CRITICAL ECOSYSTEM PARTNERSHIP FUND

Ecosystem Profile for Madagascar

Workpackage 1

Identification of important ecosystem services for Ecosystem based Adaptation (EbA)

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CONSERVATION INTERNATIONAL Madagascar

Missouri Botanical Garden

MADAGASCAR

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1 INTRODUCTION

The latest CEPF 2015-2020 funding program in the Madagascar and IOI Hotspot region was based on the Ecosystem Profile developed by Conservation International (CI) in 2014. Given the significant changes to the political context, capacity of civil society, social and economic trends as well as threats to biodiversity, including the COVID-19 pandemic that prevail in the Hotspot, it is **essential to update the Ecosystem Profile**. In addition, the update needs to consider the CEPF's Green Climate Fund (GCF) program, entitled Ecosystem-based Adaptation in the Indian Ocean which is focused on reducing the vulnerability of island populations by securing the critical ecosystem services they need to be resilient to climate change.

The updated Ecosystem Profile and the CEPF investment strategy will consequently inform the investment priorities under the GCF program; emphasizing the Ecosystem-based Adaptation (EbA) actions that will enhance the climate resilience of local communities and focusing on areas where CEPF investment in civil society can make the biggest contribution to current investments in biodiversity conservation. CEPF intends to achieve this goal by harnessing the capabilities of Civil Society and Organisations to implement ecosystem-based adaptation (EbA) activities in the Hotspot with the Union of the Comoros, Republic of Madagascar, Republic of Mauritius, and Republic of the Seychelles as the target countries

In this context, the Ecosystem profile will be used to identify and prioritize ecosystem-based adaptation (EbA) actions by civil society organizations in the four target countries. To this end, CI Madagascar is mandated by CEPF to carry out this update with local partners acting in consortium.

This Ecosystem Profile Update was designed out through three workpackages as described below:

- Workpackage 1: Identification of Important Ecosystem services and areas for EbAs
- Workpackage 2: Stakeholders consultations to set priorities for CEPF in EbAs
- Workpackage 3: Draft an update Ecosystem Profile

The current report is a draft deliverable of Work package 1 for the country of Madagascar.

2 METHODOLOGICAL APPROACH

The methodological approach integrates a literature review on Biodiversity and Ecosystem Services thematic to complement the available datasets, a stakeholder consultation through visits and experts' meetings and a desktop analysis which is a GIS analyses using existing global and national data sets for mapping of Ecosystem services: KBA tables and maps are developed in this way.

Since the aim of the WP1 is to develop the Ecosystem-based Adaptation (EbA) activities in the Hotspot, a list of 5-10 essential Ecosystem Services (ES) is developed, then they are overlaid with KBAs. The identified Ecosystem services will be **prioritized** according to the importance of their contribution to the resilience of human populations to climate change using a multi-criteria analysis approach. The results of this analysis are presented as a set of **maps.**

The KBA+ method for identifying Ecosystem services important to KBAs described by Neurgaten et *al* in 2016 is adopted. However, the analysis requires an update of ES in terms of datasets to be used and in terms of relevance to the identification of EbA areas in the funding program without redoing the entire identification process.

This method has been validated by CEPF through orientation meetings held in September-October 2021.

As a reminder, the KBA+ methodology includes seven steps:

1) Scoping of key Ecosystem Service values in and around the KBAs,
2) Develop a narrative description of service values,
3) Identify criteria for evaluating important areas,
4) Apply criteria to identify and map important areas in and around KBAs,
5) Summarize the Ecosystem service values for the KBAs,
6) Evaluate and refine the results,
7) Formulate recommendations and incorporate them into the CEPF profile.

A summary of the profile update process is given in the figure 1 below.

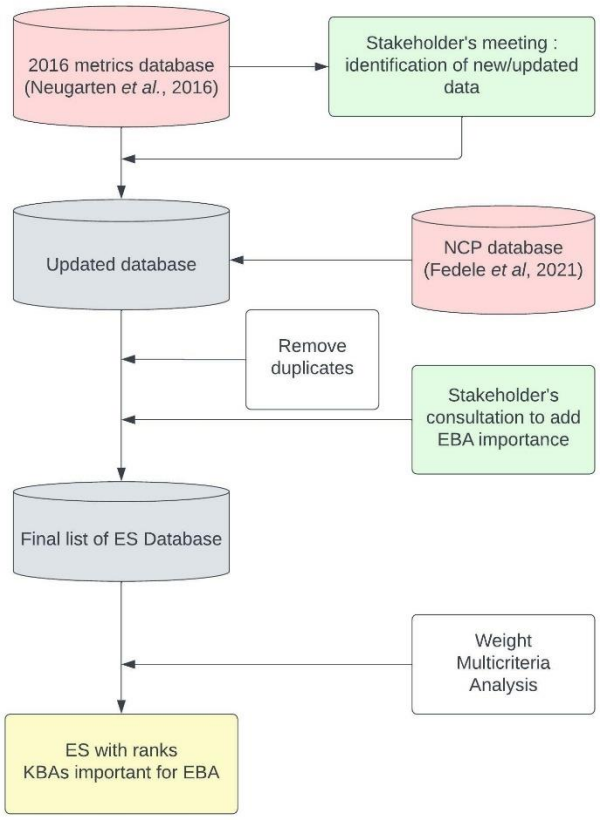

Figure 1 : Process flow of the approach to WP1

The process focused on taking the list of existing KBAs prior to the preparation of the report and updating the variables (Ecosystem Services) already in use. The updating of these data has consisted of collecting data from partners and stakeholders, as well as obtaining the different variables and the final list of KBAs.

3 SCOPING OF ECOSYSTEM SERVICES IN CONSIDERATION

According to the Millennium Ecosystem Assessment definition (MEA, 2003), Ecosystem Services are the benefits that people receive from ecosystems. These include supply services such as food and water; regulating services like flood and disease control; cultural services including spiritual,

recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the life conditions on Earth.

The Ecosystem Services classification has been revised to version 5.1 (Haines-Young and Potschin, 2018). Following the Common International Classification of Ecosystem Services (CICES), Ecosystem services can be grouped into three sections: provisioning services, regulating, and maintaining services, and cultural (and worship) services. The fourth service defined by the MEA has been included in the regulation and maintenance services.

- Provisioning services concern all the benefits that humans could obtain from nature. In addition to food, we could mention clean water, timber, firewood, natural gases, oils, plants transformed into clothing and other materials, and medical uses as provision benefits.

- Regulation and maintenance services are the benefits generated by processes that moderate or mitigate natural processes. Some examples of regulating benefits are: pollination, erosion and flood control, water purification, carbon sequestration and climate regulation. For this classification version, support services are included in this section. Supporting services are the underlying processes that make the ecosystem function, such as photosynthesis, nutrient cycling, soil formation and the water cycle.

- Cultural (and worship) services are non-material services that contribute to cultural development and thus include the development of ideas, music, creativity, but also recreation.

This last classification provides the framework for the analyses for the actual update of the Ecosystem Profil

4 KBAS INCLUDED IN THE UPDATE

The CEPF scope of work specifies that if time and resources permit, new KBAs identified after the 2014 profiling exercise could be added, based upon data in the World Database of KBAs, but no identification of new KBAs or revisions of boundaries should be undertaken as part of the profile update. Therefore, the only sites that were added to the analysis were the newly identified 23 sites by IUCN. In the end, there are 235 KBAs total of which the 212 original KBAs.

