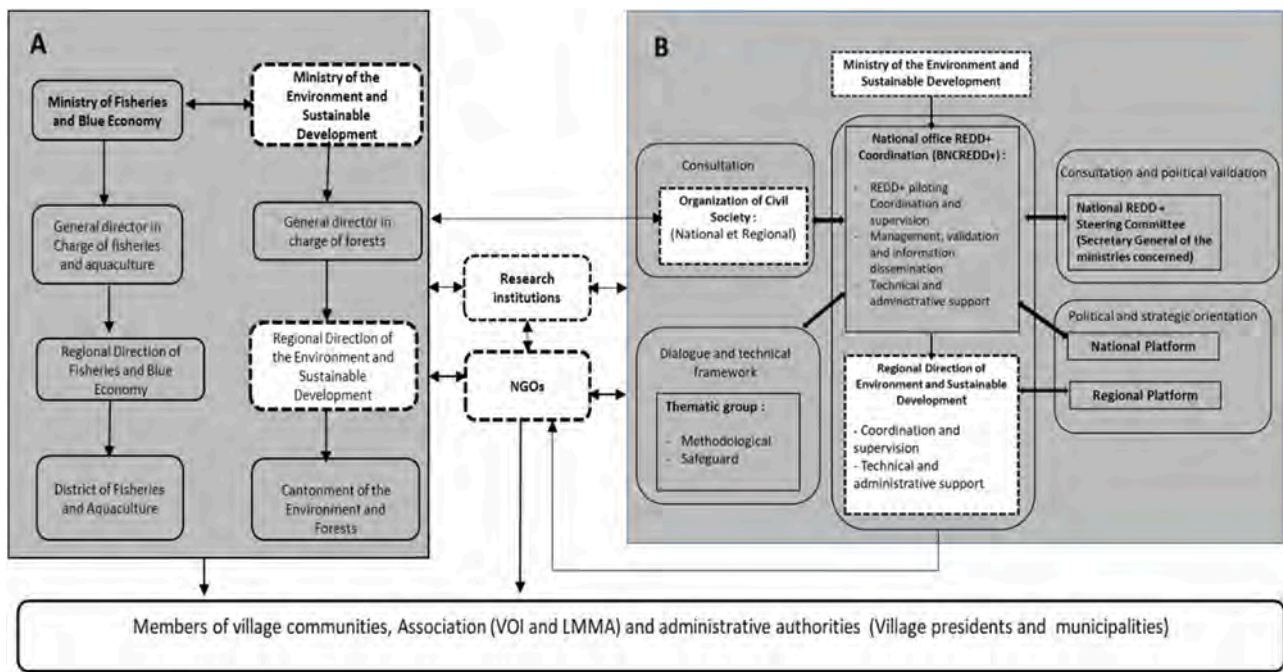


Fig. 4. Formal structure for mangrove forest (A) management (Source: MEDD and MAEP [41] and interplay between the institutional framework for operationalization of REDD+ (B) in Madagascar (source: Readiness Package Madagascar [42] modified by the author).

3.3. Challenges for the implementation of PES schemes in mangroves

3.3.1. Legal framework challenges

Of the 7 analysed legal documents, 5 of them defined the legal status of mangroves and 3 defined their management (Table 5). We found that a comprehensive and effective legal framework regarding mangroves does not exist in Madagascar. Referring to the Law 2005–019 of October 17, 2005 governing the land tenure, mangroves belong to the public domain of the state. As part of this domain, mangroves are inalienable, elusive and imprescriptible. Their management is addressed indirectly through various laws and regulations related to environmental protection, forestry, and fisheries. This situation creates an ambiguity on the definition of the legal frameworks that govern the legal status of mangroves, which complicates the ability to secure land tenure. Only the Inter-Ministerial Order N° 32100 – 2014 is specific for mangroves but this order does not consider traditional use rights for the local people. Whilst the national Law N° 96–025 of September 30th and the Ministerial Order N° 29211/2017 tend to provide common ownership of mangrove management and land rights by communities, Inter-Ministerial Order N° 32100 – 2014 bans the process. As such, the confusing multiplicity of laws generate a risk of non permanence of PES implemented in mangroves. For example, lack of clarity on mangrove tenure rights may generate conflicts among the actors operating in the management and the use of mangroves. In addition, conservation initiatives that target the sustainable use of mangroves by the local communities cannot be included as an activity to reduce carbon emissions under certain PES schemes (Plan Vivo) due to the complete ban on mangrove use. Under these schemes, a PES project must demonstrate community ownership and rights and resolve land use conflict issues.

