Plan Vivo Project Design Document

Tahiry Honko

Community Mangrove Project, Southwest Madagascar

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Submitted by: Blue Ventures

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Acronyms

Acronym	Definition
BNC-REDD+	Bureau National de Coordination de Reduction des Emissions dues aux Deforestation et Degradation des forêts (REDD+ National Coordination Office)
BV	Blue Ventures
CSE	Comité de Suivi et Evaluation
DNA	Designated National Authority
DRRHP	Direction Régionale des Ressources Halieutiques et de la Pêche (Regional Department of Marine Resources and Fisheries)
FPIC	Free, Prior and Informed Consent
DREEF	Regional Department of Environment, Ecology and Forests
GFR	General Fertility Rate
HDI	Human Development Index
IBA	Important Bird and Biodiversity Area
IUCN	International Union for the Conservation of Nature
LMMA	Locally Managed Marine Area
MEEF	Ministry of Environment, Ecology and Forests
MNP	Madagascar National Parks
MRHP	Ministère des Ressources Halieutiques et de la Pêche
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organisation
ONE	Office National pour L'Environnement (National Office for the Environment)
PDD	Project Design Document
PES	Payment for Ecosystem Services
PIN	Project Idea Note
R-PP	Readiness Preparation Proposal
REDD+	Reduction of Emissions due to Deforestation and Degradation of forests
UN-REDD+	United Nations – Reduction of Emissions from Deforestation and Degradation
VA	Velondriake Association

Glossary

Term	Definition
Dina	A law, convention or contract established collectively by the people of the same community or village in order to govern a particular concern
GFR	Number of births per 1,000 women
HDI	A composite index measuring averaged achievement in three basic dimensions of human development – a long and healthy life, access to knowledge and a decent standard of living
Masikoro	People who live in dryland areas and practice cattle husbandry for their primary source of income
Mikea	A Malagasy ethnic group of people who inhabit the Mikea forest
Velondriake	A community-managed protected area encompassing 25 villages in the commune of Befandefa
Vezo	A coastal Malagasy ethnic group whose main livelihood is fishing

Executive Summary

Small fishing communities along the western coast of Madagascar live a precarious existence, which is threatened by increasing pressure on marine stocks. This pressure comes not only from overfishing (driven by external markets for commercial seafood export and rising population) but also from the deterioration of coral reefs and mangrove ecosystems, two critical habitats for shrimp, crab, octopus and fish species.

The Tahiry Honko project is the first carbon sequestration project in Madagascar focused on a mangrove ecosystem. It is designed to earn carbon credits through the conservation and restoration of over 1,200 hectares of mangrove surrounding the Bay of Assassins in the southwest region of Atsimo Andrefana.

Local residents from ten villages have participated in multiple consultations to draft local regulations, a mangrove management plan and map the areas of strict conservation, sustainable use and reforestation. Residents will be responsible for monitoring the forest to counter the threat of deforestation from illegal logging and to ensure reforestation efforts are successful.

Quotas for sustainable harvest of mangrove wood will be established by the communities based on forest inventory and community requirements for timber. Regular forest patrols will ensure adherence to sustainable mangrove harvesting and prevent any harvest in protected areas.

Local residents have committed to replanting ten hectares of mangroves per year in deforested areas, and have already begun the restoration effort by planting twenty hectares in the last two years. Improving land management by establishing terrestrial tree species plantations will provide an alternative source of fuelwood and building material. This will reduce pressure on mangroves harvested for these purposes and prevent leakage, where an increase in deforestation occurs elsewhere.

The project is based on a 20-year crediting period, with an agreed monitoring schedule where staged payments are received on an annual basis in return for meeting performance targets. Project activities include prevention of ecosystem conversion, improved land use management and ecosystem restoration. Total carbon sequestered from these activities is estimated to be 1,443 tons of CO_2 per year throughout the crediting period.

Benefits from the sale of carbon credits will accrue to ten villages, with a total population of approximately 4,000 residents in 895 households. The project aims to engage all people, including marginalized groups such as women and young people through a participatory approach. Residents of these communities have prioritised a list of needed infrastructure projects to invest these funds including schools, wells and health clinics. Villagers have also decided to use funds from carbon credits to subsidise school fees for children in the project area. Livelihood alternatives supported by the project, including sea cucumber farming, seaweed cultivation and training in apiculture techniques, will offer local residents opportunities to increase their household income and diversify the sources of earned income.

In an area of the world with extremely scarce resources and few options for livelihoods besides fishing, the Tahiry Honko project will provide communities in the Bay of Assassins with essential services and their children with a brighter future.

A. Aims and Objectives

A1: Aims

The Malagasy phrase *Tahiry Honko* means to preserve and protect mangrove forests. The aim of this project is to establish a sustainable, long-term mangrove payment for ecosystem services (PES) scheme which will reduce deforestation and degradation and restore mangroves in the Bay of Assassins, known locally as Faritse Fagnemotse, southwest Madagascar. The project is co-managed by Blue Ventures and the Velondriake Association and the area of intervention lies within the Velondriake Locally Managed Marine Area (LMMA).

This project aims to provide a new source of long-term income for the residents of the Bay of Assassins through the sale of Plan Vivo certificates. Carbon credits generated by conserving and restoring mangrove ecosystems will make an important contribution to poverty alleviation and biodiversity conservation in the area. The sale of carbon credits will establish a secure revenue flow offering communities the opportunity, where feasible, to construct schools, dig wells, provide community health services and other related services that will directly benefit community members of all ages.

A2: Objectives

The communities of the Bay of Assassins are highly dependent on the bay's mangrove forests for a variety of services and subsistence needs. Mangroves are essential natural barriers against storm surges, a source of fuelwood and construction material, and provide nursery habitat for fish, shrimp, crab and other species that are harvested for food and sale.

Despite their value, mangroves are being threatened by degradation and deforestation. Sustainable solutions are crucial to secure these vital forests. The annual sale of carbon credits, which will be used to fund community projects, will incentivise the local communities to participate in and support the project objectives.

The strategic objectives for this scheme were developed through a participatory approach with the local community, and are as follows:

- Preserving the current quality and extent of the mangrove forests by establishing a strict conservation area (Tahiry Honko)
- Avoiding mangrove deforestation through a sustainable harvesting system (quota system)
- Restoring deforested areas of mangroves through community-led planting efforts
- Establishing terrestrial native tree plantations for use as an alternative wood source
- Reducing pressure on mangroves that are harvested for income by supporting the development of alternative livelihoods.

B. Site Information

B1: Project location and boundaries

The project site (Bay of Assassins) is located in the southern portion of the Velondriake Locally Managed Marine Area (LMMA) (Figure 1). The LMMA is situated in the Befandefa municipality and Morombe district of the southwest region of Atsimo Andrefana, Madagascar. The project encompasses ten villages within the Bay of Assassins, including Befandefa, the municipality's commune (Figure 2).

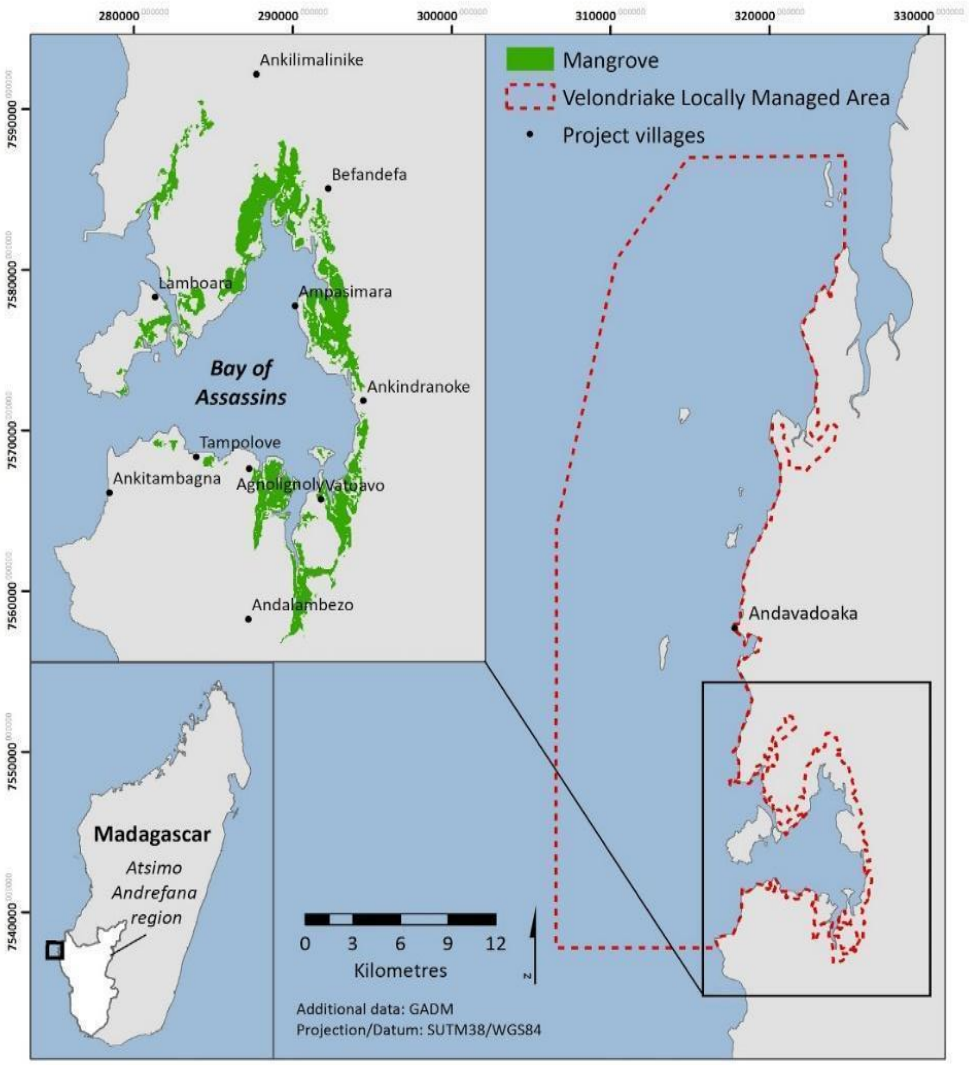


Figure 1: Bay of Assassins in relation to the Velondriake LMMA

B2: Description of the project area

The Velondriake LMMA is classified as a Category V protected area under the International Union for Conservation of Nature (IUCN) classification. It is considered a locally managed marine area (LMMA) due to the high level of involvement of local communities in the Marine Protected Area's (MPA's) inception, creation and management and is the first to be known as such in Madagascar. Velondriake has 63,985 ha of surface area, and obtained its definitive protected status in 2015 (National decree N◦ 2015-752, attached as Annex 8). The Bay of Assassins is adjacent to the Mikea Forest, a protected area of spiny forest managed by Madagascar National Parks (MNP). The Tahiry Honko project area itself encompasses 1,230 hectares of mangroves fringing the Bay of Assassins.

Located in the southwest region of Madagascar, the project area has a semi-arid climate (Salomon, 1986), and is one of the driest areas of the country, with an annual rainfall of less than 350mm (Ferry and L'Hotte, 1998), and a dry season that can last 9 to 11 months (Langley *et al.* 2006). The brief rainy season normally occurs between December and February. Despite the existence of two major rivers, the Mangoky and the Onilahy, along the southwest coast of the country, there is no significant river flow within a hundred km of Velondriake area due to the aridity and the very gradual slope in land. As a result, the vegetation is characterized by dry and spiny forest species.

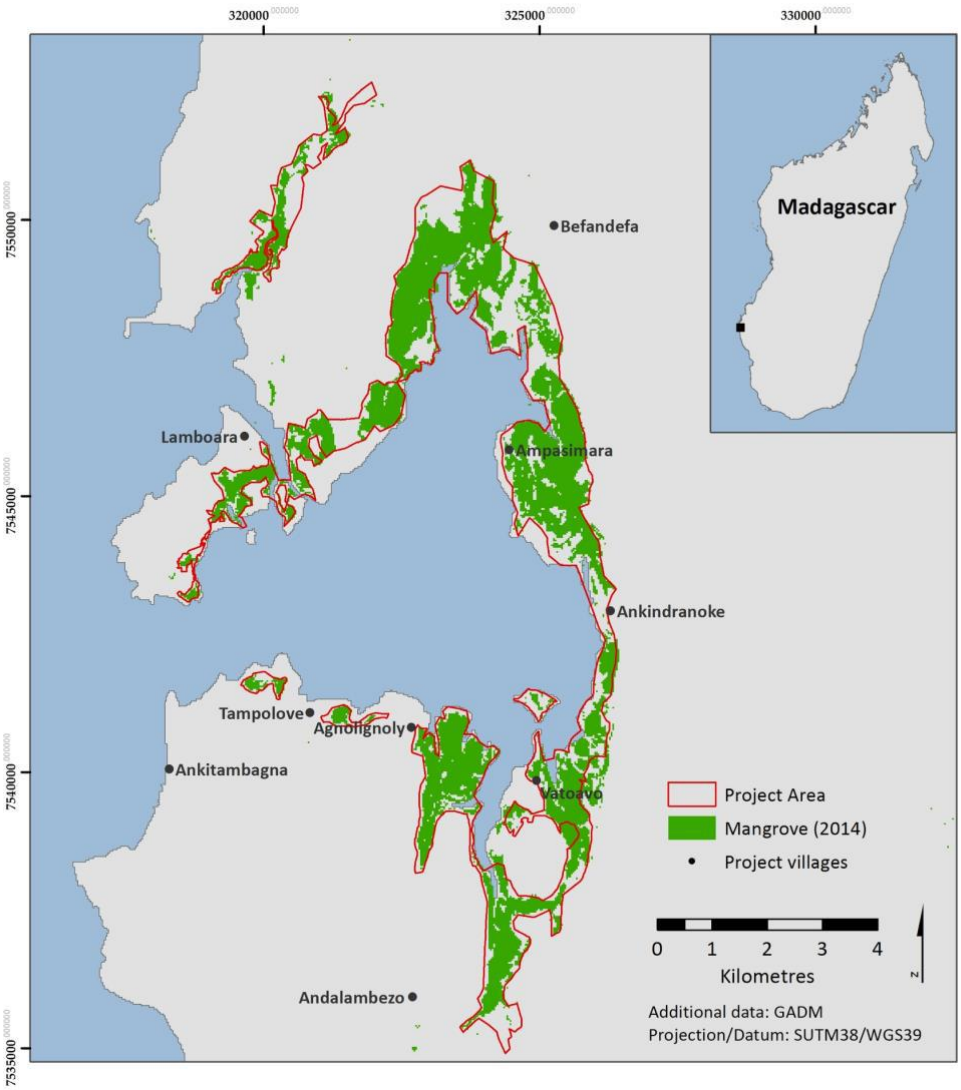


Figure 2: The Tahiry Honko project area, including the ten villages of the project

The southwest coast of Madagascar is made up of sedimentary formations in multiple layers (Nirimanitra, 2014). With the exception of mangrove areas with high salt soils specific to these vegetation formations (ONE, 2008), the main type of rock in the Velondriake LMMA is limestone, starting from the coral reefs to the forest. The soil is formed by alternating layers of sandstone, limestone and red sands (Salomon, 1986).

The Velondriake LMMA is home to mangrove forests, sea grasses, coral reefs, and terrestrial dry and spiny forest which constitute important habitats for a variety of both terrestrial and marine species. This area has been identified as one of the most diverse coral reef systems in southwest Madagascar. The adjacent spiny forest, within the 'Madagascar spiny desert' ecoregion, has one of the highest levels of endemicity and highest deforestation rate of any forest in the world. As such, the spiny forest is a 'Global 200' priority ecoregion (Olson & Dinerstein, 1998). It has also been designated as an Important Bird and Biodiversity Area (IBA) (Birdlife International, 2010) and has the highest rates of local botanical endemism in Madagascar (Phillipson, 1996).

Despite their importance, the mangrove and terrestrial forests, sea grasses and coral reefs are faced with widespread degradation primarily due to anthropogenic activities. The degradation of these habitats threatens the survival of the diverse plant and animal species that live there. Many species

found in the project area are listed on the IUCN red list of threatened species as endangered or critically endangered (Table 1).

Table 1: Critically endangered and endangered species in the project area (Humber *et al*, 2017; Nirinimanitra, 2014; Peabody and Jones, 2013; Humber *et al*, 2010)

IUCN Conservation Status	*Species*	*Categories*	*Habitats*
Endangered	*Adansonia grandidieri*	Plant	Terrestrial forest
Endangered	*Ardea humbloti*	Bird	Mangroves
Endangered	*Cheilinus undulatus*	Fish	Coral reef
Endangered	*Chelonia mydas*	Sea turtle	Coral reef
Critically endangered	*Eretmochelys imbricata*	Tortoise	Coral reef
Critically endangered	*Haliaeetus vociferoides*	Bird	Coastal forest
Endangered	*Holothuria nobilis*	Fish	Coral reef
Endangered	*Holothuria scabra*	Fish	Coral reef
Critically endangered	*Pristidae spp.*	Fish	Coral reef
Critically endangered	*Pyxis arachnoïdes brygooi*	Tortoise	Marine
Endangered	*Sphyrna mokarran*	Fish	Marine
Endangered	*Sphyrna lewini*	Fish	Marine
Endangered	*Stegostoma fasciatum*	Fish	Coral reef
Endangered	*Stylophora madagascariensis*	Coral	Coral reef
Endangered	*Xenopirostris damii*	Bird	Terrestrial forest

There is no paved road leading to the project area. It is relatively isolated, and local communities live with minimal infrastructure, where access to electricity, clean water, health services and primary schools is available only in some villages (Koopman, 2008).

B3: Recent changes in land use and environmental conditions

Apart from dieback due to natural disaster (cyclone), overexploitation of wood for construction and lime production (subsistence and commercial use) is the primary factor that leads to the destruction of mangrove forest in the project area. The local population has perceived a decrease in mangrove cover in recent years, and according to a detailed analysis of satellite imagery (Figure 3), approximately 3.18% of mangroves were lost between 2002 and 2014 (Benson *et al.*, 2017; Jones *et al.*, 2014).