4.1. KBAS IDENTIFIED DURING 2014 EXERCISE

These are the 212 KBAs identified during the 2014 analysis (MDG1—MDG 212) reported without any modification (Figure 2).

4.2. NEW KBAS IDENTIFIED AFTER 2014 : FRESHWATER KBAS

Methods for identifying KBAs used to vary from institution/organisation to another. This result in disparity of conditions and quality of identified KBAs, making difficult the assessment of the objectivity, transparency and rigour in the identification. Fortunately, IUCN developed a standard for identification of KBAs (IUCN, 2016).

The first application of this standard in Madagascar was carried out on Freshwater Ecosystems in Madagascar in 2018 under the guidance of the IUCN Freshwater Department with local and

international expert partners. The exercise resulted in the identification of 23 new freshwater KBAs important for river, lake and wetlands systems (Figure 3). Most of them are found within the North-western freshwater ecoregion, and the Eastern highlands of Madagascar.

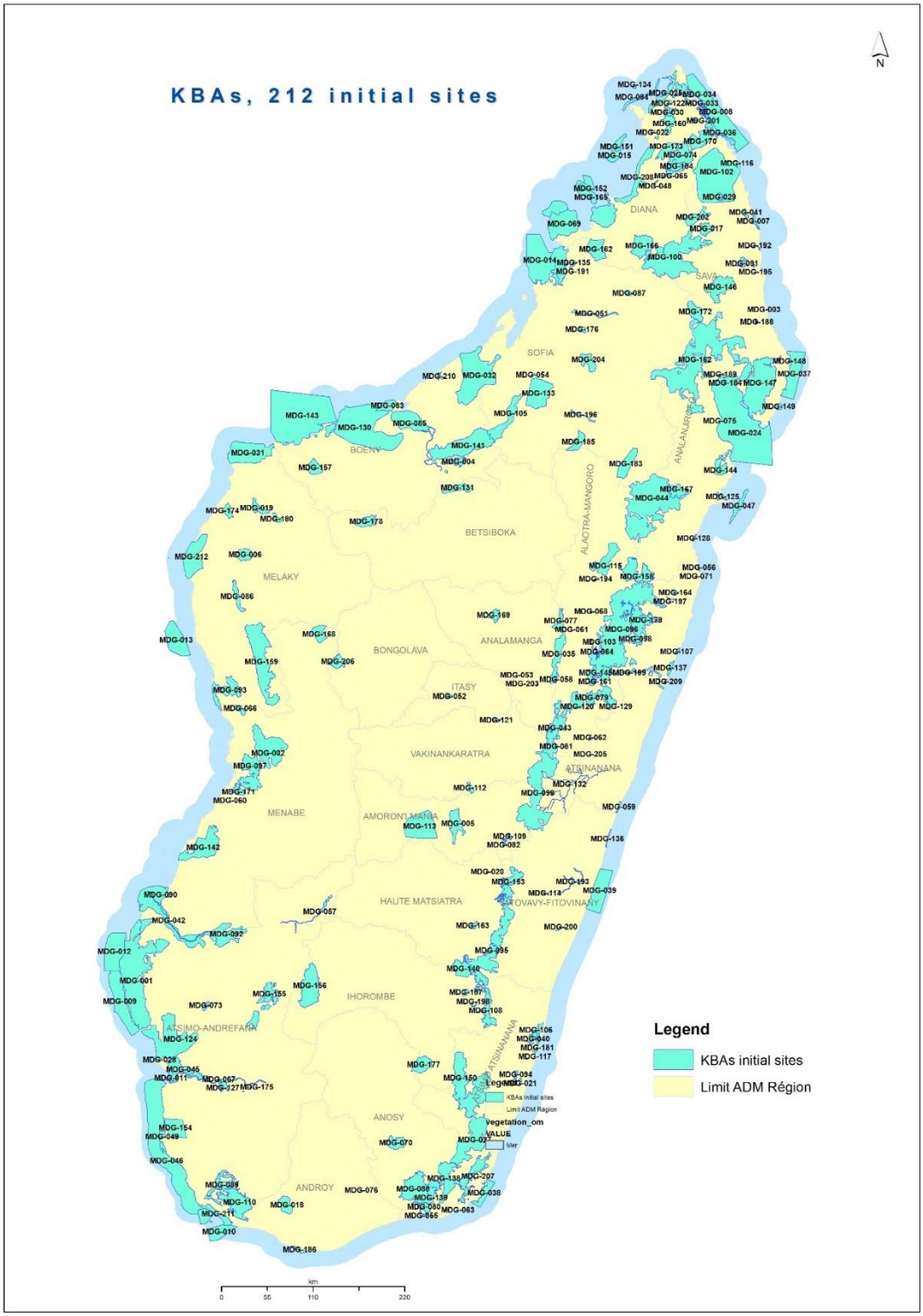

Figure 2: The 212 KBAs used during the 2014 analysis

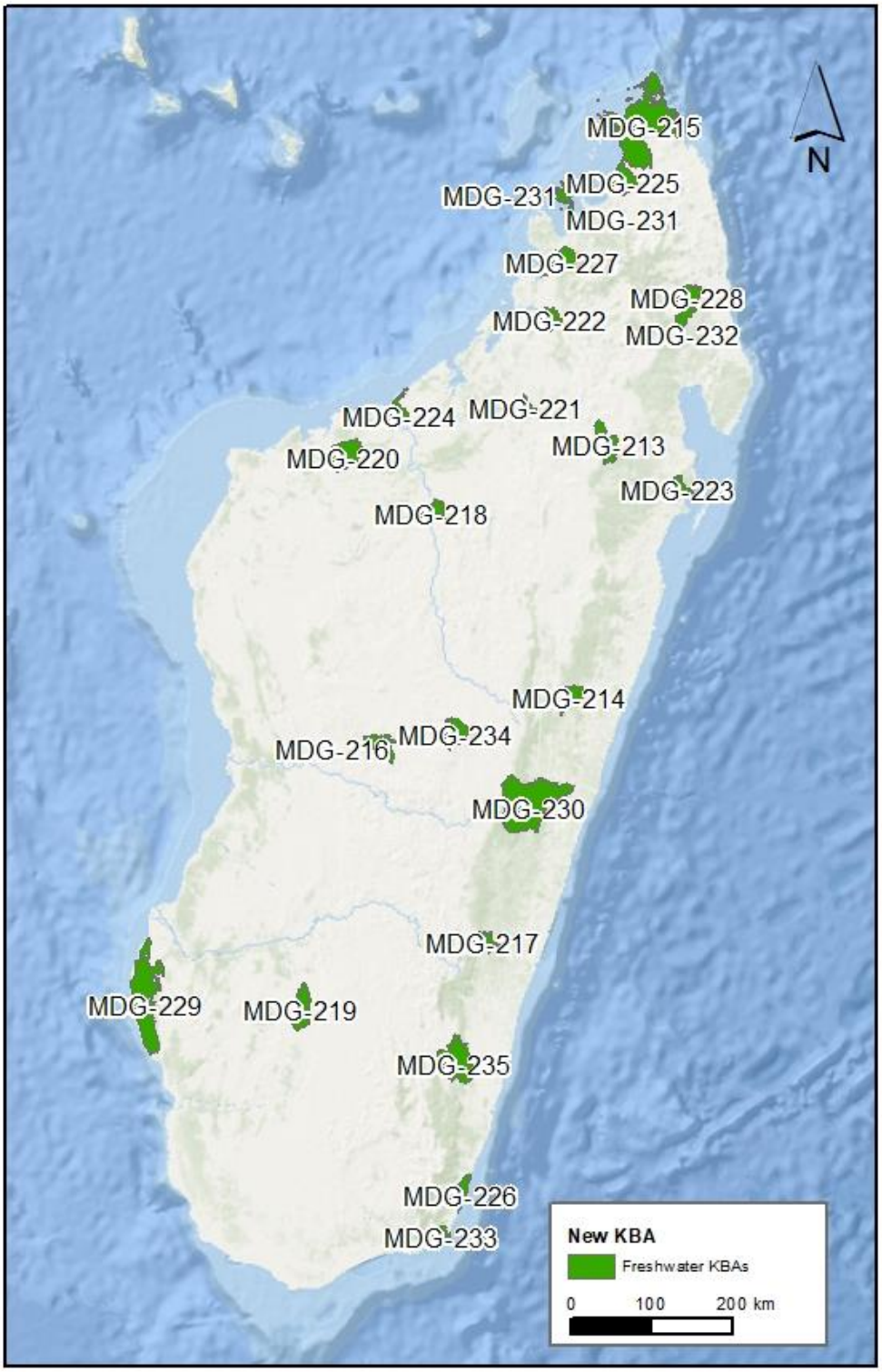

Figure 3: The 23 new freshwater KBAs identified in 2018

An overlay analysis of these new KBAs with the 212 existing KBAs clarified their spatial and legal relationship (Figure 4).

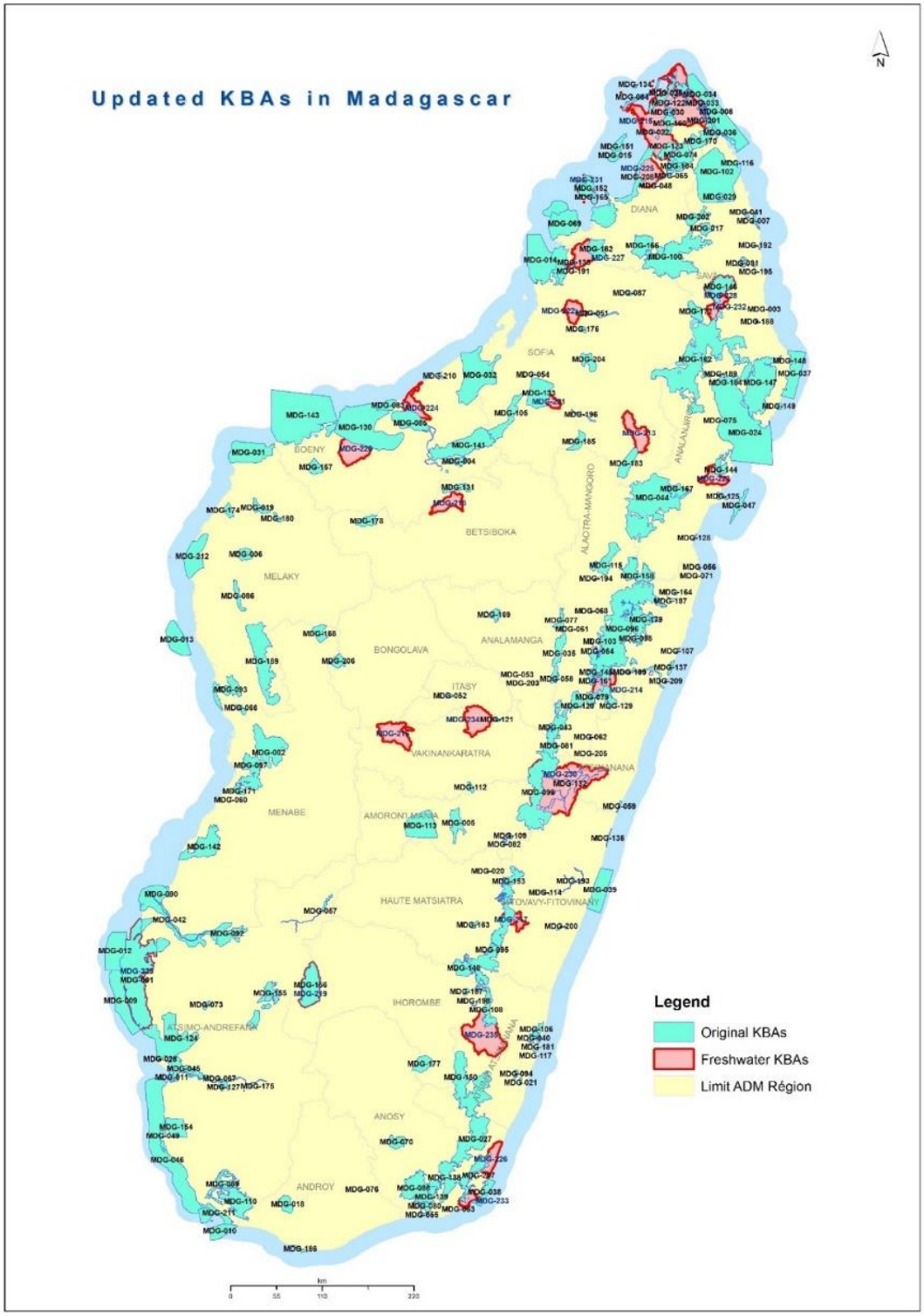

Figure 4. Overview of the overlap between the existing and newly identified KBAs

a. Only three freshwater KBAs (3) do not touch or overlap with the existing ones, these are: Mahajilo river, Ikopa lakes and Upper Kitsamby River.

To these three KBAs could be added some whose delimitation could be imprecise and that we could perhaps qualify them as new:

- Mahavavy Delta,
- Southern upper Lokoho River,
- Amboaboa Catchment,
- Lower Anove,
- Mahajanga Coastal zone.

b. In the opposite direction, 53 old KBAs intersect with the new delineated KBAs. This is because a new KBA could encompass several old KBAs within its boundary.

4.3 KBAs- AZE (Alliance Zero Extinction)

Initiated in 2005 by conservation organizations, AZE is an initiative at the global level now totalling more than 98 members and aimed at identifying and protecting sites that are the only ones where **some endangered species can be found**. The conservation of these irreplaceable sites requires the adoption of policies whose objectives are to integrate the conservation of AZE sites into national conservation strategies aligned with the objectives of the CBD, as well as the policies of the international financial institutions. In 2010, at the global level, 587 sites had been identified in relation to 920 species considered, including 21 sites for 28 species in Madagascar.