Furthermore, Madagascar is party to many conventions, treaties and international agreements on the environment. However, the integration of the obligations cited in these conventions, treaties and agreements into the political and legal frameworks of the country takes time, especially when it comes to new conservation instruments like PES schemes. The review of the existing policies and legal frameworks indicated a number of gaps. While mangrove ecosystems suffer from the ambiguity of the legal frameworks regarding their status and the

inconstancy of the texts regarding their protection and management, establishment of PES schemes also encounters political challenges. Interview conducted with the responsible for the national REDD+ implementation revealed that although Madagascar developed its REDD+ strategy in 2018, and many related projects have been piloted by international NGOs, carbon ownership rights, carbon marketing rules, and benefit sharing mechanisms remain uncertain. A terrestrial forests REDD+ project (Makira REDD+) piloted and managed by WCS which succeeded in selling its carbon credits between 2008 and 2013 only used a benefit sharing process planned at the local level that was approved by the central government. In 2017, a decree (n° 2017–1083) entitled 'REDD + carbon credits' was sorted out. The decree establishes the management modality of a trade account for carbon credits in which the Ministry of Environment was the authorizing officer of the account. The management of this trade account and the execution of operations, in terms of revenue and expenditure, are subject to compliance with the general rules governing public finances. In order to establish a legal framework related to national REDD + strategies, this decree was abrogated in 2020. A new REDD + decree that was expected to contain carbon ownership rights, carbon marketing rules, and benefit sharing mechanism is being created but has been delayed which affects the progress of many PES and REDD+ projects established or being developed in Madagascar. In addition, in terms of measuring emission removals, all current, approved methodologies were designed for terrestrial forests. A clear national, practical guideline for small scale blue carbon projects (projects that manage mangrove forests, seagrass meadows and tidal marshes which capture and store a huge amount of carbon) initiated by NGOs at the local level that would allow these projects to be included in the Nationally Determined Contributions is still lacking.

3.3.2. Institutional challenges

Although the management structure consisting of multiple institutions at various levels of organization was created to cover all aspects of mangrove resource management, the interactions between these institutions may influence each others' performance. Despite multiple efforts to decentralise the management of natural resources in

Table 5
Legal frameworks governing mangroves and challenges for the implementation of PES.

Characteristic of the challenges	Legal basis	Content that affects mangroves	Implication for implementation of the PES projects
Ambiguous legal frameworks on the status of mangrove areas	Inter-Ministerial Order N° 4355/97 of May 13th, 1997 defining and delineating sensitive areas	Article 3 stipulates that mangroves are among the sensitive areas. The article recalled that as a sensitive area, mangrove forests have an area of influence, although they have no legal definition in the global sense of the term. In other words, the text only stipulates the extent of the zone of influence relating to mangroves. We can thus see the legal vacuum on the characteristics of this area of influence.	Security of tenure is a necessary condition for the success of a PES project[43]. Ambiguous legal frameworks coupled with a multitude of interests plague mangrove forests. This situation constitutes a risk factor for the non-permanence of a PES project implemented in the mangroves.
	Law N° 97–017 of August 8th, 1997 revising forest legislation	Article 2 of the law states that mangroves are assimilated in forests. All provisions cited in forestry legislation therefore apply to mangrove forests.	
	Law 2005–019 of October 17, 2005 provide the principles governing the land tenure	Mmangrove forests are located on the land belonging to the public domain of the State by which the land tenure that applies to mangroves is characterized by its inalienability, by its limitations. This means that mangrove forests are insusceptible to appropriation by private individuals, whether moral or physical	
	Law N° 2015–005 of February 26th, 2015 overhauling the Protected Areas Management Code	When mangrove forests are in a protected area, they are governed by the Code of Protected Areas. In other areas, such as coastal towns, there are no specific laws for mangrove areas.	

Table 5 (continued)

Characteristic of the challenges	Legal basis	Content that affects mangroves	Implication for implementation of the PES projects
Inconsistency of the texts governing the protection and management of mangroves	Ministerial Order N° 29211/2017: Establishing the modalities of transfer of management of fishery resources and aquatic ecosystems.	Given that fishery resources are defined as living resources (animal and plant) of marine or freshwater aquatic environments. Mangroves are also assimilated in fishery resources, mangroves can therefore be affected by legal frameworks related to fishery resources (e.g. Ministerial Decree N° 29211/2017)	To be effective, PES projects (especially those that use the Plan Vivo standard) must demonstrate the rights of the local community and their ownership of the project. Even though the Law N° 96–025 of September 30, 1996 and Ministerial Order N° 29211/2017 offer an opportunity for local communities to have their rights of access and appropriation to the resources, the existence of Inter-Ministerial Order N° 32100–2014 constitutes a blockage. In addition, certain conservation efforts deployed by communities such as the sustainable harvest zone (collection of wood subject to the annual quota system) cannot be demonstrated to generate carbon credits.
	Inter-Ministerial Order N° 32100 – 2014 prohibiting the exploitation of mangrove wood at the national level	Article 1 stipulates the prohibition of the cutting, collection and sale of mangrove wood in the national territory and even supersedes the use rights of local communities	
	Law N° 96–025 of September 30th, 1996 relating to local management renewable natural resources (e.g. mangroves)	This law entrusts to the community (Article 1) by means of the specifications and the development of a management plan, the management of natural resources in the domain of the State or of the territorial communities in which the communities traditionally have a recognized right of use.	
	Ministerial Order N° 29211/2017: Establishing the modalities of transfer of management of fishery resources and aquatic ecosystems.	The purpose of this Decree is to set the terms and conditions for the transfer of fishery resources and aquatic ecosystems to indigenous fishing communities (Article 1) by means of a transfer contract or authorization, the specifications, the simple management plan and a fisheries management plan	