The degradation of mangroves results in:

- Loss of forest cover and any associated ecosystem goods and services
- Loss of habitats for the variety of the animal species
- Loss of fishing livelihoods for the local communities who live around the project area
- Disturbance and pressure to other surrounding ecosystems such as the coral reefs, sea grass beds and spiny forest
- Release of carbon to the atmosphere

The adjacent Mikea spiny forest has been degraded by the practice of slash-and-burn for agricultural purposes (maize, sweet potatoes and cassava), fuel wood collection and charcoal production (Blanc-Pamard, 2009). It has been identified as an area of high deforestation in the country between 1990 and 2005 (Harper *et al*. 2007).

In addition, Madagascar is a country which is highly vulnerable to the effects of global climate change. In recent years, high climate variability has led to severe droughts in the southwest region and floods in eastern Madagascar. The impact of these climatic hazards on the social and economic life of local populations, particularly fishing-dependent communities, can lead to unsustainable use of natural resources (Cinner *et al.*, 2012).

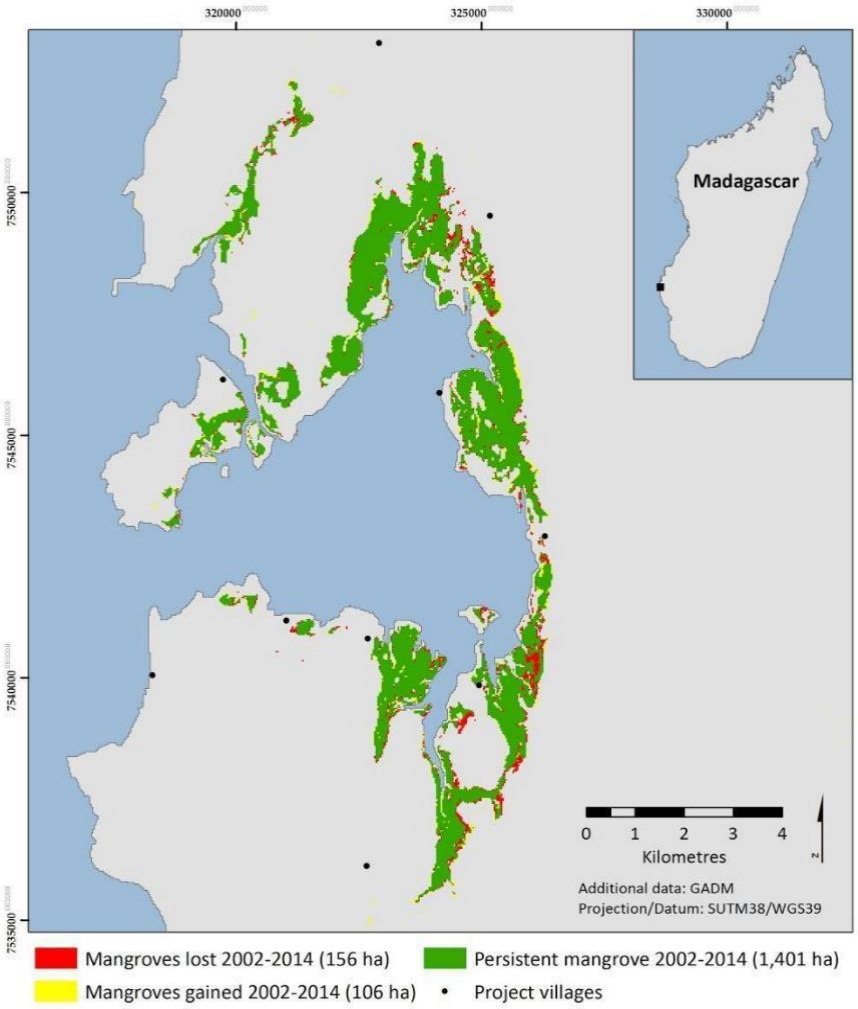


Figure 3: Mangrove deforestation from 2002 to 2014, based on Landsat 8 imagery (Jones, 2014)

B4: Drivers of degradation

One of the main threats to the mangroves of the Bay of Assassins is the harvesting of mangrove wood that is then used as fuel to produce a seashell-based lime render that improves the durability of houses. Houses made with lime render are an indicator of wealth and therefore as the wealth of the population increases so does the use of lime. Mangrove ecosystems are cleared instead of selectively cut for this purpose (Scales *et al*, 2016).

Degradation of the mangroves leads to decreases in certain resources. For example, people living around the Bay of Assassins have noticed a decrease in crab and shrimp catches over the last five years (Blue Ventures, unpublished research) probably attributable to mangrove forest degradation in the area.

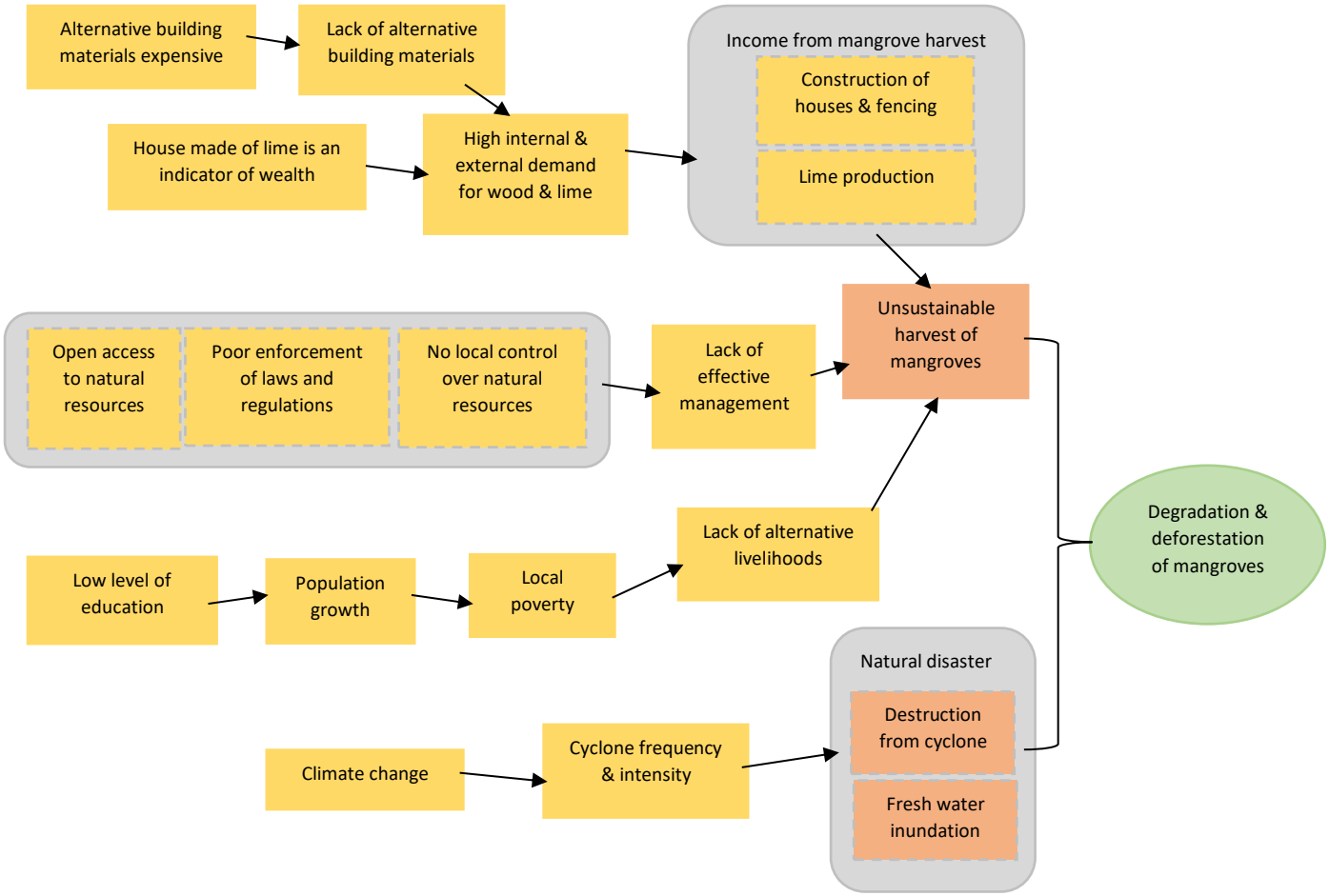


Figure 4: Conceptual model showing the drivers of mangrove forest degradation

Anthropogenic activities that destroy the forests are linked to different contributing factors such as local poverty, high population growth, low levels of education, lack of alternative building materials and poor enforcement of laws and regulations which lead to poor management of the forest resources. Figure 4, above, outlines the drivers of mangrove forest degradation from the participatory theory of change conducted with the ten villages of the Bay of Assassins.

Part C: Community and Livelihoods Information

C1: Description of participating communities

Population

The population in the project area is estimated at 3,992 residents (Table 2) with 895 households. About 33% of the adult population is illiterate and 87% of the literate adult population have completed only primary education (1-6 years of education). In 2010 the General Fertility Rate (GFR) for women aged 15-49 was 6.2 births per woman, much higher than the GFR in the capital of Madagascar, at 4.8 per woman (Mohan and Shellard, 2014).

The project area has a Human Development Index (HDI) of 0.339 (Cripps, 2009) which is significantly lower than the national average given in 2015 as 0.512 (UNDP, 2016); this reflects weak performance in all three dimensions of human development; health, education and income.

Table 2: Population in the project area, Blue Ventures Integrated Social Survey, 2015 (unpublished data)

Village	Female	Male	Total	Number of Households
Ankilimalinke	62	74	136	38
Befandefa	448	397	845	194
Ampasimara	42	49	91	18
Ankindranoke	323	318	641	130
Lamboara	196	140	336	103
Vatoavo	191	168	359	66
Andalambezo	179	186	365	77
Agnolignoly	286	263	549	125
Tampolove	247	230	477	103
Ankitambagna	103	90	193	41
Total	**2,077**	**1,915**	**3,992**	**895**

Cultural, ethnic and social groups

The communities in the project areas are composed of three main ethnic groups: the Vezo, Mikea and the Masikoro. The Vezo are traditional fishers, living in nearshore villages and are highly dependent on coastal and marine resources. The Masikoro are farmers or herdsmen and depend on agriculture and livestock rearing. Traditionally, the Mikea were nomadic hunter-gatherers, but over time they have diversified into farmers, herdsmen, fishermen and occasionally merchants. Historically, the Masikoro and Mikea communities were more dependent on the dry forests, but due to changing rainfall patterns, resulting in drought and crop failure, many people have migrated to the coast and are becoming increasingly dependent on mangroves and marine resources.

Gender and age equity

In rural Madagascar, women and youth possess limited decision-making power compared with men. In general, local women work in the fields, tend livestock, glean for sea cucumbers, octopus and crabs, process fish and take care of the household. They have limited participation in local governance structures. Women are involved in community meetings, but they remain passive. Decision making is usually the responsibility of the elder men. To empower women and youth in resources management within the project area, women's groups and youth clubs have been created in some of the villages. They are, and will continue to be, involved in the project activities (carbon stock monitoring, tree nurseries) with an objective of developing greater involvement in governance. Currently, about 44% of the Velondriake Association management committee responsible for governing natural resources in the area are women.

C2: Socio-economic context

Throughout the area approximately 60% of the population are fishermen and ten percent of local residents practise agriculture as their principal source of income, although this varies from village to village, depending on proximity to coastline and availability of suitable land to farm. The mangrove forest plays a key role in supporting community livelihoods, as a source of wood for housing and fuel and nursery habitat for fish, shrimp, crab and other species that are a vital source of food for subsistence.

Previous studies have all highlighted a heavy local dependence on both the mangrove and terrestrial forests for livelihoods. Cutting pole wood to produce lime from mangrove forest and charcoal from dry forest are means of earning additional income for some people in the village (Dave, 2006; Peabody *et al*., 2013, Andriamalala, 2008, Barnes-Mauthe *et al*., 2013).

C3: Land tenure & ownership of carbon rights

The project sits within the Velondriake community-managed LMMA which is an officially gazetted protected area as of April 2015 (Annex 8: National decree N◦ 2015-752) and is co-managed by both Blue Ventures and the Velondriake Association. As part of the MPA, the communities hold the right to manage the mangroves, however due to a 2014 national ban on harvesting mangrove trees (Law 32-100, attached as Annex 9), plans that include sustainable harvest are currently not validated by the Ministry of Environment, Ecology and Forests (MEEF). The Velondriake Association is currently applying for management transfer of the mangrove forest in Bay of Assassins from the Regional Forestry department. This management transfer will give full rights to the Velondriake Association to manage the mangrove forest resources, including sustainable harvest for personal use. Until the management transfer is granted, BV, on behalf of the VA, is applying to MEEF for a waiver to the 2014 ban on mangrove harvest based on the forest inventory, harvest quotas, monitoring by cut permits and oversight embedded in the mangrove management plan that would ensure sustainability of the forests. It is expected that MEEF will agree to either the waiver to the harvest ban or will transfer of management rights for the TH project area in 2019. As it was not legally possible to enact the sustainable harvest provisions in 2018, carbon sequestration for the sustainable harvest area has been removed from the carbon calculations (see Section G for adjusted rates of sequestration).

With respect to rights to potential carbon benefits, Decret No. 2013-785, the Delegation of Management (for forests) confirms that ownership rights to carbon rest exclusively with the state. However, the national REDD+ coordination office (Bureau Nationale de Coordination (BNC)-REDD+) issued a policy document in May 2018 (Strategie Nationale REDD+ Madagascar, attached as Annex 10). which was formalized by Decret No. 2018-500. This text states that, in relation to carbon incomes, REDD+ activity promoters who have generated GHG emission reductions through their active contribution have a legal right to carbon benefits.

The Protected Areas Code of Madagascar (Loi n° 2015-005 du 26 février 2015, attached as Annex 11) requires a contract between the Ministry of Environment, Ecology and Forests (MEEF) and the protected area manager to determine potential financing mechanisms for the protected area and local development. The use of carbon credit sales is included in the Velondriake protected area validated management plan as a potential financing mechanism for sustainable management of the associated natural resources.

As indicated in Part J: Benefit Sharing, 22% of total benefits accruing from the sale of carbon credits will be remitted to the Government of Madagascar. Avoided carbon emissions attributed to the Tahiry Honko project will be not be included in Nationally Determined Contributions (NDCs) for Madagascar, thereby enabling global buyers of carbon credits to use these as emissions offsets. The area of mangroves planted by BoA communities is included in Regional reforestation reports on an annual basis.

Part D: Project Interventions & Activities

D1: Project interventions

There are ten villages engaged in the Tahiry Honko, Plan Vivo project, submitted for registration. The activities undertaken in the project area include: prevention of ecosystem conversion, ecosystem restoration, improved land use (forest) management and support for alternative livelihoods.

- **Prevention of ecosystem conversion:** Mangrove conservation areas (Tahiry Honko) have been established by each village, in which no mangrove harvesting is allowed. Sustainable use areas have also been delineated, in which a sustainable harvesting system will be implemented, with annual quotas determined by analysis of the forest inventory. In these areas there will be no harvest of mangrove timber for lime production and a controlled, limited harvest of mangroves for building materials.
- **Ecosystem restoration:** Deforested areas of mangroves will be replanted with species of mangrove previously present. Deforested areas were delineated by the local community during the participatory mangrove zoning. Ecosystem restoration activities will also include monitoring of the sustainable use areas of the forest to ensure natural regeneration is replacing harvested trees. Maintaining acceptable density means an average of 3,200 live stems per hectare in a closed canopy mangrove forest. If replacement rates are low, fill planting will be carried out.
- **Improved land use** (forest) **management:** By adhering to sustainable harvest quotas of mangrove timber, improved land use management will ensure the preservation of the current quality and extent of the mangrove forests. Establishing plantations of terrestrial tree species will provide a source of wood for building and fuel, reducing the possibility that mangroves outside the project area will be targeted for harvest, referred to as leakage.
- **Support for alternative livelihoods:** Individuals and households are trained and supported to practice sea cucumber ranching, seaweed farming and beekeeping. This is predicted to reduce pressure on fisheries and mangrove harvest by providing alternative sources of income. The community-based sea cucumber aquaculture initiative currently underway in the Bay of Assassins was developed through partnerships between the farmers' association (community members), Blue Ventures and Indian Ocean Trepang (IOT, a private for-profit company) in late 2009. In 2011, village-based seaweed farming was also initiated, in partnership with the seafood collection and export private company, Ocean Farmers (previously called COPEFRITO). Beekeeping to produce mangrove honey has been set up in collaboration with Helvetas Swiss Intercooperation, a non-profit, non-governmental organization. Although farmers still require external technical and financial support, through extensive community training and capacity building, Blue Ventures is gradually handing over responsibility to the community to work directly with the private partners to develop their production related to these alternative livelihood activities.

D2: Project activities for each intervention

Table 3: Summary of the project activities

Description of project activities				
Intervention type	**Project Activities**	**Description**	**Target group**	**Eligible for PV accreditation**
Prevention of ecosystem conversion	Mangrove forest protection	Establishment of mangrove protected area (Tahiry Honko zone) and regular community-led patrolling and monitoring	Community group	Yes
	Sustainable mangrove harvesting	The sustainable provision of mangrove timber through harvesting quotas		

Ecosystem restoration	Mangrove reforestation	Reforestation of mangroves in deforested areas	Community group	Yes
Improved land use (forest) management	Alternative wood plantations	Establishment of alternative wood plantations for the sustainable provision of non-mangrove timber	Community group	No
Support for alternative livelihoods	Training and support to develop alternative sources of income	Establishment of sea cucumber and seaweed farming and beekeeping to diversify and expand livelihood activities	Individuals, women's associations and families in selected communities	No

D3: Effects of activities on biodiversity and the environment

The goals for prevention of ecosystem conversion and ecosystem restoration are to maintain currently healthy mangrove forests at full stocking levels of between 2500 to 3500 stems per hectare at maturity, and to return deforested areas to these levels. Forest patrols will ensure both mangrove protection and periodic surveys of key wildlife species that depend on mangroves for part or all of their life cycle.