Madagascar currently has 55 confirmed AZE sites (map below) and 13 candidate sites (where AZE site status has been proposed through the project consultations, typically in relation to taxa not comprehensively evaluated). All these sites are already recognised as being of conservation interest, and most have had management responsibility clarified, in many cases by delegation of management from the Government to other organisations, typically NGOs. Table 1 shows that among these already confirmed AZE sites, two sites have partial protection (only a part included in protected areas) and seven (7) do not even have a manager. These sites are threatened by logging, mining, oil, and national development projects.

Table 1: AZE management status in Madagascar

Sites	Site Name	With Managers	Without Managers
Candidate	13	6	7
Confirmed	55	48	7
Total	68	54	14

Table 2 shows the number of sites with on-site conservation actions.

Table 2: AZE conservation status in Madagascar.

Sites	Site Name	With Conservation action	Without Conservation action
Candidate	13	6	7
Confirmed	55	48	7
Total	68	54	14

Of the candidate sites, six already have protection status and conservation actions are underway. On the other hand, it is of concern that 14 sites (so-called 'Orphan sites'), including seven confirmed AZE sites, have no agreed managing authority and no conservation action is being carried out; in addition, parts of some key sites are unprotected.

In 2018, conservation actions were initiated and developed at the demonstration sites, the one in Madagascar being Tsitongambarika forest.

During the actual Update of the Ecosystem Profile for Madagascar, AZE sites have been analysed separately from other KBAs. According to available data 57 KBA-AZE will be analysed; 10 among them are identified as freshwater KBAs in 2018.

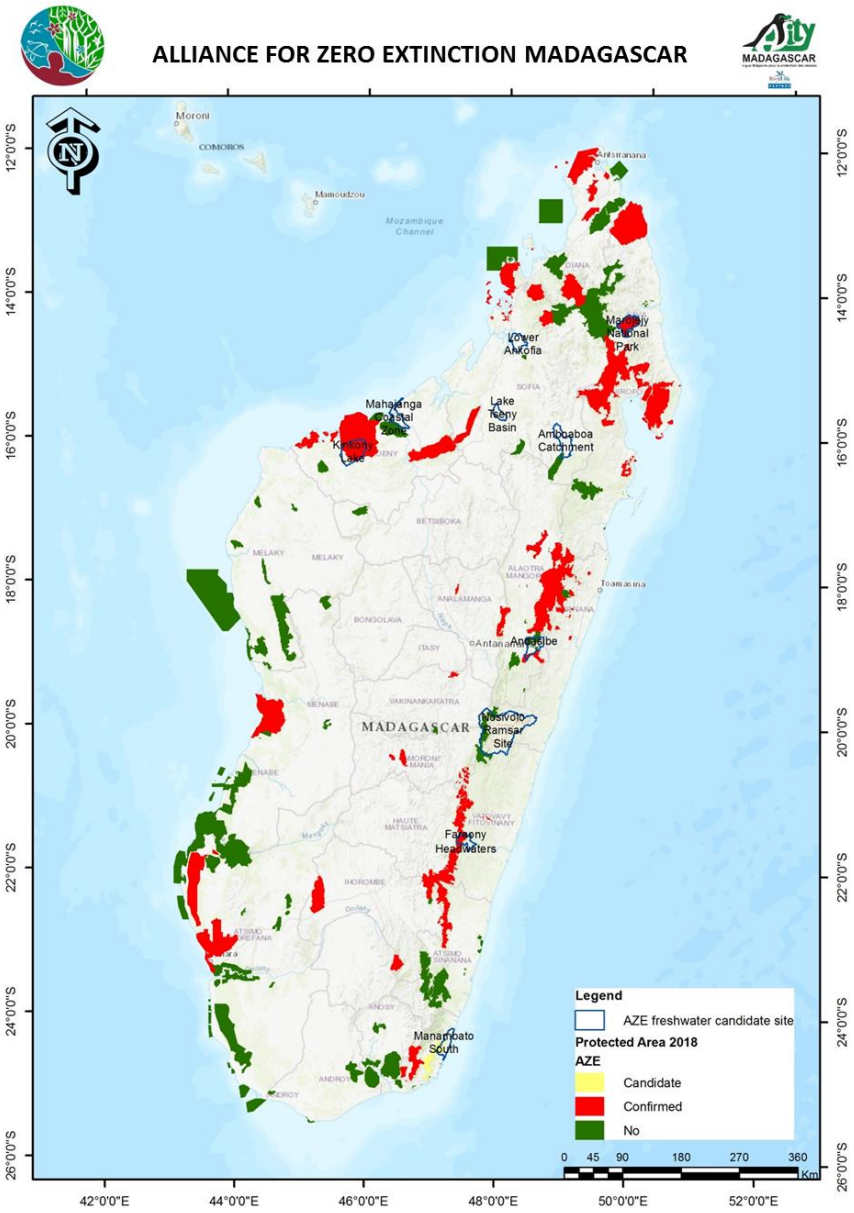

Figure 5. Alliance for Zero Extinction (AZE) sites in Madagascar

4.4. FINAL LIST OF KBAS FOR MADAGASCAR

Consortium internal discussion decided not to consider the overlaps between old KBAs and the newly freshwater KBAs and treat the old KBAs separately from the delineated wetland KBAs. The Ecosystem services of the aquatic KBAs may be different from those of the legacy KBAs. This is another reason for treating them separately.

Finally, the update of the Ecosystem Profile of Madagascar considers 235 KBA (**Figure 6)** (**Annexe 1**)