Madagascar through the promotion of local stakeholders' participation, decisions regarding the management of mangroves are generally influenced by the priorities of the two national ministries (Ministry of Environment and Ministry of Fisheries). For example, the inter-ministerial decree (n° 32100–2014 of October 24, 2014) created by the two ministries which prohibits any form of cutting of mangrove wood contradicts the law n° 96–025 of September 30, 1996 that authorizes user rights to local natural resource managers. While the decree was created to fight against both mangrove deforestation and crab overfishing, the claims of traditional user rights from the mangrove forest dependent communities cannot be addressed, a situation that reflects the lack of coordination between the existing structures. In addition, to harvest wood from the terrestrial forests, a licence is required which is only granted by the Ministry of Environment through the cantonnement of environment and forest at the district level, and the price of a licence to harvest one tree varies from 300 to 500 Malagasy Ariary (MGA). However, obtaining a licence takes a long time and as a result, people undertake illegal harvesting of mangrove wood as it is available and close to their location. Other challenges faced by Madagascar's forest sector include insufficient staffing, and hence lack of capacity for law enforcement, and limited work facilities and tools (e.g. there is no boat for patrolling the marine areas).

While mangroves are stipulated in Madagascar's strategies for REDD+ as part of forest ecosystems to develop emission reduction projects, a structure to facilitate the inclusion of blue carbon ecosystems is not mentioned within the national operationalisation plan for REDD+ (Fig. 4 B). As such, guidance and mechanisms for blue carbon projects to nest within the country's Nationally Determined Contributions (NDC) under the Paris Agreement does not exist. In addition, although a Blue Economy department has recently been created in the Ministry of Fisheries (which is expected to highlight the importance of blue carbon ecosystems), its coordination with the Ministry of Environment (as the leading institution for activities related to REDD+) is of concern. Another concern is the susceptibility of the structures to the political situation in the country. These structures are affected by the frequent changes in government institutions leading to a failure of the initiatives that have been created so far.

3.4. Effects of the challenges on the local implementation of mangrove PES projects

3.4.1. Demotivation and incompliance with the existing rules among the local communities

Implementation of the *Tahiry Honko* project in the Baie des Assassins involved from the beginning the whole stakeholders necessary for the implementation. This is evident, as all processes and project activities comply with all national policies and regulations. Interviews conducted with the members of the project developer (Blue Ventures NGO) and the project coordinator (Velondriake Association) confirmed that the implementation of the *Tahiry Honko* project is hampered by three issues at the national level: conflicting national legislation regarding the status and the use of mangroves, the legal vacuum governing carbon rights and marketing and the instability of national institutional structures. These issues affect the progress of the project, and are manifested in several aspects: local motivation, technical issues, compliance with the rules, and law enforcement capacity.

Local residents from the ten villages surrounding Baie des Assassins were highly involved in the development of the mangrove management plan (including three management areas, local regulations, and patrolling and monitoring plans). The plan was deliberately designed to combat mangrove forest degradation, prevent carbon emissions, benefit user rights of local residents, and ensure sustainable livelihoods. Shortly after the validation of the management plan, the inter-ministerial decree (n° 32100–2014 in October 2014) was promulgated in which all forms of mangrove use were prohibited. The ban on exploitation of mangrove resources (as stated by the Article 1 of the decree) constitutes a source of

demotivation for those communities because the management perspectives they themselves developed cannot meet their expectations. In terms of emission reduction, the sustainable harvest area (973 ha) cannot be declared as the communities' effort to prevent carbon emissions because the decree forbids any harvesting of mangrove trees, even for household use. In addition, although the first sale of carbon credits was expected to happen in 2018, after the project was validated by Plan Vivo, the lack of a national decree that defines the carbon rights, the benefit sharing mechanism, and a process for the sale of carbon credits has put the project's entry into the carbon market on standby. Lastly, the national institutions in charge of both mangroves and PES are affected by the frequent changes in the government members (Ministry). These changes often affect both the structure and the staff within the institutions and lead to lengthy administrative delays, including, the approval of the technical and legal documents to support the project. When the head or any key staff in the institutions change, all the processes that have previously been undertaken have to be restarted.

These delays and changes affect the motivation of the communities and their compliance with the rules established by their Association. Analysis of the data on the participation of community members in certain management activities of the *Tahiry Honko* project showed a decrease in participation from 2018 (see Fig. 5 A and B). This decline is predicted as a result of impatience and the uncertainty among the members of the community regarding the project. In addition, the difference between the definition of prohibition as stated by the national decree (n° 32100–2014) and the prohibition defined in the local mangrove management plan renders the enforcement of law and regulations at the local level complex. Although the national decree overrules the regulations established at the local level, most community members tend to refer to the user rights that they established in the management plan. As such, the efforts made by the patrollers to stop infractions in the protected areas are far from being substantial. Since the development of the mangrove management plan, only two infractions in the mangroves were subjected to the local regulations enforcement (Dina).