Seven species of mangrove trees are endemic to the Bay of Assassins, four of which were observed during the mangrove inventory surveys described in Benson *et al*., 2017; in order of dominance, *Ceriops tagal*, *Rhizophora mucronata*, *Avicennia marina* and *Bruguiera gymnorrhiza*. An additional three species have been observed by local community members (*Sonneratia alba, Xylocarpus granatum* and *Lumnitzeria racemosa*). Over the first fourteen years of management, reforestation of ten ha per year is planned for those areas which are currently deforested and are not expected to naturally regenerate to full stocking within that period of time. The three dominant species in the ecosystem (*Ceriops tagal, Rhizophora mucronata* and *Bruguiera gymnorrhiza*) are planted, as these are the most commonly harvested for building materials and were previously present in the deforested areas. *Avicennia* is not a desired species for building material, and therefore is not harvested, but seeds in naturally at reasonable densities, depending on distance from the coastline and resulting tide levels.

Table 4: Ratio of the species to be planted

Species to be planted	Ratio	Propagules per hectare
Ceriops tagal	68%	3060
Rhizophora mucronata	26%	1170
Bruguiera gymnorhiza	6%	270
Total	100%	4500

Mangrove protection measures have been included in the *Dina* (local regulations, attached as Annex 20) that were put in place by the Velondriake Association and officially approved in 2017. Among the regulations is a ban on harvesting mangroves to be used for producing lime, which has been a major cause of deforestation in recent years. Collection of deadwood for cooking fuel is approved in the sustainable use zones of the mangrove forest. Harvest of living trees is subject to annual quotas, and to be used for construction or repair of family houses, not for commercial purposes (Annex 5).

Planting terrestrial species to provide an alternative source of wood for fuel and building materials aims to supply the community's needs and prevent leakage (deforestation of mangroves or other forests outside of the project area) which will also contribute to the maintenance of healthy mangrove ecosystems. Only native and/or naturalized species which occur in the adjacent Mikea forest are planted, on land close to villages that probably had some spiny forest coverage many years in the past and is currently sparsely occupied by shrub species. An inventory of the existing native and/or naturalized trees in the project area and a verification of the suitability of plantation sites proposed by the community during the participatory mapping were carried out by a technician from the Atsimo Andrefana Regional Department of Environment, Ecology and Forests (DREEF) in 2014. The objective was to ensure the ecological suitability of the species planted. *Cordylla madagascariensis* was tested in 2015 and in 2017, the number of species planted will be increased to include *Zanha suaveolens* (hazomafinto); *Gyrocarpus americanus* (kapaipoty); *Grewia caivata varcalvata* (latabariky); and *Zanthoxylum decaryi* (monongo), which are all native species inventoried at the project area and that villagers harvest from the adjacent spiny forest for building material and other uses.

Support for developing beekeeping as an alternative livelihood is expected to have an indirect effect on the biodiversity and health of mangroves, by reinforcing the value of intact mangrove forests as a source of nectar for bees. Sea cucumber farming has beneficial effects on seagrasses in the bay, while seaweed farmers are motivated to preserve healthy marine environments essential for the production of seaweed. Any additional alternative livelihood initiatives introduced in the future will, of necessity, be either neutral or beneficial to the marine and mangrove environments to be supported by Blue Ventures, an NGO focused on marine conservation.

Part E: Community Participation

E1: Participatory project design

In 2006, while the steps towards establishing the Velondriake LMMA were in process, a form of mangrove management began in the project area, but on a very small scale. This management included temporary and permanent mangrove reserves established by three villages as a strategy to protect their mangroves. Two of these villages started temporary mangrove reserves in 2006 and one established a permanent mangrove reserve in 2009. These management strategies however, were not effective in managing the entire mangrove forest surrounding the bay as they were restricted to the area around the villages. Acting as technical support to the Velondriake Association and assisting them to manage their natural resources, Blue Ventures has been working on a new mangrove conservation strategy based on Payment for Ecosystem Services. Starting in 2011, Blue Ventures conducted several community meetings to raise awareness about the ecosystem services which mangroves provide, discuss the threats and challenges, and to inform people about the Reduction of Emissions from Deforestation and Degradation (REDD+) mechanism. In 2013, after perceiving the decrease in their mangrove resources and its impacts on their livelihood, communities in ten villages around the bay agreed to develop a mangrove carbon project under the Plan Vivo standard.

Participatory approaches were adopted and applied in village-wide consultations. These included participatory appraisals, education and awareness-raising activities and zoning. This community-led approach meant that villagers decided on the activities that would be implemented in their area. A full list of consultations and project activities completed and the related community participation is presented in Annex 7.

The project works for the benefit of 3,992 residents of the ten villages within the Bay of Assassins. The project aims to engage all people, including marginalized groups such as women and young people through a participatory approach. During the project's implementation, women and youth are involved in both activities and decision making processes. Reforestation is an activity that promotes the active participation of women, engagement can be increased by offering training in nursery techniques (mangroves and terrestrial trees) and plantation establishment. From 2014 to 2017, 71% of women in the project area took part in mangrove reforestation events and 64% have worked on the terrestrial wood plantations in 2016 and 2017. During each consultation conducted in villages, women's opinions were solicited by forming a women's group during the focus group activities. After focus group discussions, the ideas were shared at a plenary session in order to reach consensus in the decision-making process. In two of the ten villages, youth conservation clubs have been established to encourage young villagers to participate in conservation activities. Support for these clubs will be expanded to other villages to involve young people in conservation of natural resources upon which their communities depend.

E2: Community-led implementation

Design of the mangrove management plan for the Bay of Assassins was based on the communities' initiative and from the participatory mangrove zoning via community meetings and consultations (see Annex 7). Three management zones in the mangroves were outlined on printed maps by each village:

- Strict conservation areas
- Sustainable harvest areas
- Areas scheduled for reforestation

Delineation of the zones were based on the communities' knowledge and traditional uses. Strict conservation areas were chosen for their high value as fisheries nurseries. Some villages are closer to larger areas of mangroves than others, or closer to mangroves that are more critical for nurseries and as a result, have larger zones of conservation. However, these zones benefit all residents in the Bay of Assassins, by providing essential habitat for juvenile marine species. Also, residents from all villages surrounding the bay have access to all zones designated for sustainable harvest, regardless of location, to obtain trees for personal use.

Frequent consultations were held to cross-check that these management zones are truly agreed upon by the local communities. These were conducted at the village level and all of the existing sectors (lime producers, fishers, farmers and elders) were invited to participate in the mangrove zoning to ensure that all interested parties were included and their voices were heard.

Figure 5: Community members delineating the Tahiry Honko zone

Following consultations at the village level, village leaders (chiefs of villages and the elders) from the ten villages were regrouped to cross-check and pre-validate the zoning for each village to make sure that villages sharing mangrove forest agreed on the zoning. The pre-validated map was presented at each village for endorsement. Once the map of three zones was validated by each of the ten villages, field delineation and demarcation was conducted by the local communities in each village with the support of Blue Ventures technicians. A map of these three zones was then produced using GIS software (Figure 6).

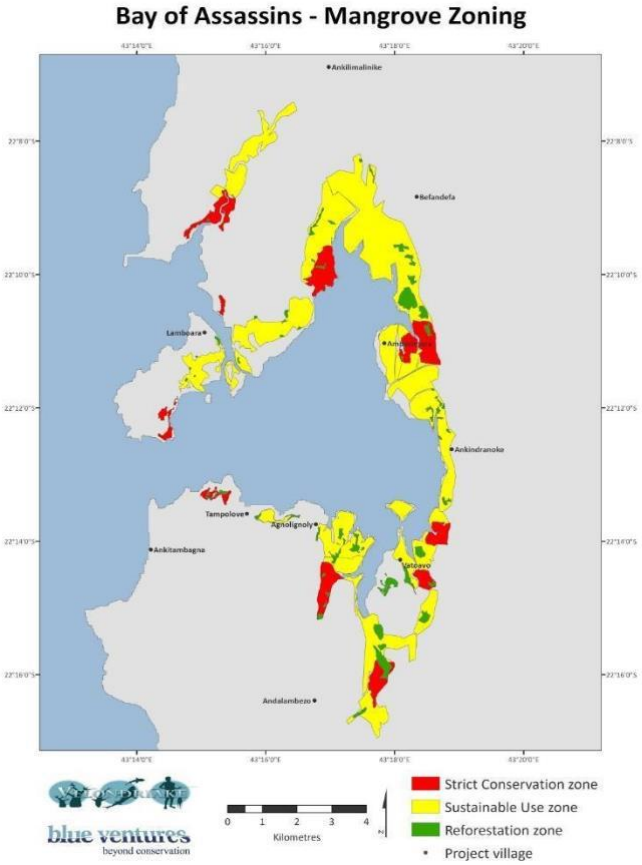


Figure 6: Mangrove zones in the Bay of Assassins

Regulations, patrols and monitoring plans for the management of the three zones were designed, discussed and validated through consultations and workshops. Once agreement on these items was reached at village level, two additional workshops were held with representatives of the ten villages,

the Velondriake Association and Blue Ventures as project co-managers, local authorities (Commune and District) and the regional representatives of the two ministries responsible for forestry and fisheries.

The aim of these workshops was to discuss the management plan, receive feedback at this level and if necessary, to revise the plan. The final version of the management plan was validated and signed off by all parties in June 2017 (see Annex 12). A document (booklet) containing the management plan was prepared and copies distributed to all parties. The booklet contains the project map showing the three management zones, a chart of activities that can be conducted within each zone, regulations, patrols and monitoring plans. The mangrove management plan will be reviewed every five years and, if necessary, revised by the communities.

In July 2017, village tours were conducted by the Blue Ventures technicians to inform local people about the validated mangrove management plan to ensure that local residents fully understand the content within the plan.

E3: Community-level project governance

The Tahiry Honko project is co-managed by Blue Ventures and the Velondriake Association, which also manages the Velondriake LMMA. The Association is divided into three sub-groups responsible for sub-areas of the LMMA, or *vondrona*; a northern, central and southern *vondrona* with each *vondrona* including about ten villages. Representatives are elected from each village within the LMMA to form village management committees who represent their villages at the *vondrona* level. The role of these representatives is to gather community opinions and concerns at regular meetings. They facilitate village members to come to decisions on the management of their villages. There are bi-monthly meetings of the *vondrona* during which the village management committees report the results of management meetings from their villages. The *vondrona*, in turn, report the results of their meetings to the Velondriake Association General Assembly. Meetings of the three *vondrona* are normally held every three months.

At each management meeting or consultation conducted by the project co-managers in each village, the number of people who have participated is recorded and decision making is minuted and signed by the meeting participants. All of these decisions are reported by the village management committees at the Vondrona and General Assembly meetings, where village decisions are discussed and validated. Therefore, any decision made by the Velondriake Association regarding the project management filters up directly from the community. Management decisions validated at the General Assembly are reported back to the villagers by the *vondrona* through the management committees.

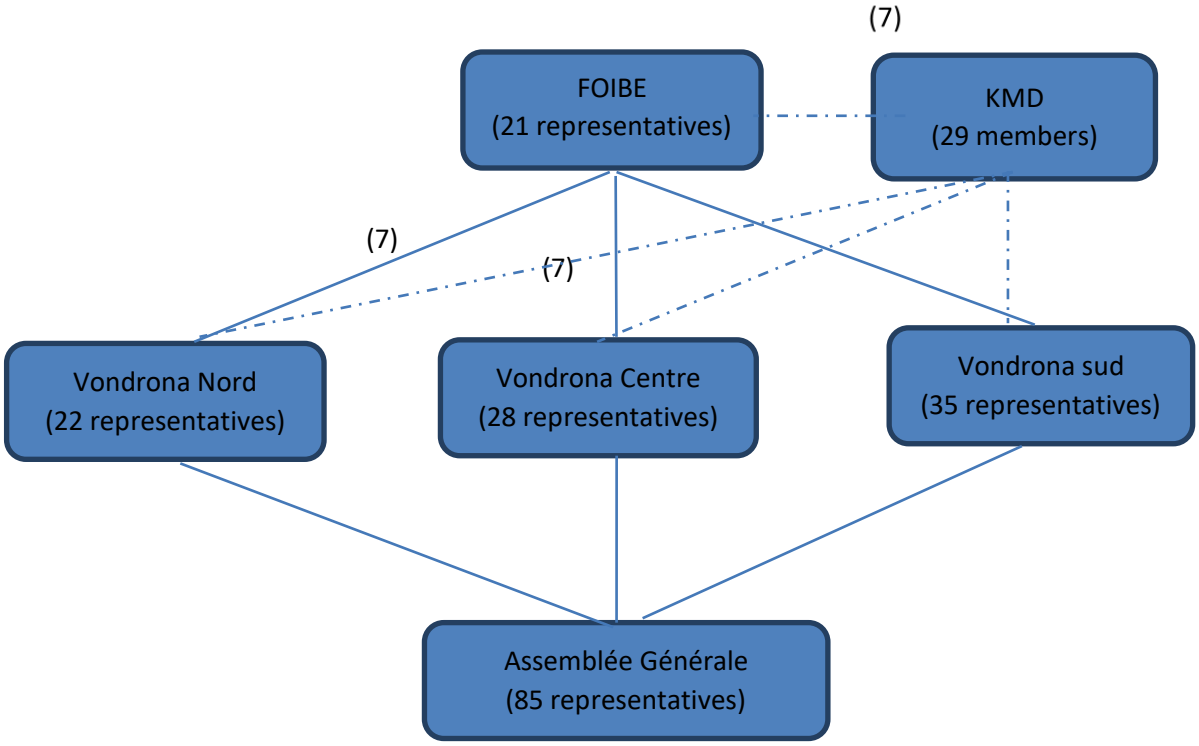


Figure 7: Structure of the Velondriake Association

The **Foibe committee** is the administrative arm of the Velondriake Association and develops the work plan within the LMMA. Foibe members are elected from the *vondrona* representatives. They meet every 3 months, and can hold extraordinary meetings if required.

***Vondrona* committees** are composed of representatives elected from each village in the geographical divisions of northern, southern and central areas, each with approximately 10 villages. The number of residents in the villages determine how many representatives sit on the committees. Each *vondrona* has a board, with meetings scheduled every 2 months. They report to the Foibe committee.

All of the *vondrona* representatives together comprise the **General Assembly**, which holds meetings biannually and can also call extraordinary meetings, if required. The GA validates the annual work plan and budget, decides major issues, and approves any modifications on internal rules or changes to the VA.

The **Komity Mpampihatra Dina** (Dina Enforcement Committee) has 29 members, one representative elected from each village, and also has an administrative committee. The KMD is an independent structure overseen by local authorities of the District of Morombe. The KMD is responsible to enforce or resolve dina infractions once they receive a complaint. They are not responsible for monitoring or patrols.

Community-based grievance mechanism

Community members participating in the Tahiry Honko project are able to raise grievances associated with project interventions with the co-managers, Blue Ventures and the Velondriake Association, using an established grievance mechanism in collaboration with the Civil Society in Toliara as a neutral third party, as detailed in Annex 13. Annual project reports will include the number and subject of received grievances, the stage of resolution if the grievance is still in process or resolutions reached and if the grievance has been resolved at the time of reporting. The grievance mechanism itself was discussed and approved by the participating communities at village consultations in February 2018.

Part F: Ecosystem Services & Other Project Benefits

F1: Carbon benefits

Table 5: Carbon benefits summary

NET CARBON BENEFITS						
		A	B	C	D	F
Management Plan Zone	Intervention type (technical specification)	Gross CO_2 Benefit (tCO_2e)	Expected losses from leakage (tCO_2e)	Deduction of risk buffer (tCO_2e)	**NET CARBON BENEFIT (tCO_2e)**	**NET CARBON BENEFIT PER YEAR (tCO_2e)**
			=A*2.5%	**= (A-B)*15%**	**=A-B-C**	**=D/20**
Strict Conservation	Prevention of ecosystem conversion	2869	72	420	2378	119
Sustainable Use	Improved land use management	10190	255	1490	8445	422
Restoration	Ecosystem restoration	20038	501	2931	16606	830
				TOTAL:	**27429**	**1371**

F2: Livelihoods benefits

Table 6A: Livelihoods benefits (Table 1 of 2)

Livelihoods benefits			
Food and agricultural production	**Financial assets and incomes**	**Environmental services (water, soil, etc.)**	**Energy**
Sea cucumber farming	Replace fishing as primary income-generating activity Support livelihood not dependant on weather or tides Increase to average household income	Preservation of mangroves to ensure integrity of coastal ecosystem Increase in seagrass productivity and carbon storage in seagrasses Increase in ability of sediment to buffer ocean acidity Provision of microhabitat Increase in sediment bioturbation	
Seaweed farming	Additional income-generating activity Diversify sources of income to increase the resilience of communities to the effects of climate change increase to average household income	Preservation of mangroves to ensure integrity of coastal ecosystem	
Beekeeping	Additional income-generating activity Diversify sources of income to increase resilience to effects of climate change Increase to average household income	Preservation of mangroves to support beekeeping (source of nectar)	
Terrestrial tree plantations	Sale of timber for additional income	Improvement in soil quality Decrease in erosion	Fuelwood
Mangrove reforestation	Increase in income from healthy fisheries Income from permit fees for local use of mangroves	Protection of coastline from wave action and severe weather events	Deadwood for fuel from mangroves

For most villagers in the Bay of Assassins, income generation to date has been largely restricted to fishing. In three of the villages agriculture is practiced, but the residents are also fishers. The project supports local community members to diversify or entirely change their sources of income. Mitigation measures to improve the sustainability of the fisheries have also been put in place.