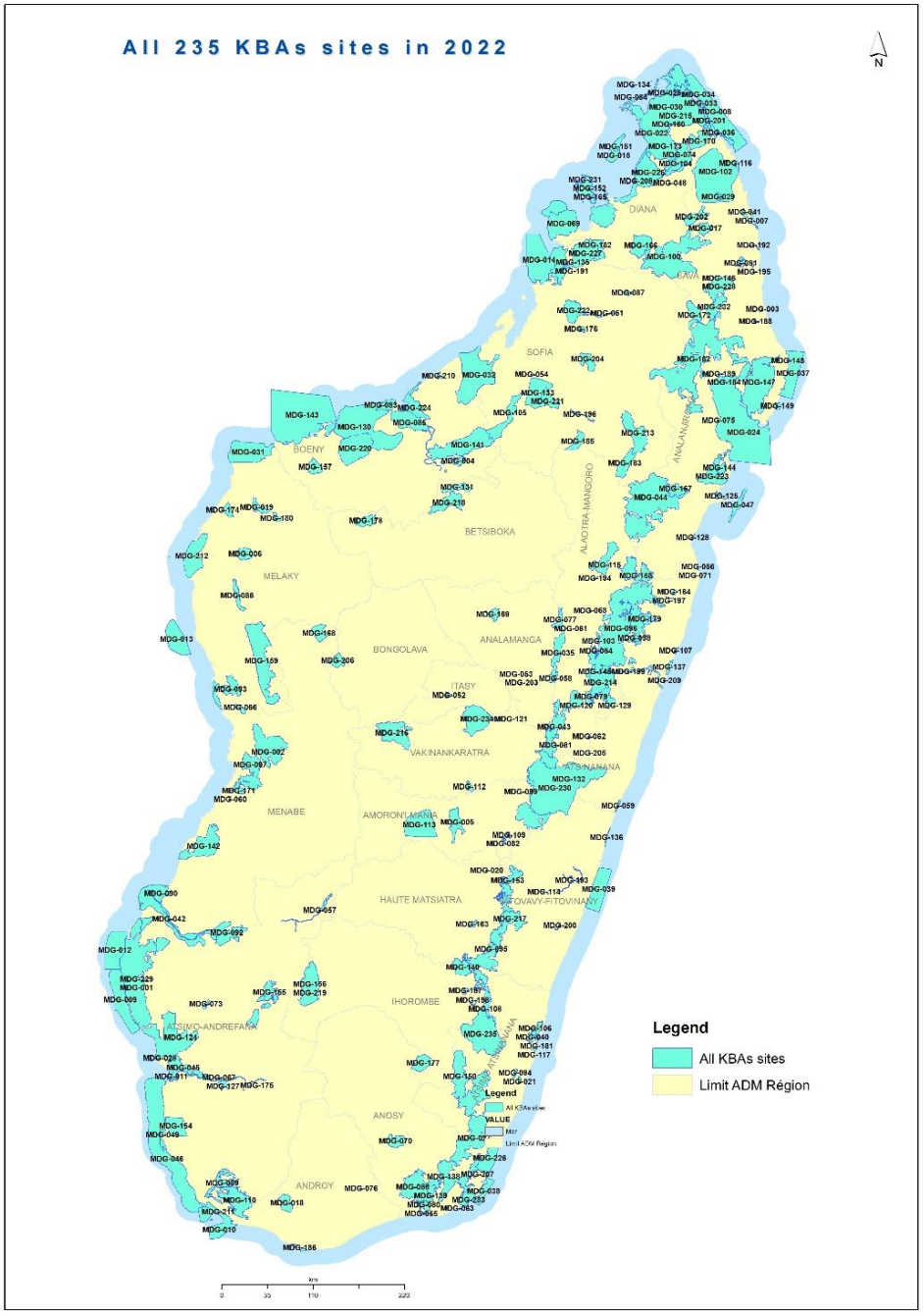

Figure 6. All KBA sites combined

5 ECOSYSTEM SERVICES (ES) IDENTIFICATION

5.1 ORIGINAL LIST OF ECOSYSTEM SERVICES

The starting point for this analysis is the list of 24 ecosystem services used during the KBA+ pilot study for Madagascar (Neugarten *et al.,* 2014; Table 3). This list follows the structure of the Common International Classification of Ecosystem Services, or CICES (https://cices.eu/). Spatial data were available for many ES and each ES could be split into several layers. For example, the carbon stock layer was separated into: (1) area with carbon stock greater than 42TCO$_2$e/ha, (2) area with carbon stock less than 42TCO$_2$e/ha, and (3) both areas combined.

Table 3: List of ecosystem services used in the pilot KBA+ analysis (Neugarten et al. *2014)*

Station	Division	Ecosystem Service
Provisioning	Nutrition	Fish
		Bushmeat
		Edible plant
		Medicinal plants
		Water flows for domestic use
		Water flows for irrigation
	Materials	Construction materials (wood, thatch)
		Materials for artisanal products (wood, sedges)
		Water flows for mining
	Energy	Fuelwood
		Charcoal
		Water flows for hydropower
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Water quality for household use
		Water quality for irrigation
		Water quality for hydropower
	Mediation of flows	Flood regulation
		Drought regulation
	Maintenance of physical, chemical, biological conditions	Carbon storage and sequestration
		Protection from cyclones
		Genetic material
Cultural	Physical and intellectual interactions with ecosystems and land-/seascapes	Ecotourism
		Existence value (biodiversity)
	Spiritual, symbolic and other interactions with ecosystems and land-/seascapes	Cultural and spiritual identity

5.2. UPDATE OF THE ECOSYSTEM SERVICES LIST

Datasets on most of the ecosystem services used in the pilot KBA+ analysis were updated during subsequent analyses conducted by CI, including the implementation of Natural Capital measurement tools (MacKinnon *et al.*, 2015) and an analysis of ecosystem services in priority biodiversity areas (Neugarten *et al.*, 2016). Other more relevant datasets also became available in the period since the

pilot KBA+ analysis was undertaken. These include datasets compiled by Fedele *et al.* (2021) for a global analysis to map human direct use of nature to meet basic needs across the tropics, which used datasets on 15 ecosystem services (Table 4).

Table 4: Global datasets on ecosystem services used in the 2021 analysis of Nature's Contributions to Humans (NCP) (Fedele et al.*, 2021).*

No.	Dataset	Notes
1	Coastal protection	Coastal protection (the version we developed for Metrics is probably better)
2	Flood protection	Flood mitigation
3	Flood protection 50 km	Flood mitigation, with the effect 50 km downstream counted
4	Fisheries	Freshwater fish - riverine fish catch
5	Fuelwood	Fuelwood
6	Grazing	Grazing
7	Nitrogen retention	Nitrogen 50km - this is the ability of natural habitats to retain nitrogen from, for example, fertilizer (an indicator of water quality provided by ecosystems)
8	Nitrogen retention 500 km downstream	Nitrogen_500km - this is another version, using a different distance to "attenuate" the service downstream, does the service travel 500 km instead of 50 km above
9	Pollination	Pollination
10	Reef tourism	Reef tourism - this is an estimate of the dollar value provided by coral reefs for tourism
11	Sediment retention (50 km)	Sediment 50 km - this is the ability of natural habitats to retain sediment (erosion control, also an indicator of water quality provided by ecosystems)
12	Sediment retention (500 km)	Sediment 500 km - another version of the above map, using a 500 km distance instead of a 50 km distance
13	Timber for commercial use	Timber extraction for commercial use
14	Timber for domestic use	Timber extraction for domestical use
15	Irrecoverable carbon	Irrecoverable carbon, as defined by Goldstein *et al.* (2020)

After considering the available national and global datasets on ecosystem services, and taking into account suggestions made by Rachel Neugarten, the lead scientist on the pilot KBA+ analysis, the expert team developed a draft list of priority ecosystem services in Madagascar. For an ecosystem service to be prioritized, two criteria had to be met. First, there needed to be available data for the whole of Madagascar at sufficient resolution to enable analysis of the relative importance of individual KBAs for that service. Second, the ecosystem service had to contribute directly to the

resilience of local human populations to climate change. The draft list was then shared during the stakeholders consultations in March 2022 and validated. In this way, the list of 24 ecosystem services from the pilot KBA+ exercise in 2014 (Table 3) was comprehensively revised and prioritized, resulting in a final list of 14 priority ecosystem services (Table 5). They are presented according to the updated classification of Ecosystem Services by CICES v. 5.1.