3.4.2. Limited local governance capacity to determine the fate of the project

In the Baie des Assassins, much of the necessary organizational structure for administering environmental programs was already in place prior to the *Tahiry Honko* project. The Velondriake Association was created in 2006 and since that time the association has managed the Velondriake LMMA resources by implementing fisheries management through temporary closures and establishment of no take zones, mangroves and seagrass management and development of alternative livelihoods such as seaweed and sea cucumber farming. The LMMA received definitive protection status in 2015. The Association is composed of 84 members who spread out to ensure that management activities are followed in 32 villages within the LMMA. The ten villages of the bay are among these 32 villages.

With regard to the governance of the *Tahiry Honko* project, the assessment of the governance capacity of the Velondriake Association (as the manager of the project) from the perception of the stakeholder groups interviewed (Fig. 6) demonstrated good capacity of the association in terms of accountability (1.2), promoting transparency (1.2), participation (1.1), equity (1.3) and, diversity (0.9). To ensure sustainable management of its marine and coastal resources, Velondriake Association promoted active participation, transparency and equity among the 32 village members. These initiatives have been applied during the design and implementation of the *Tahiry Honko* project (e.g participation in the ten villages in establishment of the mangrove management plan and benefit sharing mechanism), leading as such to a collective 'buy-in' and acceptance of the project [21]. In other words, the association has optimum motivation (0.9), institutional frameworks (0.8), and knowledge (0.7) to govern the project, but have limited resources (−0.3), power (0.2), and legitimacy (0.5). This limited resources (technical and financial), power (ability to influence and decide), and

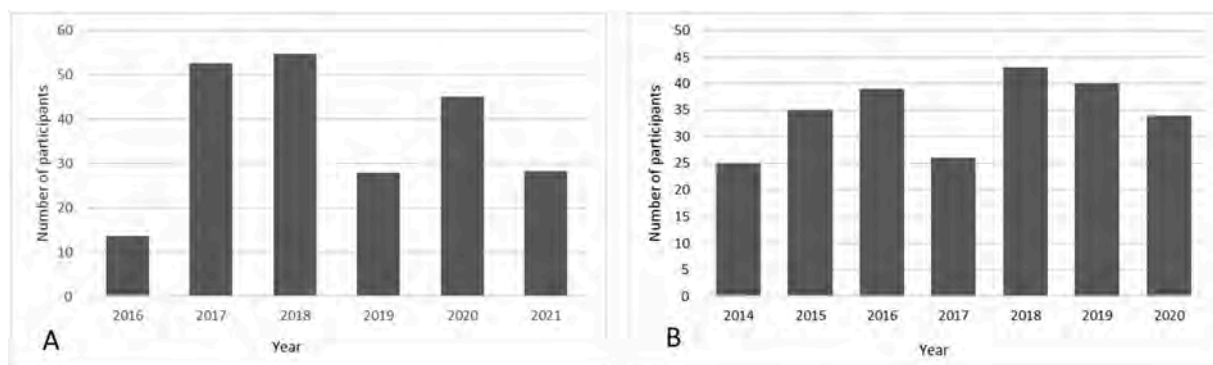


Fig. 5. Average participation in mangrove forest restoration (A) and management meetings (B) from the ten village of the Baie des Assassins.

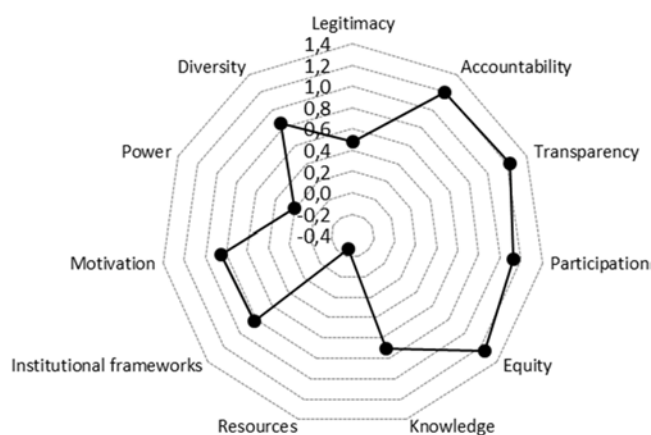


Fig. 6. Average of the sub-attributes showing the governance capacity of the Velondriake Association.

legitimacy (representation) reflect the inability of the local association to overcome the challenges within the implementation of the project.