Table 6B: Livelihoods benefits (Table 2 of 2)

Livelihoods benefits				
Food and agricultural production	**Timber & non-timber forest products (incl. forest food)**	**Land & tenure security**	**User rights to natural resources**	**Social and cultural assets**
Sea cucumber farming	Sea cucumbers for export		User rights to establish sea cucumber farms	Infrastructure for villages (schools, wells, meeting halls, marketplaces) and support for improvement to primary education (via farmers' contribution to community fund) Capacity building for associations and cooperatives
Seaweed farming	Seaweed for export		User rights to farm seaweed	Support for improvement to primary education (via farmers' contribution to community fund) Capacity building for associations and cooperatives
Apiculture	Mangrove honey for local markets	Supporting transfer of management rights of mangroves to the community	Traditional user rights to mangroves	Capacity building for associations and cooperatives
Terrestrial tree plantations	Fruit Building material	Support to landowners for tenure applications	Traditional user rights to land surrounding villages	
Mangrove reforestation	Fish, crabs and shrimp from mangrove forest Building material	Transfer of management rights of mangroves to the community	Local use Right to cut mangrove with approved quotas	

Sea cucumber and seaweed farming has been established, while beekeeping to produce mangrove honey is currently in the trial phase. Terrestrial tree species will include fruit-bearing trees that can be harvested for sale or household consumption. Diversification of income sources will increase community resilience to potential environmental effects arising from climate change.

Conservation and restoration of the mangroves ensures that essential nursery habitat for shrimp, crab and fish is maintained or improved. This will contribute to the sustainability of fisheries over the long term and will provide potential for increased income from fishing.

Management and careful monitoring of sustainable use areas of mangroves will ensure that community members have access to building material for their houses and may collect downed and

dead wood for fuelwood, but that harvesting mangroves for sale is curtailed. Alternative wood plantations of terrestrial tree species have been established and will be expanded in future years to provide a source of both fuelwood and building material.

As described in Section C3, application has been made to DREEF to transfer management rights for the Tahiry Honko mangrove forests to the communities around the Bay of Assassins, which will strengthen traditional use rights to natural resources in the Bay of Assassins. Also, this will allow the issuance of cut permits of mangroves for personal use (building materials for housing) to be locally based. The fees for cut permits will be collected by the Velondriake Association and directed to paying community monitors who patrol the area for misuse or illegal harvest.

The provision or enhancement of social and cultural assets are a key element of the project design. Communities have decided that benefits accruing from the sale of carbon credits will be used to construct essential infrastructure currently lacking in villages including wells, schools, meeting halls, clinics and marketplaces. To improve levels of education, the beneficiaries will also support school children through partial payment of annual school fees (see Annex 14: Financial summary for benefit sharing).

F3: Ecosystem & biodiversity benefits

Environmental benefits that result as a consequence of the conservation of mangrove forests include the stabilization of the coastline in the project area and a reduction in soil erosion. Improvements in soil quality, specifically water-holding capacity and fertility, can be expected from planting tree species in terrestrial plantations on land which is currently degraded dry forest.

Table 7: Ecosystem impacts

Ecosystem impacts				
Intervention type (technical specification)	**Biodiversity impacts**	**Water/watershed impacts**	**Soil productivity/ conservation impacts**	**Other impacts**
Prevention of ecosystem conversion	Maintenance of essential habitat for marine and terrestrial species	Maintenance of current state of coastline protection	Stabilize current soil productivity	Maintain current carbon stocks
Ecosystem restoration	Additional forested areas for marine and terrestrial species	Improve or enhance protection Stabilisation of coastline	Increase in sedimentation, possibly leading to changes in suitability for mangroves	Increased carbon sequestration in both above-ground and below-ground biomass
Improved land use management	Maintenance or improvement in habitat quality Additional habitat for dry forest terrestrial species	Conservation of soil water (reduced evaporation or loss to lower layers of soil)	Increase in soil nutritional levels through added organic material	Increase in shade Reduction in surface soil temperature Reduced evaporation
Support for alternative livelihoods	Increase in bee population	none	Decreased pressure on fisheries	Decrease in illegal logging for income

Part G: Technical Specifications

G1: Project Intervention and Activities

Project intervention

The Tahiry Honko project is underpinned by a community-designed mangrove management plan (Figure 6; Annex 5) covering 1,230 ha of largely intact mangroves and 163 ha of deforested or heavily degraded mangroves. The management plan divides the intact mangrove into two zones: strict conservation (known locally as 'Tahiry Honko' zones) and sustainable use. The deforested or heavily degraded areas are zoned as reforestation areas. These technical specifications deal with each of these zones separately as they have different carbon scenarios.

While following the 2013 Plan Vivo Standard, these specifications also utilise version 3.0 of the CDM AR-AM0014 A/R Large-scale methodology: Afforestation and reforestation of degraded mangrove habitats; version 3 of the VCS VT0001 Tool for the Demonstration and Assessment of Additionality in VCC Agriculture, Forestry and Other Land Use (AFOLU) Project Activities (2012); the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands; and the Plan Vivo Guidance Document for Reducing Locally-Driven Deforestation (2015). Lastly, they follow the best practice guidelines outlined in Technical Specifications Module (C) 2.1 (AD-DtPF): Avoided Deforestation – Deforestation to Protected Forest V1.0 for The Nakau Programme (2015); and the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003).

Four species of mangrove were observed in the project area during the mangrove inventory surveys described in Benson et al., 2017; in order of dominance, *Ceriops tagal*, *Rhizophora mucronata, Avicennia marina* and *Bruguiera gymnorrhiza*. However, an additional 3 species have been observed by local community members (likely *Sonneratia alba, Xylocarpus granatum* and *Lumnitzeria racemosa*).

This composition of mangrove species is prevalent along the southwest coastline of Madagascar, specifically in the regions of Atsimo Andrefana, where the project is located, and Menabe (Lebigre, 1997, Rakotomavo, 2010), the adjacent region to the north. Due to this distribution and the fact that the climate across these two regions is comparable, with low rainfall and similar temperatures (Glos et al., 2008), mangrove carbon stocks and growth rates can be assumed to be consistent. Therefore, the technical specification for the reforestation zones is applicable in these two regions of Madagascar, in which areas it can be shown that natural regeneration does not occur. However, the technical specifications for the conservation and sustainable use areas are underpinned by deforestation rates and sustainable harvest quotas specific to the project area, supported by data gathered in carbon plots. As a result, technical specifications for those two areas are only applicable in the Bay of Assassins.

Project activities and inputs

The activities in the conservation and sustainable use zones aim to maintain the current biophysical characteristics of the area, thus are applicable to local geophysical conditions. The reforestation zones will be replanted with the species that were cut down prior to the project, thus restoring the original biodiversity of the area.

Table 8 outlines the project activities in each management zone and the official regulations according to the management plan (Annex 5).

Table 8: Project activities and management regulations in each management zone

Management Plan Zone	Area	Plan Vivo Intervention Type	Activities	Management Regulations*
Strict conservation	257 ha	Prevention of ecosystem conversion	Intact mangrove forest protection	It is strictly forbidden to: - Enter the zone without prior authorization - Harvest living or dead wood - Fish for crabs, shrimp or fish at night - Destroy or remove zone identification signs - Using unsuitable tools that would damage the area (e.g. axe, spade, crowbar) - Perform research without prior authorization - Guide tourists without prior authorization
Sustainable use	973 ha	Prevention of ecosystem conversion	Sustainable mangrove harvesting	- No unlawful cutting of mangroves in the area - No damage to the signs that demarcate the zone - No cutting down young mangrove trees - No removal of wood for no specific purpose - The village head must grant logging permits for timber harvesting - The annual authorized quota for harvesting must be respected - The minimum diameter of exploitation (3cm) must be respected - The d*ina* must be applied to illegal harvesters
Reforestation	163 ha	Ecosystem restoration	Reforestation of 163 ha of mangroves over a period of 10 years (including 2 years prior to project start)	It is strictly forbidden to: - Enter the zone without prior authorization - Damage mangrove seedlings - Harvest living or dead wood if the plantation is still young - Destroy or remove zone identification signs - Fish for crabs, shrimp or fish in the zone if the plantations are still young

** Management regulations according to the 'Management Plan for Mangrove Forests in the Bay of Assassins, Velondriake Marine Protected Area' (Annex 5)*

G2: Additionality and Environmental Integrity

Relevant laws and regulations

The relevant existing laws and regulations are: the Forest Law 1995 and the dispositions for category V Protected areas in the Protected Area Code (CoAP Law No. 2015-005, GOM 2015, Art. 19c & Art. 49c), which recognize the right of communities to extract forest products, subject to regulations, for their domestic needs. Due to lack of resources available to Regional and National government departments, control of mangrove harvesting is limited. In 2014, an order (Annex 9: Arrete 32-100/2014) banning the mangrove wood harvest and sale for timber was issued by the Government of Madagascar.

As the project area is located within the LMMA, regulating the use of mangroves is mandated under the Protected Area Code (Annex 11:CoAP Law No. 2015-005) and the customary law (*dina*) which is enforced by the *dina* enforcement committee (KMD). Referring to the "*Cahier de charge Environnemental*" (Annex 15: Cahier de Charge) of the Velondriake Protected Area, Velondriake

Association and Blue Ventures, as co-managers of the Protected Area, are assigned to conduct social and environmental assessments and submit the report of the social and environmental survey to the National Office for the Environment (ONE) every year.

Planned project interventions exceed current laws and guidelines by putting in place regulations that govern activities within each zone, detailed in the mangrove management plan (Annex 5) and as shown in Table 8.

Financial, social, technical and cultural barriers

Table 9: Evaluation of barriers

Type of barrier	Description of barrier	Mitigation through project
Financial	Local residents depend on exploiting mangroves for livelihoods Lack of funds to support forest protection (surveillance, guarding and enforcement) Lack of funds to support technical work and validation necessary for carbon project Lack of funds to startup alternative fuelwood plantations	Project interventions supporting development of alternative livelihood activities (sea cucumber and seaweed farming, beekeeping) Funds from carbon credit sales will support forest protection activities Blue Ventures (BV) has been able to access grants to support forest inventory and costs of establishing carbon project, including validation and fees Support and training for alternative wood nurseries and plantations
Technical	Lack of expertise to develop management plans, map and mark forest boundaries Lack of expertise on nursery techniques and plantation establishment for terrestrial species	BV team assists in preparing management plans, lead in participatory mapping, and train villagers to mark boundaries BV team trains villagers to grow tree seedlings in nurseries and to establish and maintain plantations
Institutional / political	Legal restriction to sustainable use of mangrove	BV staff are communicating regularly with regional and national government departments and ministries to enable sustainable use
Institutional / Social	Lack of organisation to support mangrove reforestation	Capacity building for village leaders to enable future reforestation efforts

Environmental integrity

Blue Ventures has been working with communities in the Velondriake LMMA since 2003 to support sustainable fisheries. Since 2011, the Blue Forests staff have been consulting with the villages around Bay of Assassins to inform and gain their cooperation on conserving mangroves. The rate of mangrove deforestation was calculated from remote sensing analysis, and has been confirmed as relatively stable at 0.27% per year in the 2003 to 2014 time period and, to the present, no accelerated degradation of the environment has been observed. Since 2014, while participating in developing management plans and engaging in consultations to put the carbon project in place, communities

have also reforested over 30 hectares of mangroves with support from the project co-managers, which also contributed to raising awareness of the importance of mangrove ecosystems.

As can be seen in Annex 7, the primary focus of the community consultations associated with this project has been conservation and sustainable management. The partner communities are not aware of the differing climate benefits of reforestation, conservation and sustainable management. Therefore, there is little likelihood that areas of mangrove have been cleared with the intention of reforestation as part of the Tahiry Honko project.

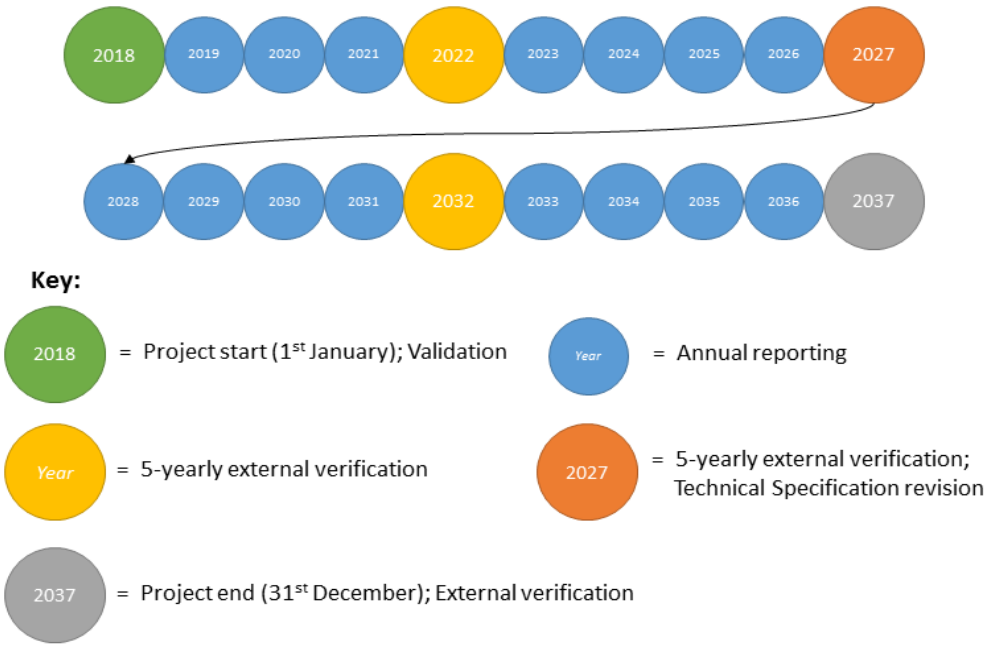
Other initiatives in the project area

There are no other projects underway to protect, manage and restore the mangroves of the Tahiry Honko project area (including carbon project initiatives).

G3: Project Period

The project start date is **1st January 2018** and greenhouse gas accounting starts on this date for all management zones. However, reforestation undertaken by the partner communities in 2016 (10 ha) and 2017 (10 ha), in anticipation of the project, is also included. Only emission removals due to this reforestation after the project start date are accounted for. The quantification and crediting period are 20 years, giving a project end date of 31st December 2037. Validation will occur in 2018, with reporting submitted annually at the start of each year, beginning in January 2019. External verifications will take place every five years in 2022, 2027, 2032 and 2037.

Figure 7: Tahiry Honko project timeline



The quantification and crediting period of 20 years was chosen to benefit both communities and the mangrove ecosystem. Villages around the Bay of Assassins require a long term commitment to develop adequate access to the basic necessities for healthy lives: clean drinking water, primary

education and health care. Residents are willing to be involved in mangrove conservation and restoration in exchange for PES that will be used for improvements to infrastructure that will provide a better life for them and their children. Also, this period of time will make it possible to verify positive changes in the ecosystem, since mangroves reach maturity between 12 to 15 years of age and monitoring of changes in marine or terrestrial biodiversity associated with the forest will be carried out at 5-year intervals. The 20-year period will ensure the permanence of mangrove conservation and restoration and can bring about a generational change in natural resource management, promoting sustainability of the forest into the future. To ensure that the partner communities realise not only the increased ecosystem goods and services but also the financial benefits of the carbon revenue, payments will be made to the partner villages annually, upon successful verification, as outlined in Annex 14.

G4: Baseline Scenario

Current conditions and trends in the project area

***Strict conservation and sustainable use zones**:*
The baseline conditions for intact forest within the project area are extensive deforestation and degradation due to unsustainable and illegal exploitation of mangrove wood for construction timber and lime production. Commercial and subsistence needs drive this overexploitation. Scales et al., 2016 outlined the emerging threat of lime production in the Bay of Assassins, during which mangrove wood is harvested and used to fire the kilns that produce a seashell-based lime that is then applied as a render on houses to improve their durability. While harvesting for construction timber is generally done in a selective manner, with only the straightest, tallest trees chosen, the clear cutting of mangroves used to fuel kilns in the production of lime render is a concerning, increasing trend within the project area.

Through satellite imagery analysis, Benson *et al*., 2017 estimated that 3.18% of mangroves in the Bay of Assassins were lost between 2002 and 2014. This equates to an annual net loss of 0.27%. This is the only mangrove loss assessment that focuses specifically on the project region. All other published studies utilise national-scale datasets, which are inherently less accurate when examined at a local scale.

While this assessment doesn't account for changes in the 3.5 years prior to the project start, this is deemed conservative because, as outlined above, lime production is an emerging, increasing threat. To prove this fact, household surveys and focus groups were conducted in all project villages with the objective of mapping the number of houses constructed using lime. This study found that on average over the reference period (2002-2014), 9 houses per year were constructed using lime. While between the end of the reference period and the start of the project (2015-2017), 10 houses per year were constructed using lime (Annex 26). Therefore, these technical specifications use a **conservative baseline mangrove deforestation rate of 0.27% for the strict conservation and sustainable use zones**.

This conservative figure also doesn't account for the full scale of mangrove loss in the area. As highlighted by Benson *et al*., 2017, the net loss figure only accounts for total deforestation; mangrove classes transitioning to non-vegetated classes. This figure alone does not accurately reflect the extent of mangrove exploitation within the bay. The mangroves of the Bay of Assassins were stratified into three classes relating broadly to canopy cover and tree height; closed-canopy, open-canopy I and open-canopy II. The open-canopy II class comprises only very sparse (<30% canopy cover), shrubby mangrove that is not considered as forest by international standards and from which wood is not utilised by local residents. The dynamics analysis described in Benson *et al*., 2017 highlighted that

22.4% of closed-canopy mangroves transitioned to open-canopy mangrove I between 2002 and 2014 and a further 9.7% of open-canopy mangrove I transitioned to the sparser open-canopy mangrove II. These trends suggest widespread, extensive degradation, an observation which is further reinforced by the high stump densities recorded during carbon inventory surveys. Similar observations were also made by Scale *et al*., 2016. During mangrove surveys in 2016, 28.7% of all trees counted in 60 randomly selected plots within the Bay of Assassins were either cut stumps or showed signs of harvested branches.

It is acknowledged that the current reference area does not include mangroves outside of the project area. To facilitate leakage monitoring, the remote sensing methodology outlined in Benson *et al.*, 2017 will be replicated to include all mangroves within the Velondriake LMMA Area, using a Landsat satellite image captured as close to the project start date as possible. These mangrove coverage data will be presented in full at the time of first verification.