Table 5: Lists of Ecosystem Services used for the 2022 KBA+ analysis

Division	Section	Group	Class	ES / parameter for evaluation of ES
Provisioning	Biomass	Cultivated terrestrial plants for nutrition, materials or energy	Cultivated terrestrial plants for grown for nutritional purposes	Agriculture (all commodities combined)
		Wild animals and plants for nutrition, materials, or energy	Wild animals (terrestrial and aquatic) used for nutritional purposes	Fisheries
			Wild plants (terrestrial and aquatic, including fungi, algae) used as a source of energy	Fuelwood
			Fibers and other materials from wild plants for direct use or processing (excluding genetic materials)	Grazing
				Timber for commercial use
				Timber for domestic use
	Water	Surface water used for nutrition, materials or energy	Surface water used as a material	Freshwater for irrigation
			Surface water used for nutrition	Freshwater for domestic use
Regulation and maintenance	Regulation of physical, biological condition	Mediation of flows	Control of erosion rates	Sediment retention
			Hydrological cycle and water flow regulation (Including flood control, and coastal protection)	Flood protection
			Protection from extreme weather events	Coastal protection
		Lifecycle maintenance, habitat and gene pool protection	Pollination (or 'gamete' dispersal in a marine context)	Pollination
		Maintenance of physical, chemical, abiotic conditions	Maintenance and regulation by inorganic natural chemical and physical processes	Nitrogen retention
Cultural	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and intellectual interactions with natural environment	Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	Reef and coastal ecotourism

5.3 ECOSYSTEM SERVICES CONSIDERED IMPORTANT FROM LITERATURE REVIEW AND EXPERTS CONSULTATION

5.3.1. CONCEPT FOR DEFINING PRIORITY ECOSYSTEM SERVICES

As a reminder, the objective of the new CEPF funding program is to "reduce the vulnerability of island populations by ensuring the essential ecosystem services they need to be resilient to climate change". In this context, the KBA+ analysis will be used to identify and prioritize sites where CEPF will support ecosystem-based adaptation *(EbA)* actions.

- The prioritization process integrates a reflection on each ES in terms of:
  - Resilience appropriation: indeed, the vulnerability of the ecosystems that are sources of the ecosystem services considered must also be assessed.
  - Eligibility for ecosystem-based adaptation actions.

- This reflection went beyond "mechanical ratings" as the opinions of experts and different categories of stakeholders coupled with the results of relevant literature reviews were considered.
  - The multifunctional approach would be the ideal
  - The interdependence between the different ES should drive the reflection: the balance between the three divisions of ecosystem services should be carefully assessed: if priorities are given to the Provisioning function, there could be an implicit consequence on the Regulation and Maintenance function, for instance.
  - The definition of priority ES should consider some underlying issues such as urbanization at the detriment of the natural ecosystem, and migration, which could be considered as maladaptation if it becomes a threat to the resilience of ecosystem services.

5.3.2. EXPERT CONSULTATION

- Expert advice in the person of Rachel Neugarten, who was involved in the pilot ES assessment exercise in 2014, was sought. She recommended prioritizing the following 10 ES:
  - ✓ Carbon : total, vulnerable and irreplaceable carbon
  - ✓ Sediment retention
  - ✓ Freshwater for domestic use (based on freshwater index for natural ecosystems)
  - ✓ Pollination services to crops
  - ✓ Grazing (based on a global model)
  - ✓ Fuelwood (charcoal and firewood)
  - ✓ Coastal protection
  - ✓ Timber production for commercial use
  - ✓ Fisheries
  - ✓ Nitrogen retention: habitat preventing nitrogen into the stream.

- All of these recommendations were taken into account apart from the first, because carbon storage does not directly contribute to resilience to climate change.
- Maps of these ES in relation to the KBAs were submitted to the stakeholders for their review and validation, to ascertain their confidence in these datasets. This ensured that all datasets

used for the multi-criteria analysis were reliable. The concept of Multiple Benefits could also be applied in this prioritization process.

- In addition, the consultation with stakeholders resulted in five additional ES being recommended by experts who have worked on climate change thematic on both mitigation and adaptation mechanisms in Madagascar. These experts were identified through bibliography and past work in Madagascar and were interviewed face-to-face or online or during one of the stakeholder consultation workshops:
  - ✓ Agriculture,
  - ✓ Flood protection,
  - ✓ Freshwater for irrigation,
  - ✓ Timber production for domestic use,
  - ✓ Reef and coastal ecotourism.

5.3.3. LESSONS FROM THE LITERATURE REVIEWS AND CLIMATE CHANGE POLICY DOCUMENTS

REPORT ON BIODIVERSITY AND ECOSYSTEM SERVICES FOR AFRICA (SOURCE: IPBES, 2018)

The assessment concludes that Africa's biodiversity and nature's contributions are economically, socially, and culturally important, essential to providing the continent with food, water, energy, health and secure livelihoods, and represent a strategic asset for sustainable development and the achievement of the Sustainable Development Goals.

The report states that Africa, including Madagascar, has the potential to manage its biodiversity in a way that contributes to international efforts to mitigate and, more importantly, adapt to observed and projected climate change impacts, including the frequency and intensity of extreme events, through

- ✓ Improved reforestation efforts, restoration of degraded ecosystems, extension of appropriate agricultural systems, and commitment to reducing greenhouse gas emissions.
- ✓ The expansion and effective management of terrestrial and marine protected areas and the establishment of a network of corridors that link protected environments are also critical to climate change mitigation and adaptation efforts.

PLAN NATIONAL D'ADAPTATION AU CHANGEMENT CLIMATIQUE (NATIONAL PLAN FOR ADAPTATION TO CLIMATE CHANGE OR NAP)- SOURCE MEDD, 2019

The report states that over the past decade (2011-), several specific climate change adaptation initiatives have been carried out in Madagascar. Although funding is mostly multi-sectoral, the agriculture and forestry and biodiversity sectors are the largest recipients of support. The vulnerable regions of southern Madagascar are home to the greatest concentration of adaptation actions, receiving 20 to 25% of the initiatives identified that directly or indirectly address climate change adaptation.

One of the strategic axes of the NAP is to finance adaptation to climate change through the implementation of a priority sectoral action program, the following of which may focus on ecosystem services. The priority sectors are Agriculture-Livestock-Fisheries, Water Resources, Public Health, Biodiversity and Forestry, and Coastal Zones, For the Biodiversity and Forestry sector, Table 6 gives the responses of various ecosystems to climate hazards in Madagascar.

Table 6: Responses of various ecosystems to climate hazards. Adapted from Madagascar's NAP

Climatic Hazards	Risks
Temperature increase	Degradation of biodiversity and ecosystems
Decrease in precipitation	
Tropical Cyclones	Degradation of coral reefs and underwater coastal ecosystems Degradation of terrestrial ecosystems Increased coastal flooding affecting coastal ecosystems
Sea level rise	Marine intrusion and salination of surface and groundwater in coastal areas and destruction of salt-intolerant coastal habitats

Natural river systems, wetlands, and upstream forest ecosystems reduce flood risk by storing water and slowing water flow. Coastal wetlands protect against coastal erosion and flooding associated with storms and sea level rise

Figure 7. Importance of risks caused by climate change on the "Biodiversity and Forestry" sector by region, adapted from Madagascar's NAP (note: Region in white: lack of data)

CHALLENGE: Rapid biodiversity loss is the main threat to resources (goods and services provided by biodiversity) that are crucial to national adaptive capacities.