4. Discussion

The recognition of the important role of mangroves in mitigating climate change has led to their consideration under policy frameworks such as PES, REDD+, and other UNFCCC mechanisms [44,45]. Despite this consideration, significant political and institutional barriers remain to be resolved before these mechanisms can be applied widely to the mangrove ecosystems in Madagascar. However, we see the need to provide conservation practitioners with the knowledge to understand the contexts in which PES is likely to be a viable and effective policy solution. This case study linking the international and national policy contexts with the context of implementation of a PES scheme in the mangroves at the local level highlights some practical lessons learned that can be used to complement the general frameworks for PES presented in the large body of literature in this domain. As an early example of a PES program established in the mangrove ecosystems of Madagascar, the *Tahiry Honko* project managed by the local Velondriake association, provides lessons for practitioners at a time when mangroves are drawing increasing attention as important ecosystems in terms of climate change mitigation [46]. Our results demonstrated, in general, that a variety of political, institutional and societal factors can affect the applicability of PES.

4.1. Policy interplay, gaps and implications for the local implementation of PES

The effectiveness of PES implementation depends on several factors,

including policy reforms, their feasibility, and the degree of commitment to implement them [47]. Lessons learned for REDD+ from PES and Conservation Incentive Programs in Costa Rica, Mexico and Ecuador by the World Bank [48] stated that a lack of clear policies and experience in PES hinders its adoption in many developing countries. Our results revealed that Madagascar sectorial policies including environment, fisheries, and land use planning have initiatives that interact with the PES global design rules. Some of the policy initiatives adopted in these sectors interplay with the emission reduction activities defined under the UNFCCC frameworks. Activities to reduce deforestation and forest degradation, forest restoration, improved forests governance, improved land use planning, and increasing the size of protected areas [49] have been adopted as a result of the heavy deforestation and degradation of Madagascar's tropical forests, (an estimated annual loss of 90,000 ha since 2010, [50]). Additionally, the political problems that the country experienced in 2009 led to a decline in environmental funding, including financing for the management of parks and protected areas [51]. As a result, PES schemes gained more consideration in the sphere of Madagascar's environmental policies as a potential source of sustainable funding to improve forest management and incentivise local communities [52]. Although there are no specific policies that define mangrove management strategies, our results indicate that the policy initiatives related to environment, fisheries and land use planning offer an opportunity for mangroves to be managed and incorporated into PES schemes as part of the forests (according to the national law N° 97-017 of August 8th, 1997) and the fisheries resources (Ministerial Order N° 29211/2017). The problem that we identified from the policy analysis is that this opportunity is hampered by the lack of legal frameworks to support the implementation of those political initiatives. As a result, capacity of the local stakeholders (e.g. regional and local government department, NGOs, local associations) is limited to implementing conservation programs especially using new tools like PES schemes. Given the complexity of the social-ecological systems in which PES programs are implemented [53], no single disciplinary perspective is likely to provide all necessary insights for their creation. Many instances of enabling conditions are broadly divided along disciplinary lines. For example, a legal framework of a country can enable the successful development and implementation of PES program [54]. Indeed, a PES scheme can only work with good governance in place, comprising an effective political, legislative as well as institutional system [29,32]. Even though the Ministry of Environment prioritises the implementation of emissions reductions programs across the country under the national REDD+ strategy, Madagascar is still slow to reach its political objectives due to the legislative and administration issues. In addition, in Madagascar's society, voluntary initiatives to manage forests are rather weak due to poverty and other socio-economic constraints. Thus, the presence of the legal frameworks that support the policy initiatives implemented at the national level would encourage local stakeholders to initiate conservation activities that address forest degradation in the country.

4.2. Uncertainty about property rights and implications for the local implementation of PES

Razzaque [55] stipulated that initiating PES schemes without first protecting and allocating land ownership as well as access and user rights of forest-dependent communities will almost certainly lead to rent-seeking behaviour regarding forests. Our results showed that most of the legal frameworks that favour the management of mangroves (e.g. Law N° 96–025, Ministerial Order N° 29211/2017, and Law N° 2015–005) define the rights and entitlements of individuals to natural resources. This is conducive to PES implementation because the practicality of natural resources and conservation initiatives such as PES is often defined by bottom-up processes [56,57]. In contrast, the conservation initiative supported by each of these three legal frameworks defines the type of mangrove management and the power of the governance structure differently. For example, law N° 96–025 delegates the power of the Ministry of Environment to local communities to manage forest resources (e.g. mangroves) through the structure called ‘*Vondron’Olona Ifotony*’ (local community grassroots). This structure manages mangrove resources through the establishment of management contracts of 5 years’ duration with this Ministry, which can be renewed according to the effectiveness of the management. Within the defined management areas stipulated in the contract, the *Vondron’Olona Ifotony* has the right to exercise the function of the ministry with references to specifications validated by the Ministry itself. The Ministerial Order N° 29211/2017 in turn, delegates the power from the Ministry of Fisheries for the management of fishery resources and aquatic ecosystems (including mangroves) to the members of fishing communities who self organize as a fishermen’s group. The management of the resources by the fishermen’s groups under this order are enabled through the community regulations including local regulations. These regulations have been approved by the competent court in the place of implementation and specifications duly concluded between the management delegate and the administration in charge of Fisheries. Within this order, there is no specific text that clearly defines community rights and access to resources.