***Reforestation zones**:*
The reforestation zones cover previously deforested areas. Both the project coordinator and the partner communities see little natural regeneration in these areas. These observations are further corroborated by the data presented in Benson *et al.*, 2017. It is assumed that natural regeneration of mangroves would be indicated by satellite image pixels changing from either the barren, tanne or open-canopy II classes to closed-canopy or open-canopy I mangrove classes. Table 7 in Benson et al., 2017 shows that out of all of the barren, tanne or open-canopy-II pixels that changed class between 2002 and 2014, only 5% changed to open-canopy I and none changed to closed-canopy mangrove. So, the assumed baseline scenario for these zones is that they remain deforested for the duration of the quantification period.

Carbon pools

Given that tree stumps are generally left in deforested mangrove areas, the dead wood class may be a potentially significant pool. Benson *et al*. 2017 found that the biomass of standing dead wood in the Bay of Assassins contributed to an average of 8% of the total mangrove vegetation biomass. However, these calculations were done using methods specific to standing dead trees, rather than cut stumps, which results in an overestimation of biomass carbon when applied to stumps. At the time of writing, no protocols exist specifically for the estimation of biomass in cut mangrove stumps. Because of this uncertainty, and the fact that monitoring the dead wood pool is both complex and time consuming, the dead wood pool has been excluded from the technical specifications.

Table 10: List of carbon pools and emissions sources

Carbon Pools	Included	Justification
Above-ground tree biomass	Yes	Significant carbon pool
Below-ground tree biomass	Yes	Significant carbon pool
Dead wood	No	Difficult to measure and likely insignificant (see main text)
Leaf litter	No	Conservative to exclude
Soil organic carbon	Yes*	Highly significant carbon pool in mangrove ecosystems. Conservative to exclude from conservation and sustainable use zones (see main text). Conservative default values used for reforestation zones

** The soil organic carbon pool is only accounted for in the reforestation zones.*

Given the presence of healthy trees with foliage in the with-project scenario and dead trees with no/minimal foliage in the baseline scenario, the exclusion of the leaf litter carbon pool is therefore conservative.

As is typical of wetland environments, between 84-86% of the total ecosystem carbon in the mangroves of the Bay of Assassins is situated in the soil organic carbon pool (Benson et *al.*, 2017). Many studies have shown how this carbon is emitted following mangrove deforestation (Donato *et al*., 2011, Lang'at *et al*., 2014, Lovelock *et al*., 2017). However, measuring and monitoring this loss is beyond the technical capacity of this project. Therefore, this highly significant carbon pool is conservatively excluded from the emission reduction calculations for the strict conservation and sustainable use zones. The conservative, default value defined in version 3.0 of the CDM 'AR-AM0014 A/R Large-scale Methodology: Afforestation and reforestation of degraded mangrove habitats' has been used for the reforestation zones.

Baseline methodology and data sources

Both the forest stratification and carbon stock values used in these technical specifications are detailed in full in Benson *et al*. 2017. This reference was chosen because at the time of writing it was the only publication of mangrove carbon stocks in southwest Madagascar and focuses primarily on the Tahiry Honko project area.

The methodology used to measure the carbon stocks in each carbon pool is described and justified at length in Benson *et al*., and draws heavily on the landmark protocols of Kaufmann and Donato, 2012, and Howard *et al*., 2014. Due to the strong spectral influence of the underlying bare ground, as detailed in Benson *et al*., 2017, it is challenging to accurately monitor using remote sensing techniques. As a result, the open-canopy II class (<30% canopy cover) is not included in the project area and thus excluded from these technical specifications.

Figure 8 shows the coverage of the closed-canopy and open-canopy I classes, as of June 2014, in relation to the three management zones delineated in the project area. Table 10 describes the 2 classes, including their vegetation carbon stocks, and gives the average initial vegetation carbon stocks (above- and below-ground tree biomass carbon pools) in the management zones, calculated according to the aerial coverage of each class in each zone.

Weighting the carbon stocks according to aerial coverage is conservative. The remote sensing results detailed in Table 7 in Benson et al., 2017 show that from 2002-2014 a higher percentage (22.4%) of closed-canopy mangroves degraded to open-canopy I mangrove than open-canopy I mangrove degraded to open-canopy II mangrove (9.7%). From these figures it could be deduced that closed-canopy mangroves are more targeted for harvesting than open-canopy I mangroves. Therefore, considering that open-canopy I mangroves cover more of the project area, weighting the carbon stocks according to areal extent is a conservative approach.

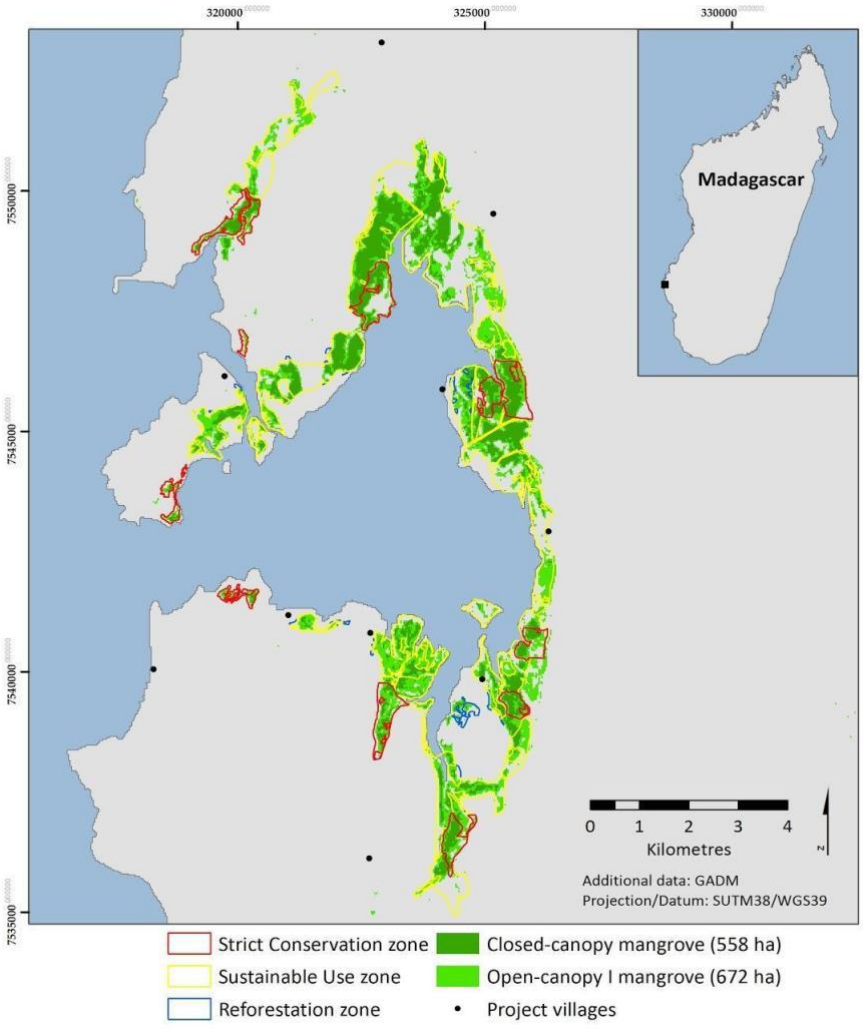


Figure 8: Mangrove class coverage in 2014 in relation to the management zones

Table 11: Summary of average initial vegetation carbon stocks in each management zone

Management Plan Zone	Total Area	Mangrove Class	Class Area	Initial Vegetation Carbon Stock*	Average Initial Vegetation Carbon Stock in Management Zone*
	A	B	C	D	= (C/A)*D
Strict conservation	257 ha	Closed-canopy	122 ha	73.9 tC/ha	59.3 tC/ha
		Open-canopy I	135 ha	46.2 tC/ha	
Sustainable use	973 ha	Closed-canopy	436 ha	73.9 tC/ha	58.6 tC/ha
		Open-canopy I	537 ha	46.2 tC/ha	
Reforestation	163 ha	Deforested mangrove	163 ha	N/A**	N/A**

**Vegetation carbon is the sum of the above- and below-ground tree biomass carbon pools*
***Initial carbon stocks were not measured in the reforestation areas. The project assumes that there is no net change in the vegetation and soil carbon stocks and no carbon will be sequestered.*

Baseline emissions in the strict conservation and sustainable use zones:

The baseline emissions from the two forested zones assume a **deforestation rate of 0.27%/year**. Therefore, 0.27% of the vegetation carbon stocks in these zones would be lost each year without intervention. This loss of vegetation carbon stocks is accounted for in the baseline emissions calculations (Tables 12 and 13).

The mangrove forest within the strict conservation and sustainable use zones is mature, stable forest. Therefore, it is assumed that the trees are no longer sequestering carbon. Natural regeneration is not observed in deforested areas, so changes in above- and below-ground sequestration are not accounted for in the baseline scenarios for the strict conservation and sustainable use zones.

Table 12: Baseline emissions scenario for the strict conservation zones

	BASELINE SCENARIO:		
	A	B	C
	Forest (ha):	Forest lost in that year (ha):	Total Vegetation Carbon lost in that year (tC)
	Assuming a starting forest area of 257 ha and an annual deforestation rate of 0.27%		=B*59.3
Y1	256.24	0.69	41.16
Y2	255.54	0.69	41.05
Y3	254.85	0.69	40.94
Y4	254.17	0.69	40.83
Y5	253.48	0.69	40.72
Y6	252.80	0.68	40.61
Y7	252.11	0.68	40.50
Y8	251.43	0.68	40.39
Y9	250.75	0.68	40.28
Y10	250.08	0.68	40.17
Y11	249.40	0.68	40.07
Y12	248.73	0.67	39.96
Y13	248.06	0.67	39.85
Y14	247.39	0.67	39.74
Y15	246.72	0.67	39.63
Y16	246.05	0.67	39.53
Y17	245.39	0.66	39.42
Y18	244.73	0.66	39.31
Y19	244.06	0.66	39.21
Y20	243.41	0.66	39.10

Total Vegetation Carbon lost after 20 years (tC) =	**802**

Table 13: Baseline emissions scenario for the sustainable use zones

	BASELINE SCENARIO:		
	A	B	C
	Forest (ha):	Forest lost in that year (ha):	Total Vegetation Carbon lost in that year (tC)
	Assuming a starting forest area of 973 ha and an annual deforestation rate of 0.27%		=B*58.6
Y1	970.85	2.63	154.11
Y2	968.23	2.62	153.69
Y3	965.62	2.61	153.28
Y4	963.01	2.61	152.86
Y5	960.41	2.60	152.45
Y6	957.82	2.59	152.04
Y7	955.23	2.59	151.63
Y8	952.65	2.58	151.22
Y9	950.08	2.57	150.81
Y10	947.51	2.57	150.40
Y11	944.95	2.56	150.00
Y12	942.40	2.55	149.59
Y13	939.86	2.54	149.19
Y14	937.32	2.54	148.78
Y15	934.79	2.53	148.38
Y16	932.27	2.52	147.98
Y17	929.75	2.52	147.58
Y18	927.24	2.51	147.18
Y19	924.74	2.50	146.79
Y20	922.24	2.50	146.39

Total Vegetation Carbon lost after 20 years (tC) =	**3004**

***Baseline emissions in the reforestation zones**:*
It is acknowledged that some trees do remain in the deforested areas zoned for reforestation. However, it is assumed that these zones will not naturally regenerate to forest over the project timeframe. Therefore, it is assumed that there will be **no net change in the vegetation and soil carbon stocks** and **no carbon will be sequestered**.

Table 14: Baseline emissions scenario for the reforestation zones

BASELINE SCENARIO	
Total Vegetation Carbon lost after 20 years (tC) =	**0**
Total Sequestered Carbon over 20 years (tC) =	**0**
Total Soil Organic Carbon sequestered over 20 years (tC) =	**0**

G5: Ecosystem Service Benefits

Expected climate benefits in the strict conservation zones
Delineation of the strict conservation zone, as for the other forest zones, was carried out through participatory mapping by each of the 10 villages, facilitated by the project co-managers. The mapping activity followed several community meetings at which the community members themselves expressed concern for the fisheries and full awareness of the direct link between intact mangrove ecosystems and fish, crab and shrimp populations. Residents of the bay had, previous to work starting on the carbon project, established a small mangrove permanent reserve to protect a vital area serving as a fisheries nursery. The villagers then, through the carbon project participatory mapping, established larger areas for strict conservation zones in which no harvesting of mangrove wood is

allowed. Commitment to this plan is strong; community members have voluntarily delimited the zones on the ground and fully support forest patrols to monitor infractions. Therefore, it is assumed that **no vegetation carbon will be lost** in these areas over the project quantification period. Given the current degraded state of the mangroves within the project area, assuming no gain in vegetation carbon is highly conservative.

The mangrove forests in the strict conservation zones are mature, stable forests. So, as in the baseline scenario, it is assumed that the trees are no longer sequestering carbon. Meaning that in the with-project scenario carbon stocks do not change in the strict conservation zones.

Establishment and maintenance of the strict conservation areas results in the lost opportunity for community members to access mangrove timber from these areas for fuelwood and building materials. However, harvesting wood in these zones would degrade the fisheries stocks which for many villagers are their primary source of income and for the remainder, a primary source of sustenance. Requirements for mangrove timber for personal consumption will be met through harvest quotas of wood cut in sustainable use zones, which are significantly larger in area than the strict conservation zones. In the process of establishing these quotas, rates of mangrove use for personal consumption were assessed and the quota allowances are ample for these personal needs. Also, actively pursuing full reforestation of deforested areas will eventually result in enlargement of both conservation and sustainable use zones, thereby increasing access to resources and protection for fisheries.

Table 15: With-Project scenario for the strict conservation zones

	WITH-PROJECT SCENARIO:		
	A	B	C
	Forest (ha):	Forest lost in that year (ha):	Total Vegetation Carbon lost in that year (tC)
	Assuming a starting forest area of 257 ha and an annual deforestation rate of 0.27%		=B*59.3
Y1	257	0.00	0.00
Y2	257	0.00	0.00
Y3	257	0.00	0.00
Y4	257	0.00	0.00
Y5	257	0.00	0.00
Y6	257	0.00	0.00
Y7	257	0.00	0.00
Y8	257	0.00	0.00
Y9	257	0.00	0.00
Y10	257	0.00	0.00
Y11	257	0.00	0.00
Y12	257	0.00	0.00
Y13	257	0.00	0.00
Y14	257	0.00	0.00
Y15	257	0.00	0.00
Y16	257	0.00	0.00
Y17	257	0.00	0.00
Y18	257	0.00	0.00
Y19	257	0.00	0.00
Y20	257	0.00	0.00

Total Vegetation Carbon lost after 20 years (tC) =	**0**

Expected Climate Benefits in the sustainable use zones

With active forest protection and harvest quotas below replacement levels in force in sustainable use areas, the expectation is that the mangrove area in these zones will be maintained at 973 hectares, with no deforestation over the 20-year project period. Therefore, the **same assumptions as employed for the strict conservation zones** have been used for the sustainable use zones. However, because this form of management is new to the partner communities, it is assumed that the harvest quota system will not be fully operational during the first year of the project. Therefore, it is conservatively assumed that the with-project scenario will be the same as the baseline scenario for the first year of the project. Following this, carbon stocks remain stable.

Table 16: With-Project scenario for the sustainable use zones

	WITH-PROJECT SCENARIO:		
	A	B	C
	Forest (ha):	Forest lost in that year (ha):	Total Vegetation Carbon lost in that year (tC)
	Assuming a starting forest area of 973 ha and an annual deforestation rate of 0.27%		=B*58.6
Y1	970.85	2.63	154.11
Y2	970.85	0.00	0.00
Y3	970.85	0.00	0.00
Y4	970.85	0.00	0.00
Y5	970.85	0.00	0.00
Y6	970.85	0.00	0.00
Y7	970.85	0.00	0.00
Y8	970.85	0.00	0.00
Y9	970.85	0.00	0.00
Y10	970.85	0.00	0.00
Y11	970.85	0.00	0.00
Y12	970.85	0.00	0.00
Y13	970.85	0.00	0.00
Y14	970.85	0.00	0.00
Y15	970.85	0.00	0.00
Y16	970.85	0.00	0.00
Y17	970.85	0.00	0.00
Y18	970.85	0.00	0.00
Y19	970.85	0.00	0.00
Y20	970.85	0.00	0.00
Total Vegetation Carbon lost after 20 years (tC) =			**154**

Expected climate benefits in the reforestation zones

As one of the project interventions, communities have committed to planting 10 hectares of mangroves per year in deforested areas zoned for reforestation in the management plan. In 2016, 10 hectares were reforested and in 2017 communities planted 10 hectares of mangroves. The total area to be reforested is 163 ha, so 10 ha will be planted for the first 14 years and 3 final hectares planted in year 15.

Version 3.0 of the CDM AR-A0014 A/R Large-scale Methodology: Afforestation and reforestation of degraded mangrove habitats defines a conservative default value for soil organic carbon sequestration in reforested mangrove ecosystems. They state that 0.5 tC/ha/yr can be assumed to be sequestered over the first 20 years following planting, with no further sequestration after 20 years. This assumption has been applied in these technical specifications and the calculations are shown in Table 17B below.