SOLUTIONS: Madagascar is rich in natural potentialities that are not yet fully exploited to build resilience to climate change; the ecosystem-based adaptation approach, which can help to better exploit them, remains to be promoted. In a country with a large majority of rural inhabitants on the one hand, and recognized as a global biodiversity hotspot on the other hand, the agriculture and forestry sectors are naturally at the forefront of adaptation initiatives in Madagascar

Thus, the Ministry in charge of the Environment coordinates PRIORITY ACTIONS for the adaptation of the sector which are:

- ✓ Maintain the existing forest cover and create a network of forest conservation corridors,
- ✓ Establish a large-scale restoration program for the most threatened ecosystems,
- ✓ Encourage the sustainable use of the wood resource,
- ✓ Strengthen the management of protected areas and secure land tenure in protected areas,
- Create income-generating activities that are less dependent on natural resources,
- review and strengthen the implementation of legislation and policies related to sustainability, conservation and restoration of habitats in degraded ecosystems

IMPACTS, ADAPTATION AND VULNERABILITY (SOURCE 6TH REPORT Intergovernmental Panel on Climate Change 2022)

This report recognizes the interdependence of climate, ecosystems and biodiversity, and human societies and integrates more knowledge from natural, ecological, social and economic sciences than previous IPCC assessments. The section dealing with "Adaptation measures and Enabling conditions" is highlighted in the following paragraphs, which may provide points of reflection in the Directions that Madagascar may adopt in terms of Adaptation using Biodiversity and Ecosystem services

Observation 1: On the current adaptations and their benefits

Progress in adaptation planning and implementation has been observed in all sectors (including ecosystem services). Many initiatives prioritize immediate, short-term climate risk reduction, which reduces opportunities for transformational adaptation.

Table 7: Various feasible climate responses and existing adaptation options to address key representative risks of climate change on terrestrial and ocean ecosystems. Adapted from the feasibility tables in the 6th Report of the IPCC.

		Potential feasibility	
Representative key risks	**Climate responses and adaptations options**	**Level and synergies with mitigation**	**Confidence level**
Coastal socio-ecological systems	Coastal defense and hardening	Medium	High
	Integrated Coastal Zone management	Medium	High
Terrestrial and Ocean ecosystem service	Forest-based adaptation	High	High
	Sustainable aquaculture and fisheries	Medium	Medium
	Agroforestry Biodiversity Management and Ecosystem Connectivity	Medium	Medium
Water security	Water use efficiency and water resource management	Medium	Medium
Food security	Improved cropland management Efficient livestock's systems	Medium	Medium

Various feasible climate responses and existing adaptation options to address key representative risks of climate change on terrestrial and ocean ecosystems

Observation 2: Future adaptations and their feasibility

Integrated multi-sectorial solutions that address social inequities, differentiate responses based on climate risk and cu across systems, increase feasibility and effectiveness of adaptation in multiple sectors.

Adaptation to WATER-related risks and impacts makes up the majority of all documented adaptations.

i- Improving natural water retention, for example by restoring wetlands and rivers, or managing upstream forests, can further reduce flood risk.

ii- Soil moisture conservation and irrigation are among the most common adaptation responses and provide economic, institutional, or ecological benefits and reduce vulnerability. Irrigation is effective in reducing drought risk and climate impacts in many regions and has several livelihood benefits, BUT requires appropriate management to avoid potential negative impacts, which can include accelerated depletion of groundwater and other water sources and increased soil salinization. Large-scale irrigation can also alter local to regional temperature and precipitation patterns, including both mitigating and exacerbating extreme temperatures. The effectiveness of most water-related adaptation options to reduce projected risks decreases with increasing warming.

Human food

Effective adaptation options, coupled with supportive public policies, improve food availability and stability and reduce climate risks to food systems while increasing their sustainability.

- ✓ Effective options include cultivar improvement that could utilize wild biodiversity genes, agroforestry,
- ✓ Agroecological principles and practices, ecosystem-based management of fisheries and aquaculture, and other approaches that work with natural processes support food security, nutrition, health and well-being, livelihoods and biodiversity, sustainability and ecosystem services. These services include pest control, pollination, protection from extreme temperatures, and carbon sequestration and storage.

Forests

Adaptation in natural forests includes conservation, protection, and restoration measures. In managed forests, adaptation options include:

- Sustainable forest management;
- Diversification and adjustment of tree species composition to build resilience;
- and managing increased risks from pests, diseases, and wildfire.

Restoring natural forests and improving the sustainability of managed forests generally improves the resilience of carbon stocks and sinks.

Cooperation and inclusive decision-making with local communities and indigenous peoples, as well as recognition of the inherent rights of indigenous peoples, are integral to successful forest adaptation in many areas

Conservation, protection and restoration of terrestrial, freshwater, coastal and ocean ecosystems, combined with targeted management to adapt to the inevitable impacts of climate change, reduce the vulnerability of biodiversity to climate change.

Resilience of species, biological communities, and ecosystem processes increases with the size of the natural area, through restoration of degraded areas, and through reduction of non-climatic stressors.

Adaptation options, where circumstances allow, include facilitating the movement of species to new ecologically appropriate locations, particularly by increasing connectivity between conserved or protected areas, targeted intensive management of vulnerable species, and protection of refuge areas where species can survive locally.

Observation 3: Biodiversity resilience and Ecosystem services: guaranteeing adaptation

Biodiversity and ecosystem resilience to climate change are reduced by inappropriate actions, which also limit ecosystem services. Examples of such maladaptive actions for ecosystems include fire suppression in naturally fire-adapted ecosystems or hard defences against flooding. These actions reduce space for natural processes and represent a severe form of maladaptation for the ecosystems they degrade, replace, or fragment, reducing their resilience to climate change and their ability to provide adaptive ecosystem services. Consideration of biodiversity and autonomous adaptation in long-term planning processes reduces the risk of maladaptation.

Biodiversity and ecosystem services have a limited capacity to adapt to increasing levels of global warming, which will make climate-resilient development increasingly difficult to achieve beyond 1.5°C of warming. The consequences of current and future global warming on climate-resilient development include reduced effectiveness of EbA and ecosystem-based approaches to climate change mitigation and amplification of feedbacks to the climate system.

Safeguarding biodiversity and ecosystems is fundamental to climate-resilient development, in light of the threats they face from climate change and their role in adaptation and mitigation

Recent analyses, drawing on a range of data sources, suggest that maintaining global biodiversity resilience and ecosystem services depends on the effective and equitable conservation of approximately 30% to 50% of the Earth's land, freshwater, and ocean areas, including ecosystems currently close to nature

Build biodiversity resilience and sustain ecosystem integrity to maintain benefits for people, including livelihoods, human health and well-being, and the provision of food, fiber, and water, while contributing to disaster risk reduction and climate change adaptation and mitigation

CLIMATE CHANGE RISKS AND ADAPTATION OPTIONS FOR MADAGASCAR (SOURCE: Weiskopf et al. 2021)

Some Ecosystem Services for EBA important for marine and costal ecosystems are transcript here. Also, key adaptation strategies for Madagascar are mentioned

Mangroves provide important ecosystem services such as protection from natural disasters, including wave attenuation during storms and provision of fuelwood and building materials. The heavy reliance on mangrove ecosystems is leading to increasing and wide-spread degradation and deforestation throughout Madagascar, with an estimated net loss of 21%

between 1990 and 2010 (Rakotondrazafy et al. 2014, Benson et al. 2017, García-Ruiz et al. 2017, Rakotondravony et al. 2018).