Under the code of protected areas (Law N° 2015–005), mangroves are managed by the association (created by the Ordinance N°. 60–133 of October 3, 1960) through protected areas and marine protected areas in which they can be designated as within core or buffer zones, as defined by the law. Harvesting of mangrove resources for non-commercial purposes to meet domestic needs is permitted, as long as a cut permit is obtained from the local representative of the Ministry of Environment. Among these three legal frameworks, only the law N° 96–025 defines full rights to local communities to own and access mangrove resources, to collect fees, and to use and share benefits among them. Although full community rights in using and accessing mangrove resources is covered by this law, the ban of mangrove use defined by the Inter-Ministerial Order No 32100 – 2014 (which is the only applicable law at present) makes PES difficult to implement effectively in mangrove ecosystems. If the state decides to retain property rights, the government will control all potential benefits [58]. The existence of this order therefore revokes the roles of individuals or community groups as the ecosystem services’ providers. Top-down mangrove regulation like this may not, on its own, be the best option to protect mangrove forest ecosystem services because the ban creates confusion amongst communities, administrations, and NGOs involved in mangrove management. As such, communities lose their motivation to protect forests (as indicated in the results) unless their benefits are secured and guaranteed by a clear legal mandate. PES will not work if the favourable enabling conditions such as tenure or land use rights are insufficiently defined or enforced [59]. A country like Madagascar where co-management arrangements around forests is triggered by the conflicting national level policies related to ownership rights [60], it is important to ensure that property, access and use rights are well established to support implementation of PES schemes.

While the market for carbon credits generated in mangrove

ecosystems is growing exponentially [55], their complex legal status [57], illustrated by a lack of national laws and policies which explicitly define carbon rights and benefit sharing under the development of the market-based mechanism PES, constitutes another challenge in Madagascar. Although the country received funding from Forest Carbon Partnership Facility (FCPF)¹ of the World Bank to establish its national REDD+ strategy (in which development of legal frameworks is part of CFPF priority areas), establishing carbon rights and benefit sharing for PES remains legally complex due to the evolutionary process of the mechanism at the international level (as indicated by the staff members interviewed at Madagascar REDD+ national office). This situation hinders the effective implementation of PES projects at the local level. Although efforts to protect the mangrove ecosystem (through conservation and restoration) and ensuring sustainability of the project (through marketing of carbon credits) had some progress in the Baie des Assassins, a lack of comprehensive principles for defining carbon rights and benefit sharing mechanisms at the national level blocks the sale of these carbon credits at the international level. Even though the State is proceeding to adopt these principles under the national REDD+ strategy, the length of time and process required for the adoption are challenging. As a result, the level of trust between the NGO (as technical and financial support) and the local communities is damaged and in the worst case, deforestation of the mangroves could increase as the planned objective (earning carbon revenue) is not achieved within the expected time frame. We argue from the experience of the *Tahiry Honko* project that to be effective, national governments must be involved in order to change or create the policies necessary to implement PES because as a market-based instrument, PES requires appropriate national laws, regulations and policies especially in the blue carbon ecosystems (mangroves, seagrasses and tidal marshes) where application of this instrument is recent [61].

4.3. Coordination interplay, issues and implication for the local implementation of PES

Coordination at different levels, from local stakeholders to international actors, plays an important role in the governance of forest ecosystems [62,63]. We saw from our results that there is positive interplay between the coordination of mangrove forest management and PES schemes. This is due to the fact that both mangroves and operationalisation planning for the PES schemes fall under the same ministry: the Ministry of Environment. Administratively, incorporation of mangroves into PES schemes in Madagascar is quite possible because policy objectives, strategies, planning and stakeholders to fulfill this incorporation are combined under this one institution. The complexities of incorporating mangrove ecosystems into PES schemes are a result of the status of mangroves as part of fisheries resources where another ministry (Ministry of Fisheries) is involved in their coordination. This means that no single ministry has authority for their management [64]. Making decisions regarding the management and governance of mangroves is therefore difficult because those sectoral ministries must agree on the decisions, and this process takes considerable time. In addition, those sectoral ministries have their own upwardly accountable structures and budget disbursement mechanisms, creating no incentive for cross sectoral coordination. Certainly, lack of coordination creates a gap in the mangrove conservation approach which local people continue to exploit to the detriment of the mangrove forests. Another complexity arises from the remote nature of the areas where mangrove ecosystems occur across Madagascar (e.g., the Baie des Assassins) and the insufficient staff establishment from the sectoral ministries resulting in a lack of communication among the stakeholders, a lack of capacity for law enforcement, and limited work facility [65]. Proximity of actors to each