Table 17A: With-Project scenario for the reforestation zones

REFORESTATION WITH-PROJECT SCENARIO		Carbon Sequestered in Each Year of the Project (tC)																			
Year:	Ha planted	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Previous reforestation (2016)	10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Previous reforestation (2017)	10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
1	10	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
2	10	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
3	10	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
4	10	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
5	10	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
6	10	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
7	10	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
8	10	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
9	10	-	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
10	10	-	-	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
11	10	-	-	-	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
12	10	-	-	-	-	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
13	10	-	-	-	-	-	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
14	10	-	-	-	-	-	-	-	-	-	-	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0
15	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	4.5	4.5	4.5	4.5	4.5
16	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total area reforested	163																				
Total Above-ground Sequested Carbon (tC)	**A**	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0	165.0	180.0	195.0	210.0	225.0	240.0	244.5	244.5	244.5	244.5	244.5	244.5
Total Below-ground Sequested Carbon (tC)	**B=A*0.29**	13.1	17.4	21.8	26.1	30.5	34.8	39.2	43.5	47.9	52.2	56.6	60.9	65.3	69.6	70.9	70.9	70.9	70.9	70.9	70.9
Total Carbon Sequestered in the Vegetation (tC)	**C = A+B**	**58.1**	**77.4**	**96.8**	**116.1**	**135.5**	**154.8**	**174.2**	**193.5**	**212.9**	**232.2**	**251.6**	**270.9**	**290.3**	**309.6**	**315.4**	**315.4**	**315.4**	**315.4**	**315.4**	**315.4**

Table 17B: With-Project scenario for the reforestation zones, soil organic carbon

Annual Soil Organic Carbon Sequestration (tC/ha/yr)																				
Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

REFORESTATION WITH-PROJECT SCENARIO		Soil Organic Carbon Sequestered in Each Year of the Project (tC)																			
Year:	Ha planted	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Previous reforestation (2016)	10	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-	-
Previous reforestation (2017)	10	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-
1	10	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2	10	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
3	10	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
4	10	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
5	10	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
6	10	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
7	10	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
8	10	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
9	10	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
10	10	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
11	10	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
12	10	-	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
13	10	-	-	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
14	10	-	-	-	-	-	-	-	-	-	-	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0
15	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.5	1.5	1.5	1.5	1.5
16	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total area reforested	163																				
Total Carbon Sequestered in the Soil (tC)		15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	81.5	81.5	81.5	81.5	76.5	71.5

WITH PROJECT SCENARIO	
Total Vegetation Carbon lost after 20 years (tC) =	0
Total Sequestered Carbon over 20 years (tC) =	4466
Total Soil Organic Carbon sequestered over 20 years (tC) =	1139

Total benefits for all carbon pools combined

As described in detail above, the project activities have been carefully designed by the project villages to ensure they are realistic and attainable. However, it is acknowledged that this is a new initiative and it is not conservative to assume 100% activity success rate, particularly at the project start. To acknowledge this, it is assumed that the project will only be 97.5% effective and 2.5% of the carbon benefits are deducted accordingly. The appropriateness of this deduction will be reviewed in year 5 of the project.

Tables 18-20 summarize carbon stored in each of the three pools; conservation zone, sustainable use areas and reforestation areas. The baseline and with-project carbon storage estimates are graphically displayed.

Table 18: Summary of total climate benefits for the strict conservation zones

PROJECT BENEFITS:					
A	B	C	D	E	F
Total Vegetation Carbon lost after 20 years in baseline scenario (tC)	Total Vegetation Carbon lost after 20 years in with-project scenario (tC)	Project effectiveness (%)	GROSS C BENEFIT OF PROJECT (tC)	GROSS CO_2 BENEFIT OF PROJECT (tCO_2e)	GROSS CO_2 BENEFIT OF PROJECT PER YEAR (tCO_2e/year)
From Table 11	From Table 14		=(A-B)*C	=D*(44/12)	=E/20
802	0	97.5%	782	**2869**	**143**

Figure 9, below, compares the baseline and with-project scenarios of the strict conservation zones. The area between the baseline and with-project lines is equivalent to the total climate benefits of the project in these zones.

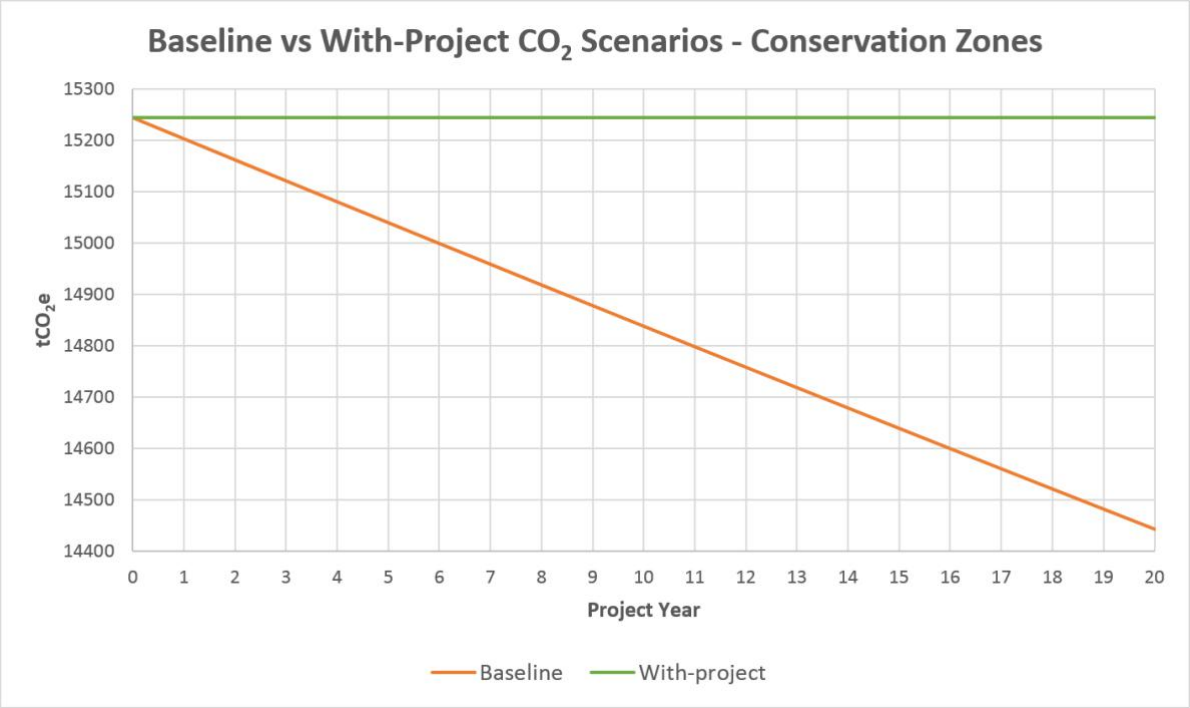


Figure 9: Comparison of baseline and with-project scenarios, strict conservation zones

Table 19: Summary of total climate benefits for the sustainable use zones

PROJECT BENEFITS:					
A	B	C	D	E	F
Total Vegetation Carbon lost after 20 years in baseline scenario (tC)	Total Vegetation Carbon lost after 20 years in with-project scenario (tC)	Project effectiveness (%)	GROSS C BENEFIT OF PROJECT (tC)	GROSS CO_2 BENEFIT OF PROJECT (tCO_2e)	GROSS CO_2 BENEFIT OF PROJECT PER YEAR (tCO_2e)
From Table 12	From Table 15		=(A-B)*C	=D*(44/12)	=E/20
3004	154	97.5%	2779	**10190**	**509**

Figure 10, below, compares the baseline and with-project scenarios of the sustainable use zones. The area between the baseline and with-project lines is equivalent to the total climate benefits of the project in these zones.

Figure 10: Comparison of baseline and with-project scenarios, sustainable use zones

Table 20: Summary of total climate benefits for the reforestation zones

PROJECT BENEFITS:					
A	B	C	D	E	F
Total Vegetation Carbon lost after 20 years in baseline scenario (tC)	Total Vegetation Carbon lost after 20 years in with-project scenario (tC)	Total Vegetation Carbon sequestered over 20 years in baseline scenario (tC)	Total Vegetation Carbon sequestered over 20 years in with-project scenario (tC)	Total Carbon Sequestered in the Soil over 20 years in baseline scenario (tC)	Total Carbon Sequestered in the Soil over 20 years in with-project scenario (tC)
From Table 13	From Table 16A	From Table 13	From Table 16A	From Table 13	From Table 16B
0	0	0	4466	0	1139

G	H	I	J
Project effectiveness (%)	GROSS C BENEFIT OF PROJECT (tC)	GROSS CO2 BENEFIT OF PROJECT (tCO2e)	GROSS CO2 BENEFIT OF PROJECT PER YEAR (tCO2e/year)
	=((A-B)+(D-C)+(F-E))*G	=H*(44/12)	=I/20
97.5%	5465	**20038**	**1002**

Figure 11, below, compares the baseline and with-project scenarios of the reforestation zones. The area between the baseline and with-project lines is equivalent to the total climate benefits of the project in these zones.

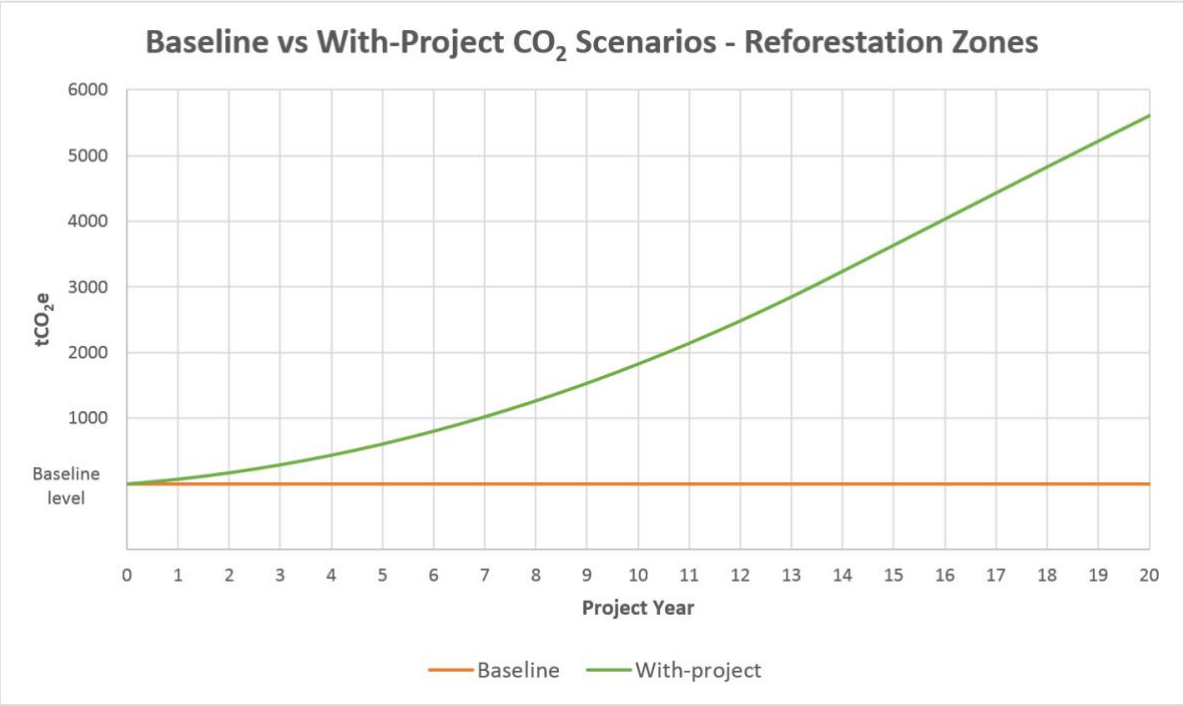


Figure 11: Comparison of baseline and with-project scenarios, reforestation zones

G6: Leakage and uncertainty

Potential leakage and mitigation

Some residents in the Velondriake LMMA currently use lime rendering to construct more durable houses. Lime production demands significant quantities of mangrove wood to fire kilns that are used to burn shells. Harvesting mangroves for this purpose is against *dina* (local regulations) and the KMD will be able to charge infractions for people cutting trees for lime production. As BV and the VA continue to hold awareness-raising sessions throughout the area we expect this method of construction to become unacceptable in the area.

Communities in the TH project area extract timber from the mangrove forests for personal use to build and repair houses and fences. As an essential component of the mangrove management plan (attached at Annex 5), annual consumption of mangrove timber per household was determined through village consultations asking such questions as: “How often do you need to build a new house?” and “How much wood is used in housing construction?”. The forest inventory by diameter class was calculated from data collected in carbon plots. These two sources of information were used to establish annual quotas of mangrove timber that could be harvested from sustainable use zones, which will adequately supply community needs. Fuelwood is collected from the mangrove forests, but as deadwood only; living trees are not harvested for this purpose and therefore no cut quota is given for use as fuel.

By establishing strict conservation zones and quotas on timber harvest in sustainable use zones, there is the possibility that mangrove forests in the north of the Velondriake LMMA will be subjected to greater harvesting pressure to satisfy needs for building materials and fuelwood, a potential effect referred to as leakage. In collaboration with Asity, the Madagascar branch of Birdlife International, located in Morombe, the Velondriake Association will support establishment of regular forest patrols in the northernmost part of the Velondriake LMMA, which overlaps a Protected Area managed by Asity. The patrols will ensure that these mangrove forests are not placed under greater pressure as a

result of restrictions to use of the Bay of Assassins mangroves. The Velondriake Association will also work with Asity to hold community consultations on the importance of maintaining mangrove ecosystems and to explore opportunities for alternative livelihoods for residents of the northern zone of mangroves.

Additional mitigation measures to forestall leakage are to promote alternative building materials for housing and fencing. The entire area is richly supplied with limestone rocks which are currently quarried and cut to construct some houses. BV and the VA will encourage building with this more durable material and will source masons to train villagers. Infrastructure projects (schools, clinics, meeting rooms, etc.) planned by communities and financed through PES benefits will be constructed using stone, due to its durability and as examples of alternative building methods.

BV and the VA will also promote living fences to replace mangrove pole wood in delineating household compounds. Small pole wood of local tree species (local names: Boy and Sointsoy) used to form living fences are considerably more effective in maintaining property boundaries over a longer period of time.

Residents of three villages in the Bay of Assassins have been trained in tree nursery and plantation establishment of terrestrial tree species. These plantations will supply building material and fuelwood to local communities, and eventually provide an additional source of income when more than enough trees are planted to satisfy the needs of local residents. Native dryland species with multiple uses will be planted in order to diversify plantations and provide a higher probability of success in the challenging environment. Additional nurseries will be established and land identified to expand the number of hectares planted to terrestrial native and naturalized tree species.

There is no legal market-driven displacement that will contribute to leakage, because commercial exploitation of mangroves is banned under current government regulations. Forest patrols that result in identifying and charging timber poachers will reduce the incidence of illegal harvesting. Awareness-raising, encouraging adherence to *dina* and facilitating access to building materials alternative to mangrove wood will effectively result in negligible leakage occurring in the northern mangrove forests of the Velondriake LMMA.

Given the demand for building lime and mangrove timber is known to come from villages within the Velondriake LMMA, and the nearest mangroves outside of the LMMA is 4 hours by cow-drawn cart (the primary means of transporting bulky material in the area), 2 hours by 4x4 and approximately 3 hours by boat from the largest village within Velondriake, we do not feel that lime or mangrove timber production poses a threat to mangroves outside the LMMA.

In order to ensure leakage is not occurring, in addition to ongoing forest patrols across the LMMA area, the remote sensing mangrove dynamics analysis outlined in Benson *et al.*, 2017 will be repeated in year 5 of the project and every subsequent 5 years, including the mangroves in the north of the Velondriake LMMA. As detailed in Section G4, baseline mangrove coverage for all mangroves within the LMMA but outside the project area will be made available at the time of first verification. These data will be used to assess leakage as the project progresses - with any forest loss detected outside the project area conservatively assumed to be leakage. However, despite the precautions described above, in order to be conservative we assume a 2.5% leakage reduction. This assumption will be reviewed in year 5 of the project using the remote sensing results.

Reduction of uncertainty in calculations

To ensure estimates are conservative and realistic three classes of carbon pools that could potentially contribute to the total carbon sequestration have not been included in calculations. Carbon stored in dead wood has been omitted because there are currently no protocols for estimating biomass of cut stumps of mangrove. Leaf litter is also omitted to ensure conservative carbon estimates. While soil in mangroves potentially stores more than 80% of the total ecosystem carbon, this pool has not been included in calculations for the intact mangroves (strict conservation and sustainable use zones) due to the technical difficulty in measuring and monitoring soil organic carbon in intact forests. These decisions substantially reduce any uncertainty in calculations of carbon sequestration in the Bay of Assassins mangroves.

In addition, areas of mangrove forest identified as open-canopy II class are omitted from the project area, due to difficulty in monitoring this class of mangroves using remote sensing.

Although the Mikoko Pamoja technical specifications have been used as a reference to design the Tahiry Honko project, the more conservative above-ground carbon sequestration figure of 0.16 tC/ha/year from 2006 IPCC Guidelines has been selected rather than the Mikoko Pamoja rate of 4.5 tC/ha/yr. To estimate below-ground sequestration, the Mikoko Pamoja ratio of 0.15 below-ground sequestration:above ground sequestration was chosen as opposed to the 2013 IPCC Supplement to Guidelines of 0.29 which further reduces uncertainty in carbon calculations.

Key assumptions

The baseline scenario annual net loss of 0.27% of mangroves is based on satellite imagery analysis of the Bay of Assassins between 2002 and 2014. Considering population growth in the area will likely place greater pressure on natural resources over the project's 20-year timeline, the assumption that, without project intervention, mangroves will continue to be lost at this rate is conservative. The net loss figure does not include estimated potential for conversion of closed-canopy mangroves to open-canopy; this contributes further to a conservative estimate.

The assumption that natural regeneration of deforested mangroves will not occur over the project's lifetime is based on observations made by the project co-managers and partner communities. Therefore, planting and monitoring are planned to ensure regeneration of the deforested areas that will contribute to carbon sequestration within the quantification period. This assumption will be verified before every reforestation event by surveying the area to be planted and determining the stems per hectare of naturally seeded-in mangroves.

Part H: Risk Management

H1: Identification of Risk Areas

The risk assessment for the Tahiry Honko project is based on the VCS standard risk assessment for carbon projects, and is presented in Annex 16. Categories of risk assessed are internal, external and natural with a percentage calculated for each, the total of which gives a final risk buffer calculation. The risk assessment and mitigation measures will be reviewed annually and adapted as necessary.