¹ : <https://climatefundsupdate.org/the-funds/forest-carbon-partnership-facility/>

other (e.g. forest users, local government agencies) is crucial to defining responsibilities, duties, and obligations among them [66]. Poor understanding of responsibilities and duties may lead to potential social conflicts and limited commitment and participation in mangrove conservation [23,67], which in turn results in the implementation of non viable PES programs. A number of case studies (e.g. Huber-Stearns et al., [53]) highlighted that, to effectively implement a PES program, the existing governance structure has to fit with the PES structure and scale. Our results also showed that, like the case of many developing countries, the national governance structure of mangrove and PES is sensitive to the national political situation. Administrations within the national environment agencies experience disruption if the minister changes, leading to administrative delays resulting in inaction, duplication of efforts, or deterring positive actions taken by the supporting organisation and local communities who run PES programs. Despite efforts made over five years, this situation is one of the main obstacles for the advancement of the *Tahiry Honko* project in the Baie des Assassins. Stability, clarity and coherence among the institutional mandates related to PES schemes are crucial to overcome misunderstandings and conflicts among those involved in the schemes, and to accelerate the process of implementation.

4.4. Local governance capacity, limits and implication for the implementation of PES

The Velondriake LMMA managed by the Velondriake Association where the *Tahiry Honko* project is located is one of the oldest Marine Protected Areas in Madagascar. Interviews conducted with the stakeholders involved in the implementation of the project highlighted that the Velondriake Association is effective in assuming its responsibilities as manager of the MPA and promoting participation, transparency, equity and diversity in its decision making process (Fig. 6). This is due to the decentralisation of responsibilities promoted by the State through the protected areas code (Law N° 2015–005, Article 1) and a series of trainings provided by the supporting NGO (Blue Ventures) which enable the association to assume its responsibilities and to promote community involvement as well as to produce a more effective governance structure. Although having strong legal frameworks (e.g., official association receipt, written rules and internal regulations) and the members are motivated to perform their duties, the association still has limited legitimacy (e.g., legal right to make decisions that affect access to and use of natural resources, see Fig. 6), power (e.g., power to implement management plans without interference from others, authority to convene a meeting with senior government officials and power to prevent people who are not part of the community from using natural resources on the community's territory), knowledge (e.g., necessary technical skills to manage their natural resources) and resources (money to cover the cost of resources management).

In general, although some legislative frameworks to decentralise management of natural resources exist in Madagascar, power is still retained by the central government. Power of the government is highly reflected in the execution of laws, decrees and orders (see Table 6). Power of the association is limited to the execution of local regulations. Indeed, when adopting national laws, decrees and orders, knowledge held by local people is often overlooked [68]. But the strong power of the government is often hampered by the insufficient resources (finance and staff) to conduct awareness raising, patrols and enforcement in the field which enables local illegal activities impacting the natural resources to occur [69]. In addition, a lack of interaction between government (due to the remoteness of areas and lack of operational funding) and the local communities does little to build confidence that the actions taken by the government are in the best interest of those communities.

Lack of resources (financing) and technical skills are a major challenge to designing and implementing PES schemes in local communities. Although the Plan Vivo standard used by the project encourages the engagement and empowerment of local communities [70], the standard

Table 6
Governance tool and level of execution.

Type of governance tool	Examples	Execution level
Policy	- Madagascar Forest Policy - National REDD + Strategy - National Climate Change Policy - Blue Policy letter	Government/Ministries
Law	- Law N° 97–017 of August 8th, 1997 revising forest legislation - Law N° 2015–005 of February 26th, 2015 overhauling the Protected Areas Management Code - Law N° 96–025 of September 30th, 1996 relating to local management renewable natural resources (e.g. mangroves)	Government/Ministries
Decree	- Decree N° 2017–1083 entitled 'REDD + carbon credits'	Government/Ministries
Order	- Inter-Ministerial Order N° 4355/97 of May 13th, 1997 defining and delineating sensitive areas - Inter-Ministerial Order N° 32100 – 2014 prohibiting the exploitation of mangrove wood at the national level - Ministerial Order N° 29211/2017: Establishing the modalities of transfer of management of fishery resources and aquatic ecosystems	Ministries, Decentralized Territorial Collectivities and Deconcentrated Technical Services
Technical documents	- Mangrove Management Plan - Project Design and Documentation	Decentralized Territorial Collectivities, Deconcentrated Technical Services and NGOs
Local regulation	- MPA local regulation (DINA)	Local communities, Association

also requires considerable scientific and technical capacity, and funding to be implemented, and therefore, support from an external agency (NGO) is crucial. Meeting the technical requirements is especially challenging in a remote location like the Baie des Assassins, where access to the appropriate equipment, facilities, and skills training is difficult. Our results highlighted that the *Tahiry Honko* project is still dependent on external technical expertise and both donors and government support to operate. To mitigate the requirement for external support to certify the project, there is a need for continued capacity building in different skills for the association as the members have no prior experience in this domain. Although government and other intermediary institutions (NGOs) play vital roles in bringing together the providers and the purchasers of ecosystem services, represented by carbon credits, by creating the legal and institutional frameworks, their greater involvement increases the risk of excluding vital community participation. The role of the government and the NGOs should be limited to facilitators or enablers of the PES implementation and negotiators of carbon sales [71].