Internal risks

Risk factors associated with project management are related to the necessity for ongoing enforcement, in the form of forest patrols to reduce or eliminate illegal logging. Mitigation measures are put in place under the guidance of an experienced management team and an approved adaptive management plan that will be regularly reviewed and updated. These will pay particular attention to determining whether harvest quotas are sustainable and if reforestation targets are being met.

The financial viability of the project is good. Technical back-stopping and support to establish the project is underwritten by long-term grants obtained by Blue Ventures, as the project co-manager. It is expected that the project will be financially independent prior to the 10-year mark.

The opportunity cost of foregoing exploitation of the mangroves is the potential income earned by individuals from the sale of timber. Regular monitoring of mangroves to enforce local regulations prohibiting commercial exploitation is expected to eliminate this activity. Provision of support to develop alternative livelihoods in the project area, particularly those dependent on healthy mangrove ecosystems, will offset the risk of continued illegal harvest.

The Tahiry Honko project is planned for a 20-year period, resulting in a project longevity score of 20. Adding all internal risk factors, the total internal risk is calculated at 12.

External risks

The mangrove forest area is publicly-held land, but local communities have traditional right of tenure which will be reinforced by obtaining transfer of management rights to the communities from the Regional Department of Environment, Ecology and Forests. This process was initiated in September 2017 and is expected to be completed in 2018. This is a legally binding commitment for the communities to follow the approved mangrove management plan.

Extensive village consultations have been done within the Tahiry Honko area throughout the establishment phase of the project. Communities outside the project area have also been consulted and the Velondriake Association, comprised of representatives from throughout the larger LMMA, is the project co-manager and therefore has responsibility for oversight of the project and is included in all decisions governing project management.

Political risk was calculated using the World Bank Institute's Worldwide Governance Indicator score averaged over the last 5 years. The National Government of Madagascar is currently implementing REDD+ readiness plans which is a mitigating measure for political risk. The resulting total external score is calculated at -3, however the risk assessment does not allow a negative external risk, resulting in an external risk score of 0 in the overall calculation.

Natural risks

It is estimated that, with appropriate mitigation measures as described in the mangrove management plan, loss of carbon stocks will be less than 5% or can be recovered within 10 years in the event of loss due to natural occurrences. The natural risks considered are pest and disease outbreaks, extreme weather and changes to habitat suitability due to erosion or sedimentation of coastline.

Extreme weather includes unusual levels of drought which is the most prevalent natural risk in the project area. Low or infrequent rainfall can cause fresh water inundation and weak tide dispersion, leading to dieback of mangroves. Extreme weather may damage mangroves fringing the coastline, however recovery can be assisted by reforesting the area. Pest and disease outbreaks that may cause significant deforestation are unlikely, but incidence is possible, and therefore this factor is included in

the score. There is also a small risk of sedimentation and erosion causing natural degradation in habitat suitability for mangroves. There are no large waterways running through the project area, so these effects would result from changes to tide levels which generally occur at a slow pace. Monitoring of dieback in forests and adjustments to assisted reforestation plans will mitigate these effects if they occur. The resulting total natural risk from the above factors is calculated at 3.

H2: Risk Buffer

The overall risk for the project is calculated at 15, by summing internal risk calculated at 12, external risk at 0 and natural risk at 3%, as indicated above and in the risk assessment table in Annex 16. Therefore, 15% of carbon credits will be set aside as a risk buffer in the Plan Vivo risk buffer account. Additionally, 5% of the funds earned from carbon credit sales will be held in a risk account by BNC-REDD+ in accordance with their policy.

Part I: Project Coordination & Management

I1: Project Organizational Structure

The application for this project is being submitted by Blue Ventures. Blue Ventures has been working in Velondriake for over 15 years and the Velondriake LMMA is currently co-managed by both Blue Ventures and the Velondriake Association. The Memorandum of Understanding formalising our cooperation on the project is given in Annex 17 (Annex 17A: signed version in Malagasy, Annex 17B: English text of the MoU).

Table 21: Responsibilities of each organization/group involved in the Tahiry Honko project

Organization	Responsibilities
Blue Ventures	Project coordinator and applicant organisation Provide technical support and training to producers in planning and implementing project activities Manage administrative and marketing tasks Administer project registration costs Develop carbon models, technical specifications and undertake biomass inventories Provide technical support on governance Report the project activities Collect socio-economic information for project registration and reporting purposes
Velondriake Association (VA)	Help communities to demonstrate carbon rights/land tenure Serve as the central governance body for project management plans Securing communities and VA share of benefits in VA bank account and disbursement to build approved infrastructure, pay school fees and CSE salaries Approve the benefits sharing arrangements
Comité de Suivi et Evaluation (CSE)	Patrol for infractions in mangroves within project area and in northern mangrove forests Conduct ecological and socio-economic monitoring

Dina Enforcement committee or KMD (*Komity Mpampiatra Dina)*	Enforce the *dina* established by the VA Report d*ina* enforcement to the VA management committee and the regional authorities
Local monitors (women's groups)	Conduct the carbon stock measurement and monitoring
Civil Society of Toliara	Acts as independent facilitator to hear grievances
BNC-REDD+	Signatory to all carbon sale agreements Processing and disbursement of funds from sale of carbon credits Oversight for transparency of funds Approval of annual budgeted activity plans

Blue Ventures (Applicant organisation and Project Coordinator)

Blue Ventures is a registered UK charity (no. 1098893) which operates in the UK, Belize, Indonesia and five sites along the west coast of Madagascar. Blue Ventures is a social enterprise, legally licensed to operate in Madagascar, which has worked with local communities in Madagascar since 2003 to conserve threatened marine and coastal environments through application of an integrated approach to biodiversity protection and poverty alleviation.

Blue Ventures' work includes facilitating community-based management of fisheries, community-based aquaculture, community health and education initiatives and community-led forest management. Blue Ventures' Blue Forests programme was started in 2011. This programme tackles the problem of mangrove deforestation by undertaking rigorous scientific research to quantify the value of mangrove forests and by putting communities at the helm of their long-term forest management. The Blue Forests team is experienced in the technical aspects of REDD+ and are piloting the world's first mangrove REDD+ project in northwest Madagascar (Jones *et al., 2014).* The Blue Forests programme has also contributed meaningfully to Madagascar's Readiness Preparation Proposal (R-PP) for REDD+ by providing mangrove carbon stock data. The Blue Forests team has already conducted consultations and established communications with several key actors in the national and local government responsible for natural resource management.

Blue Ventures is well-equipped with expertise and staff capacity to maintain long-term PES services agreements with project participants and the Plan Vivo Foundation. A team of 8 core staff members is playing a key role in coordination and implementation of the work on the Plan Vivo project, one of whom was recruited from local communities. Three of Blue Ventures project management staff are based full-time at the project site.

Table 22: Key staff involved in project implementation

Role	Name	Expertise
Project Leader	Lalao Aigrette	Leading the project activities and liaising with national and regional authorities
Carbon Science	Leah Glass	The voluntary carbon market and geospatial science
Forest Science	Jennifer Hacking	Forestry management and tree plantation
Project regional manager	Dolce Augustin	Local development and community management of protected areas
Mangrove carbon scientist	Jaona Ravelonjatovo	Carbon stock monitoring of mangroves
Social scientist	Cicelin Rakotomahazo	Socio-economic survey and participatory appraisal, CSE training

Community liaison officer	Aina Celestin	Community outreach and forestry technician
Forestry technician	Christelle Razananony	Forestry technician and support to alternative livelihoods

Velondriake Association

Velondriake, which means "to live with the sea" in Malagasy, is part of the largest network of community-run coastal and marine protected areas in the Western Indian Ocean. Velondriake is managed by communities from 31 villages in the remote southwest of Madagascar, and supported by Blue Ventures. The Velondriake Association (VA) was created officially in 2006 through the initiative of the local communities and recognised by the Province of Toliara (Annex 18: Récépissé of VA). The VA is made up of three sub-association groups, called *vondrona*, to which community representatives from each village are elected in village elections. The last election occurred in April 2016; elections take place every three years.

The Velondriake Association has ten years of experience in sustainable fisheries management that has been replicated by neighbouring communities over 100 times in southern and western Madagascar. The government of Madagascar has used the project as a model to create new fisheries legislation and seasonal closures of octopus fishing throughout the country.

The successes of Velondriake have resulted in a groundswell of community interest in developing broad scale marine conservation programmes targeting other fisheries and ecosystems. They have also inspired international exchanges by fishermen, community groups and NGOs, who have travelled from countries in the Western Indian Ocean including Mauritius, Seychelles, Comoros, Mozambique and Kenya to learn from the success of the Velondriake Association.

The Velondriake Association plays several important roles including: facilitating the implementation of sustainable natural resource management, enforcing local traditional laws and participating actively in community conflict resolution. They also manage grants that fund community monitoring and other initiatives.

The ***Dina*** **Enforcement Committee (KMD)** was formally created in 2012 and subsequently restructured in 2016. There are 29 KMD members throughout the Velondriake area; 12 of them are residents of the Bay of Assassins (Annex 19: List of the Velondriake KMD). The committee is made up of community representatives from each village chosen by village election. Their mandate is to enforce the *dina*, the local regulations developed and approved by all communities in Velondriake and ratified by the District court. The regulations governing the mangrove conservation zone and reforestation zone are incorporated into the Velondriake *dina* and were ratified at the court of Morombe in April 2017 (Annex 20: Copy of the Dina). The ritual ceremony to officialise the d*ina* was held in August 2017.

The ***Comité de Suivi Evaluation*** **(CSE, Monitoring and Evaluation Committee)** has been created to carry out forest patrols and monitoring. The members are recruited from the communities within the Velondriake LMMA. They are trained in their duties by Blue Ventures technical staff, and will also receive further training at regular intervals.

Ten **Local monitors** from two villages have been trained in carbon stock measurement of mangrove forests using a method adapted for the community. Local monitors will be trained further in specific carbon monitoring methods building their capacity to conduct the mangrove carbon monitoring within the project area. Additional consultations with the Velondriake southern *vondrona*, the

Velondriake Association, and local women's groups will be conducted. These consultations will shape how the ongoing monitoring will expand to other villages and work in the long term.

The **Civil Society of Toliara** is a municipal entity based in the city of Toliara that has agreed to provide facilitation services in the event of a grievance being lodged against the project co-managers, as described in Section E3 and Annex 13.

The **Bureau Nationale de Coordination-REDD+** (BNC-REDD+) is a government agency seated within the Ministry of Environment, Ecology and Forests that is responsible for oversight of all carbon projects in the country. The agency's mandate is to support and promote REDD+ projects and to administer the funds from the sale of carbon credits to ensure transparency.

Stakeholder Analysis

A chart of identified stakeholders is presented in Annex 21.

I2: Relationships to national organisations

A series of consultations and information sessions were held at the national level, with key ministry officials, including the Designated National Authority (DNA) of the MEEF, Director of Environmental Information and REDD+ National Coordinator. A workshop was held at the BNC-REDD+ office in February 2017 to discuss and negotiate partition of the revenue derived from the sale of carbon credits generated by the Tahiry Honko project (Annex 22: attendance sheet).

A Memorandum of Understanding between the Blue Ventures and the Government of Madagascar through the BNC-REDD+, under the Ministry of Environment, Ecology and Forests (MEEF) has been signed (attached as Annex 23) Blue Ventures and BNC-REDD+ have agreed to work together to advance mangrove REDD+ and blue carbon in Madagascar through the development and implementation of pilot projects.

Key regional stakeholders, such as the Regional Department of Environment, Ecology and Forest (DREEF), the Regional Fisheries Department, and the Regional Development Departments, were also consulted. The Institut Halieutique et des Sciences Marines (IHSM), a leading marine sciences unit attached to the national University of Toliara, is a partner on the project, and the manager of the Mikea National Park (managed by Madagascar National Parks) in the region was also consulted about the project on August 1st, 2014 (Annex 24: attendance sheet).

I3: Legal compliance

The *dina* governing the project activities, preservation and restoration of the mangrove forest has been ratified by regional courts and its content is in harmony with the law in force in Madagascar. With respect to the national legal framework, a law came into force in October 2014 prohibiting the exploitation of mangrove timber (Annex 9: inter-ministerial order 32.100/2014). This means that the implementation of the sustainable harvest system (project activities) is in contradiction of this law. The regional representatives of the forestry administration responsible for the project area have assured the project co-managers that exploitation for domestic use based on the annual harvest quota given per village will be allowed. The texts on which this decision is based are in the regulations for category V protected areas in the Protected Areas Code (Annex 11: CoAP Law No. 2015-005, GOM 2015, Art. 19c & Art. 49c) which recognizes the right of communities to extract forest products, subject to regulations, for their domestic needs.

BV policy staff meet regularly with the BNC-REDD+ office at the national level to maintain current awareness on any potential changes to policies that may affect communities' rights to exploitation for domestic use. Workshops and presentations on Tahiry Honko have been given to inform regional and national representatives. As the first carbon project based on mangroves in Madagascar, there is a high level of interest in the success of this project.

Ensuring equal opportunities for employment
The recruitment of community members who will be employed on the project is done through job competitions which are open to all adult community members. The selection of community members engaged temporarily on project activities (nursery technicians, local helpers, carbon monitors) is done by the communities themselves.

I4: Project management

Table 22 below outlines key project activities completed by Blue Ventures and the Velondriake Association to implement the Tahiry Honko carbon project.

Blue Ventures will be responsible for assisting the Velondriake Association with communications and technical support including interactions with Plan Vivo, Markit Registry, participating brokers and buyers. Blue Ventures will also provide assistance with monitoring and the preparation and submission of annual reports.

Table 23: Timeline of implementation of the project

Month	Year	Project Activities
October	2013	First community consultation
November	2013	Introduction of project to regional government
July	2014	Community decision to implement carbon project
August	2014	Regional consultation for project implementation
November	2014	Carbon stock inventory
February	2015	Project Idea Note validated by Plan Vivo
August	2015	Carbon stock inventory with community monitor training
June	2017	Mangrove management plan completed
March	2018	Project Design Document submitted to Plan Vivo
September	2018	Revised PDD submitted to Plan Vivo

I5: Project financial management

Due to logistical constraints arising from the Velondriake Association's remote location and limited communication avenues, Blue Ventures takes sole responsibility for the marketing and sale of Plan Vivo carbon certificates. Total certificates which may be sold are issued with the 15% risk buffer of total emissions reductions already deducted, which is held in the Plan Vivo risk buffer account. In compliance with the recently released Strategie Nationale REDD+ Madagascar (attached as Annex 10), the Government of Madagascar, through the BNC-REDD+ office will be signatory to all carbon sale agreements. All revenue from the sales will be held in a REDD+ Fund managed by BNC-REDD+ from which disbursements to the Velondriake Association will be made in accordance with the agreed-upon benefit sharing arrangements (see Part J: Benefit Sharing below).

The Velondriake Association has a Bank of Africa bank account in Morombe into which the community and Velondriake Association funds from the sale of the carbon credits will be transferred. Blue Ventures will receive 7% of total funds in order to cover the cost of external verification. The Association will be responsible for managing the revenue and Blue Ventures will provide oversight for all financial transactions for the VA account, as well as performing regular audits of the account.

With start-up funding from the Darwin Initiative (DEFRA), MacArthur foundation, and UNEP-GEF, Blue Ventures has financed the implementation of the project activities (carbon inventories, mangrove replanting, mangrove zoning and preparation of the management plan). The Velondriake Association received a small grant from the Critical Ecosystem Partnership Fund (CEPF) to finance some project activities (training of the CSE, delimitation of the sustainable harvest zone, committee meeting). The total cost of project registration, validation, and first verification will be covered by Blue Ventures through the International Climate Fund (ICF) grant. A summary of funding sources is given in Annex 2. The financial plan for sharing benefits is outlined in Annex 14, with an analysis of the minimum carbon pricing to achieve the communities' goals.

I6: Marketing

There will be a dedicated staff member located in the BV UK office to administer the Markit account, answer inquiries and be responsible for all sales of carbon certificates. If necessary, training will be provided on administering the Markit account. The marketing plan is still in development and includes the following components:

- Establishing a customized website which will host a short film of the Tahiry Honko project, downloadable brochures, explanatory text, personal stories from villagers living in the Bay of Assassins and photos. Credits will be available for purchase directly from this website.
- Blue Ventures has a dedicated media team and an extensive social media presence. This social media presence will be leveraged to advertise the opportunity to purchase Tahiry Honko credits.
- Selling carbon credits to Blue Ventures' volunteers who join expedition groups traveling to Madagascar, Belize and East Timor on a regular basis throughout the year. Expeditions were first started in 2003, and from 2014 to 2017, 722 volunteers took part.
- Approaching private companies in Madagascar with significant carbon emissions to offset via the purchase of Tahiry Honko project credits.
- Presentation and promotion of the Tahiry Honko project at national workshops and international conferences at which brochures will be distributed to enable participants to purchase carbon credits either to offset travel or simply to support the project.
- Blue Ventures will also offset the emissions associated with staff members' international work travel.

I7: Technical support

The Blue Ventures field staff have supported communities in project implementation from late 2013 until the present time. The participatory approach was adopted, and community members have been involved in all project activities (management planning, tree planting, replanting monitoring, carbon stock inventory and nursery maintenance). Members of the CSE (Comité de Suivi et Evaluation) have been trained to carry out forest patrols (use of GPS device, map reading, recording observed infractions, collecting data) and will receive additional training in 2018 on monitoring (mangrove

reforestation monitoring and biodiversity surveys). Community capacity building will be conducted if and when necessary.

Part J: Benefit sharing

J1: PES Agreements

As outlined in Section E1, communities in the Bay of Assassins were first approached by Blue Ventures in 2011 about the potential for a carbon project and the possibility of establishing a mechanism that allows communities to benefit from Payment for Ecosystems Services (PES). Consultations began in 2013, the entire series of which is listed at Annex 7.

To reach agreement on benefit sharing of the project, extensive consultations have been undertaken with the REDD+ coordination office of the Government of Madagascar (Bureau National de Coordination REDD+). In May 2018, BNC-REDD+ issued a national strategy document (Annex 10) establishing policy to govern REDD+ and PES projects in the country. Twenty-two percent of revenue accruing from the sale of carbon credits will be retained by the government in the REDD+ fund which will be used to support current projects, initiate new REDD+ projects and for oversight and administration purposes. An additional 5% of all funds accruing from the sale of carbon credits will be held in the BNC-REDD+ risk account

Project monitoring will ensure adherence to obligations under the PES agreement, the template for which is given in Annex 3. The communities were involved in the design of local regulations (*dina*) which govern use of natural resources throughout the LMMA. Community monitors will be responsible for ensuring these regulations are followed, as described in Sections I and K. As well, individual beneficiaries who participate in development of alternative livelihoods (sea cucumber and seaweed farming, and beekeeping) are each required to sign a conservation agreement that requires them to abide by the local regulations and participate in mangrove reforestation efforts when scheduled by their village.

J2: Payments and Benefit Sharing

It was agreed by the communities and approved by the VA that the benefits from PES will be received over a 20-year period and that annual revenue from sale of the carbon credits will be divided as follows:

- 73% to communities for project activities and social development
- 22% to the Government of Madagascar
- 5% BNC-REDD+ risk buffer

The share of benefits received by communities will be used to support continuation of activities that result in emissions reductions (forest patrols, mangrove reforestation, establishment of alternative fuelwood plantations, etc.) and for projects dedicated to social investment and development. Community consultations were held in each of the 10 villages to identify infrastructure projects that will provide greater access to services. Community members also agreed to use some of the benefits to subsidise school entrance fees for all village children within the project area. In the current political

and economic climate of Madagascar, remote communities do not have access to financial resources essential for provision of basic services including access to clean drinking water, primary education and basic health care. Community members realise that over the 20-year period of earning PES some infrastructure will have greater immediate impact (for example, building a school in a village that has none) than others, and therefore needs have been ranked on a priority list, shown at Annex 14, and will be scheduled for completion accordingly.

The opportunity cost incurred by local residents is the income generated from commercial exploitation of mangroves. Project interventions are designed to replace this income by giving community members support and access to develop alternative livelihoods.

Table 24: Beneficiaries of PES funds

Recipients	Use of funds received from PES
Communities	Costs associated with project monitoring, mangrove reforestation events, community awareness raising events, meetings, trainings (for village leaders, VA committee members, CSE, KMD), materials for the VA committee, and salary for a local staff member. Social investment via priority infrastructure including electricity, wells, schools, clinics, marketplaces, roads; support to families to pay school fees.
Government (MEEF)	Support the management of the Tahiry Honko project, development projects, oversight missions, meetings, producing documents in support of the project.
External verification	Partial payment for external verifiers to audit the project every five years. BV will also be contributing to costs for external verification from grant funding as the share allocated from PES will not cover the total cost.

The share of PES payments for communities will be deposited to the Velondriake Association bank account. Requests for money to complete infrastructure projects will be administered by the VA treasurer. Invoices for materials and services needed for social investment and development projects, ongoing project activities, VA expenses and costs of external verification will be required for all disbursements made from the account. Annual audits of the VA account will be performed by an outside consultant, paid from the PES benefits.

Threshold indicators that may affect PES payments are described in Section K and in more detail in Annex 25. Nine indicators are chosen for measurement against the threshold standards. The project co-managers will be monitoring additional elements that will track progress in more detail, discussed in Section K, however the indicators chosen to include in annual reporting are readily quantifiable and are targeted to measure the efficacy of project interventions.

Part K: Monitoring

As stated in the previous section, nine indicators will be monitored to periodically evaluate activities and determine whether stated goals have been achieved (Table 25). Annual reports will be prepared by the project co-managers and will include results of monitoring which will be carried out according to the schedule attached at Annex 25. This schedule gives 3 levels of achievement; green indicates that annual threshold targets have been achieved, amber (Level 1 mitigation required) indicates that, over the past year, one or more of the indicators has failed to reach the green level, and red (Level 2 mitigation required) indicates that significant shortfall has occurred in one or more of the indicators. Mitigation measures are put in place at the amber and red levels which must be followed to bring the indicator back to a green level of achievement. Payments of benefits to communities will only be affected for two of the indicators (change in average dbh in carbon plots and number of hectares reforested annually) and only if mitigation measures have failed to improve the performance in these indicators within a reasonable length of time. Communities have little scope of action that would affect the remaining indicators and much of the mitigation that must be put in place depends on good project management rather than community initiative.

A monitoring and evaluation committee (Comité de Suivi et Evaluation/CSE) has been formed by recruiting and training local residents from throughout the Velondriake LMMA. CSE members will carry out regular forest patrols in the mangroves and report any infractions against the local regulations that they observe. They will be responsible for submitting written reports after each patrol, these data will then be electronically filed and available to inform annual reporting on the project, feedback results to the communities and identify any necessary adaptations to the mangrove management plan. Furthermore, CSE members will be trained to collect forest inventory data, including reforestation survival surveys, carbon plot measurements and biodiversity surveys.

The CSE supervisor is responsible for assisting CSE members to plan patrols, reviewing reports for accuracy, ensuring that data are entered in a timely fashion and that any infractions observed during patrols are reported to the VA as soon as possible. The VA will then contact the KMD to pursue follow up action, if possible; i.e. in the event the CSE member was able to identify the person(s) responsible for the infraction. The CSE supervisor will also carry out regular audits of the work of CSE members, by verifying reported observations, in the field if necessary.

CSE members and the CSE supervisor, as well as any expenses incurred by the CSE related to monitoring will be paid from the PES revenues. The VA has also agreed to continue to apply for small community-based grants to supplement this revenue and ensure that all monitoring needs can be met.

The monitoring results will also be used to update the technical specifications. The dbh measurements along with the remote sensing data will be used to update the with-project mangrove vegetation carbon stocks. Also, the reforestation survival data will be used to check the assumptions with-project assumptions for the reforestation areas. If the survival rates are lower than predicted, the technical specifications will be updated accordingly.

Table 25: Monitoring plan summary table

Specific: Characteristic	Measurable: Indicators		Attainable					
Ecosystem services benefits		Target	Green	Amber Level 1 mitigation	Mitigation measures	Red Level 2 mitigation	Mitigation measures	Impact on PES payments
Tahiry Honko	Carbon plots: change in average dbh	No decrease within SE	no decrease within SE	< 10% decrease outside SE	Review management plans and adjust activities, quotas or zones, if necessary	> 10% decrease outside SE	Review management plans and adjust activities, quotas or zones, if necessary	Reduce PES to communities by 10% until average dbh stabilises (no further decrease)
	Number of stumps (harvest not allowed in TH)	No harvest in conservation zones Below quotas for sustainable harvest in sustainable use zones	Less than 5% of number of trees/ha are cut	Between 5% to 15% of number of trees/ha are cut	Increase forest patrols Meet with communities to ensure "no harvest within conservation zones" is understood and respected Ensure signs delineating zones are present	Greater than 15% of number of trees/ha are cut	Increase forest patrols Adjust management zones to enlarge conservation areas Reduce quotas in sustainable use areas	
Forest area	Area replanted (in first 16 years)	10 ha/year for first 16 years	10 ha/yr	Between 7 and 9 ha/year	With communities, plan additional reforestation events to increase hectares planted	< 7 ha/yr	With communities, plan additional reforestation events to increase hectares planted Hold community meetings to discuss reasons for low numbers of reforested hectares	Reduce PES by percentage of shortfall in reforested hectares over any 5-year period if mitigation measures do not succeed
	Survival rate	>60% survival rate	>60% survival rate	30% to 59% survival rate	With communities, have areas with low survival fill planted	< 30% survival rate	With communities, have areas with low survival fill planted Investigate possible causes of mortality and address these	
Drivers of degradation	Infractions for illegal logging	% of Dina infractions enforced	> 80% of Dina infractions are charged when individuals responsible are identified	60 - 79% of Dina infractions are charged when individuals responsible are identified	Meet with KMD and VA to review infractions that were not charged Charge any additional infractions	< 60% of Dina infractions are charged when individuals responsible are identified	Meet with Chef Cantonment and regional authorities to reinforce authority of KMD to charge infractions Provide additional training and awareness raising on importance of charging infractions Charge any additional infractions	
	Number of patrols	Target = 16 per month	Annual average ≥ 16/month	Annual average between 10 and 15/month	Review with CSE supervisor reasons for lower number of patrols Provide additional training and support for CSEs, if necessary	Annual average < 10/month	Review with CSE supervisor reasons for lower number of patrols Provide additional training and support for CSEs, if necessary Recruit new and/or additional CSEs, if necessary	
Other monitoring								
Institutional indicators	Capacity & activity level of VA	Number of meetings per year	4 or more per year	2 to 4 per year	Review minutes of the VA meetings held Meet to discuss requirements for project co-management	Less than 2 per year	Review schedule and minutes of VA meetings Provide additional capacity building in association management	
	Effectiveness of CSE monitors	Auditing of CSE work	90% of audited reports were accurate	Between 60 and 89% of audited reports were accurate	CSE supervisor to evaluate work of CSEs and provide additional training, if necessary	Less than 60% of audited reports were accurate	CSE to evaluate work of CSEs and provide additional training Replace CSEs with new hires, if necessary	
	Number of grievances handled according to procedure	> 90% of grievances received were handled according to procedure	> 90% of grievances received were handled according to procedure	Between 70 and 90% of grievances received were handled according to procedure	Co-managers to meet with Civil Society of Toliara and review grievances that were not handled properly Co-managers to undergo additional training on grievance procedures, if necessary	< 70% of grievances received were handled according to procedure	Civil Society of Toliara asked to review all grievances over the past year and recommend changes to the procedures, if necessary Co-managers to undergo additional training on grievance procedures	

K1: Ecosystem services benefits

Three aspects of ecosystem services benefits generated by the Tahiry Honko project will be monitored and reported for threshold payments. The summary of characteristics, indicators, associated thresholds and frequency of monitoring is shown at Annex 25.

Trees in one-fifth of the carbon plots previously established in the project area will be re-measured annually to verify that carbon sequestration is maintained or is increasing throughout the life of the project. Data collected during these monitoring events are: estimates of overall canopy cover and separate stratum cover for trees, sapling and seedlings, dbh of all trees and circumference at 30 cm of all saplings, height and crown dimension of all trees and saplings located within the 20m by 20m plots. These data will be aggregated to indicate trends over 5-year periods, to eliminate small fluctuations in measurements due to the slow growth rate of mangroves. As any harvesting is prohibited in the strict conservation zones and harvest quotas are set for the sustainable use zones, the number of stumps will be counted in the carbon plots to monitor for illegal logging or harvesting in excess of the quota, with associated thresholds for number of stumps per hectare to determine the level of illegal activity or adherence to quotas.

In addition to this field monitoring, as detailed in Section G6 the remote sensing mangrove dynamics analysis outlined in Benson *et al.*, 2017 will be repeated in year 5 of the project and every subsequent 5 years, including the mangroves into the north of the Velondriake LMMA. These data will be used to both verify climate benefits and assess leakage as the project progresses. However, because the remote sensing methodology is not one that all project participants can understand, the PES payments will not be directly linked to the results of these analyses. Rather, if the remote sensing analysis suggests that mangrove deforestation is occurring, these technical specifications will be promptly updated (before the scheduled review in 2027 if necessary), mitigation measures put in place and transparent discussions held with the partner communities to adjust future payments as necessary.

To restore degraded areas of mangrove forest, communities have committed to planting 10 hectares per year over the first 16 years of the project. PES are associated with this commitment and annual monitoring of the effort will be done by the project co-managers by completing reforestation event reports. Data collected during reforestation events includes area planted, number of propagules planted and number of community members participating in the event. The first tier mitigation action, if annual targets are not reached, is to meet with the communities and support them to plan additional reforestation events in the following year to increase the number of hectares planted. An average of 10 hectares per year will be maintained over 16 years until all deforested areas are replanted. If successful reforestation of 50 hectares is not achieved over any 5 years, second tier mitigation action will be to reduce the PES available to communities by the same percentage of shortfall in reforested area. For example, if only 40 hectares are successfully reforested from Year 1 to Year 5, PES will be reduced by 20% until the average of 10 hectares per year are re-established.

Community monitors will be trained to conduct survival surveys at regular intervals after planting events to ensure successful reforestation. There are mitigation measures associated with rates of survival are also associated, if necessary, as shown in the attached Annex 25.

Monitoring for drivers of degradation will use two indicators; the number of monthly patrols completed by community monitors and the number of infractions for illegal logging enforced annually.

Village meetings will be held at least annually to communicate the results from monitoring for ecosystem services benefits. Survival percentages of seedlings, increase in forest area, number of

infractions and number of illegally harvested trees will be displayed using charts, maps and graphs and methods to improve on parameters, if necessary, will be discussed.

K2: Socio-economic impacts

A baseline socio-economic survey in the Velondriake area was conducted by Blue Ventures in 2015, and will be repeated at 5-year intervals to gauge the socio-economic welfare of community members. Results from the surveys will be reviewed by the VA and village leaders, and relayed to communities through village outreach tours organised by the project co-managers. Socio-economic indicators will be used to determine whether BV programmes affect the livelihoods of village residents and will have no impact on PES to communities.

Socio-economic impacts are measured through a mixed methods approach. The methods drawn upon include:

- Census: a simple rapid census using mobile technology to measure how many people are living in target areas and assess broad demographic information about partner communities
- Focus groups: targeted discussions with community groups focusing on key themes
- Storytelling: to explore the complex ways in which people engage with, and benefit from, our interventions we collect both short and in-depth stories from community members about how they interact with our models and what this contributes to/impacts in their life
- Quantitative household and individual surveys: Quantitative anchor points allow us to understand how a community is doing. For example, what is the average income in the community, what is the state of food security and which activities do people rely on for providing food and income

In 2015, the socio-economic survey was carried out in 33 villages, 10 of which are in the Tahiry Honko project area. Parameters that are covered in the survey are:

- Population divided by gender and age groupings;
- Number of years of formal schooling attained by each individual;
- Occupation of all individuals over 15 years of age; and
- Literacy rate for all individuals 15 years of age and older.

The same survey will be carried out every 5 years and the comparative data analysed for impacts of the TH project. The expectation is that the literacy rate will improve and the number of years of school attended will increase, due to the increased access to education through subsidization of school fees and building schools in villages which currently have none. Also, it is possible that an increase in average lifespan may occur due to better access to health care by establishing clinics in several of the TH villages, although this effect will probably only be detectable over the long term, perhaps by the end of the 20-year project.

It is possible that the proportion of individuals engaged in fisheries as a primary occupation may decrease given greater opportunities in aquaculture and other alternative livelihoods, as these are further developed. It is expected that by restoring and protecting the mangroves, the numbers of fishers can at least remain constant, and there will be adequate resources to support the occupation.

Every 5 years, results from the surveys and analysis will be reviewed by the VA and village leaders, and relayed to communities through village outreach tours organised by the project co-managers.

Non-participating communities closest to the Tahiry Honko project area may also benefit through greater access to education and health care, depending on the distance to the nearest centres for

these services. Currently, in the southern part of the Velondriake area, the Tahiry Honko project communities are among the most in need of improved access to services.

Since the planned infrastructure will be built over the 20-year project period, meetings have been held with all community leaders and members to prioritise the requirements based on villages' needs. Discussions included the necessity of adaptability of infrastructure planning, due to the 20-year time scale. During that time, if the needs of the villagers change, the plan will be adjusted, in consultation with all communities involved in the Tahiry Honko project.

Completion of each infrastructure project will be reported annually, as well as celebrated with an opening ceremony.

K3: Environmental and biodiversity impacts

In order to assess potential impacts of the mangrove management plan and, in the broader context, the Tahiry Honko project, a baseline biodiversity survey was conducted in February 2018, adding to some basic information collected in 2014 in the area. The survey identified key species which will potentially be affected by changes in the environment. Community monitors have been trained to survey for the indicator species, and regular monitoring will be carried out to determine any impact on the key species, both marine and terrestrial.

Annual surveys will be collated to model 5-year population trends, and adjustments to the management plan will be considered if the estimated population of key indicator species is shown to be negatively affected. Impacts on biodiversity cannot be directly mitigated by community action, and therefore these indicators will not influence PES to communities. However, if negative trends are discovered, communities will be required to review the mangrove management plan, with the support of the project co-managers, and adjust management activities, redraw zones or increase patrols, as indicated by the review.

K4: Other monitoring

Institutional indicators will be monitored and reported to evaluate the effectiveness of the governance model, CSE monitors responsible for data collection in the field and the grievance resolution mechanism. The indicators associated with governance include the number of meetings held by the Velondriake Association on an annual basis. If the VA fails to meet at least four times per year, co-managers will review records of meetings held in the past year to establish whether issues governing the Tahiry Honko project were adequately administered and additional capacity training for VA members may be recommended.

Attendance by adult residents of the Tahiry Honko communities at regular village meetings will also be monitored, and mitigation actions or reductions to PES payments will result if low attendance is found in any given year of the project, as detailed in Annex 25.

Reports filed by CSE monitors will be regularly audited by the CSE supervisor to ensure that appropriate data are collected, observations are relevant and issues are followed up and resolved. If annual audits show that CSE reports are inaccurate or incomplete, the CSE supervisor will review field work procedures with the CSE member(s) and provide additional training, if necessary. In the event a CSE member continues to submit poor work, they may be dismissed and replaced.

The grievance mechanism must be rigorously followed to ensure community members are confident that any perceived negative impacts of the project are examined and explained or resolved. If, at the

time of preparing the annual report, it is found that the grievances are not being resolved or handled appropriately, co-managers will meet with the Civil Society of Toliara to review all grievances that were received in the past year to ensure the mechanism is sound and to reinforce the necessity of following the established procedures. Additional training for co-managers may be sought, if deemed necessary by the Civil Society personnel. To ensure that additional harvest pressure is not placed on mangrove forests to the north of the Velondriake MPA (leakage), BV staff will maintain regular contact with Asity, the NGO that engages communities in that area to manage mangroves, and if necessary, offer technical support. These forests will be included in monitoring by remote sensing repeated at 5-year intervals to ensure that deforestation is not occurring.

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