4.5. *Tahiry Honko* project of Baie des Assassins: a catalyst for the development of Blue Carbon project in Madagascar

Tahiry Honko project is the first blue carbon project implemented in Madagascar. Much research has been conducted on national (e.g., Benson et al. [33]; Rakotomahazo et al. [21], Scales and Friess [72]; Rakotomahazo et al. [22]) and international [67] blue carbon governance, highlighting the social and ecological aspects. We argued that despite being considered as a small PES project, *Tahiry Honko* is part of

the initiatives that contribute to the Paris Agreement. Carbon-oriented environmental management like this is an opportunity to protect threatened coastal and marine habitats [73] that have a crucial role in carbon sequestration in line with avoiding catastrophic climate change [74]. Although limited initiative to incorporate blue carbon ecosystems into Nationally Determined Contributions (NDCs) is lacking, staff interviewed at the national REDD+ coordination office confirmed that the existence of *Tahiry Honko* project is an opportunity to test the feasibility of blue carbon in the country. This is because the Ministry of Environment (where REDD+ coordination is affiliated) is currently harmonising technical guidance for the implementation of REDD+ projects in both terrestrial and marine ecosystems. In addition, certain initiatives that target mangroves were recently established. One of these is the National Commission for Integrated Mangrove Management (created by the national Decree N°. 2015–629) with the main mission to develop national strategies for mangroves and to integrate coordination of mangrove management. Madagascar is also a member of the Indian Ocean Rim Association (IORA) which is a dynamic inter-governmental organisation aimed at strengthening regional cooperation and sustainable development within the Indian Ocean region through its 23 Member States. Promotion of the blue economy in the Indian Ocean (including blue carbon) is part of the top priorities of the association where the *Tahiry Honko* project is known as an example from Madagascar. Reducing greenhouse gas emissions through the prevention of illicit exploitation of natural resources is part of the initiative for the emergence of Madagascar [75] which is a general state policy from 2019 to 2023. The *Tahiry Honko* project is part of this initiative.

Action planned by the local communities from the ten villages of the Baie des Assassins to cope with the weak legal framework surrounding PES is to lobby the government [22]. This will be proceeded through marine conservation platforms/networks because those platforms have more power to raise their voices which increase the chance of being considered by the government and then being incorporated during the processes of policy development and reform. In other words, although tenure rights regarding mangroves are uncertain in the country, the *Tahiry Honko* project, as located in the Velondriake LMMA, is supported by this LMMA definitive protection status (National decree No, 2015–752) and has secured tenure [76]. Lastly, the successful conservation of important and endangered tropical mangrove ecosystems of the country (including those of the Baie des Assassins) can only be brought about through the real and sincere integration of scientific knowledge, legislation and policy into the national strategies. Understanding the economic values of blue carbon ecosystems should not only improve their management and governance, and offer incentives for community-based conservation, but also contribute to an improved national economy [77].

5. Conclusion

Our paper analysed the implementation of the PES schemes associated with the mangroves of the Baie des Assassins with a special focus on the implication of policy, legal, and institutional frameworks. Results from the analysis revealed that most of Madagascar's policy initiatives in the context of environment, fisheries and land management with which mangroves are affiliated, are supportive of PES implementation. Despite this, legal frameworks to support those initiatives are still lacking in the country. Implementation of PES schemes in the mangrove ecosystems is hampered first by the lack of clarity over tenure rights in mangroves (due to the conflicting legal frameworks to define their status), and secondly by the long lasting adoption of a legal framework to define carbon rights and benefit sharing. Additional factors contributing to the complexity of implementing PES in mangroves include lack of coordination between the Ministry of Environment and Ministry of Fisheries regarding the management of mangroves, weakness of government organisations due to political instability (both mangroves and PES), and

insufficient budget and staff from those ministries to ensure field coordination, monitoring, patrolling, and enforcement. At the local level, limited legitimacy, technical knowledge, power, and financial resources among the local governance structures constitute other challenges for implementation. A case study of the Baie des Assassins's mangrove PES scheme provided lessons learned on how national policy, legal and institutional frameworks affect the implementation of the PES scheme in the local context. Although PES schemes have recently been implemented in mangrove ecosystems, we argue that with effective governance tools in place (e.g., clear tenure rights for local communities, effective national policy and legal frameworks, stable national structures, clear carbon rights, adequate funding, access to information, and participation of local communities in decision making), the schemes can be an effective tool to achieve environmental as well as social benefits in mangrove forest management.

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CRedit authorship contribution statement

CR was responsible for the Conceptualization, methodology, interviews, data collection and analysis, and writing. review & editing. J. R., N.L.R., G.G.B.T., E.R., M.E.R. and T.L. reviewed, edited and commented on the manuscript as well as brought suggestions for its improvement. They also ensured academic supervision.

Conflict of Interest

The authors have no conflict of interests to declare.

Data Availability

Data will be made available on request.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2022.105450](https://doi.org/10.1016/j.marpol.2022.105450).

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