Coral reefs

The widespread decline in warm-water corals has led to alternative restoration approaches to enhance climate resilience, such as "coral reef gardening," and research on assisted evolution, colonization, and chimerism for reef restoration (IPCC 2019). Assisted evolution uses gene manipulation to enhance resilience to climate change and other human impacts, whereas assisted colonization involves moving species outside their historical ranges to mitigate loss of biodiversity or in anticipation of climate-induced habitat changes. Coral chimerism occurs when a coral has cells that originate from at least two sexually born individuals of the same species and is a natural tissue transplantation or fusion (Rinkevich 2019).

Key strategies for adaptation

Activities described in the coastal section, such as mangrove and coastal reef restoration, are important adaptation strategies for fisheries.

Mangrove restoration may be an effective adaptation strategy. Recently, C3 has moved to using tree nurseries rather than direct planting so that trees are large enough to withstand strong storms when they are planted. However, more information is needed about ideal conditions and timing for restoration activities. Identifying salt tolerant mangrove species that are more likely to survive as sea levels rise and water becomes more saline may also be an effective approach

Ecosystems that are already degraded from non-climate stressors are less resilient to a changing climate. Therefore, increasing enforcement of protected areas, maintaining the integrity of intact forests, promoting restoration of additional habitats, and addressing underlying causes of deforestation are key adaptation strategies for Madagascar (Busch et al. 2012, Morelli et al. 2020). Preventing forest loss and degradation is cheaper and more effective than restoring forests after they have been destroyed, although reforestation will likely still be needed to conserve some species (Busch et al. 2012). Protecting corridors to allow species to shift their distributions as the climate changes will be particularly important (Kremen et al. 2008, Busch et al. 2012). CI is planting native species in core protected areas but working with communities on agroforestry in the buffer areas (CI interview). However, changing behavior and species preferences in communities can be challenging and inhibit adoption (Commune Ambalavao visit), therefore more effort is needed to communicate the benefits of native species with local communities.

6 ECOSYSTEM SERVICES AND KBA RANKING

The following steps were followed to determine the rank of ecosystem services according to their importance in producing population benefits:

- Standardization of ecosystem services;
- Aggregation of ecosystem services in KBAs ;
- Aggregation of ecosystem services according to the importance assigned by experts and stakeholders (after stakeholders' consultation).

The process can be schematized as in Figure 8 below:

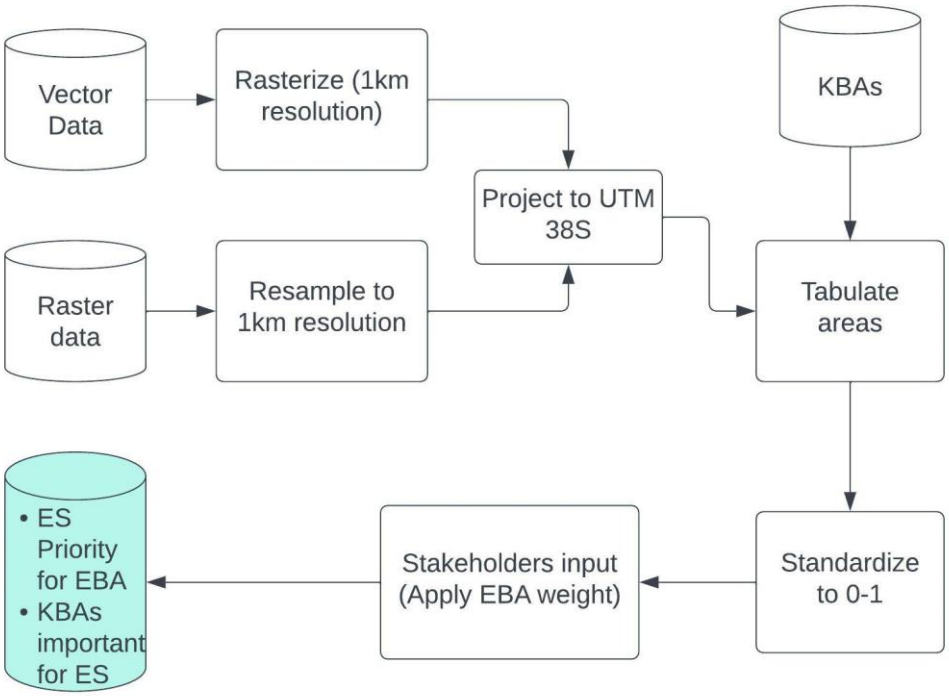

Figure 8: Process used to determine the rank of KBAs for ecosystem services

6.1 STANDARDIZATION OF ECOSYSTEM SERVICES

Different sources of data and formats are used to compile the data. Data normalization is necessary before being able to analyze them and to make meaningful comparison. Two normalizations were performed with the data:

- Normalization by percentage or relative abundance: each of the data will be reclassified to evaluate their relative importance, and thus the parameter value would be divided by the maximum value. A value between 0 and 1 will be obtained.
- Normalization by presence/absence: each ecosystem services will be reclassified in binary form: 0 if it is absent, and 1 if it is present.

For the final multi-criteria analysis, the former normalization was used.

Regarding format differences, all shapefiles are converted to raster, with a resolution of 1km, and the spatial reference system UTM zone 38 South (WGS84 UTM 38S). The existing rasters will also be resampled to have the same characteristics.

6.2 PARAMETERS AGGREGATION IN KBAS

The ecosystem services are overlaid with the KBA boundaries to infer by addition the importance of each ecosystem services, based on their importance in the KBAs. The process results in a table containing in KBAs in columns and ecosystem services in the rows. The rows total would indicate the importance of each ecosystem services and the columns total, the importance of the KBAs.

6.3 IMPORTANCE OF KBAS FOR ECOSYSTEM SERVICES

During the first aggregations, each ecosystem service was evaluated according to its presence/absence and or relative importance at each of the KBAs. While this technique indicated the relative importance of KBAs for ES, the experts consulted during the exercise devised a system of weighting, to provide balance and highlight the most important ecosystem services for climate change adaptation. The following weightings were based on the system used by Neugarten *et al.* (2014) with modifications recognizing the different list of priority ecosystem services used for this analysis. These modifications were made to the weightings during the stakeholder consultations. During the multicriteria analysis, each individual ES score for each KBA was multiplied by the weighting according to Table 8 below to obtain a weighted score. The weighted scores are then added together to obtain the final ES scores, which the ES rank is based on.

Table 8. Ecosystem services weighting used in the multi-criteria analysis

Ecosystem services	Weight
Division 1 : Provisioning services	**40**
• Agriculture (all commodities combined) • Fisheries • Fuelwood • Grazing • Timber for commercial use • Timber for domestic use • Freshwater for irrigation • Freshwater for domestic use	
Division 2 : Regulation and maintenance services	**40**
• Sediment retention • Flood protection • Coastal protection • Pollination • Nitrogen retention	
Division 3 : Cultural services	**20**
• Reef and coastal ecotourism	
TOTAL	**100**

In addition, spatial weighting of KBAs was implemented by superimposition with vulnerability of ES to climate change and adaptation capacity to climate change. The vulnerability to climate change and the adaptation potential to climate change stressors has been derived from a study realised by OMS (2008) as seen in Figure 9.

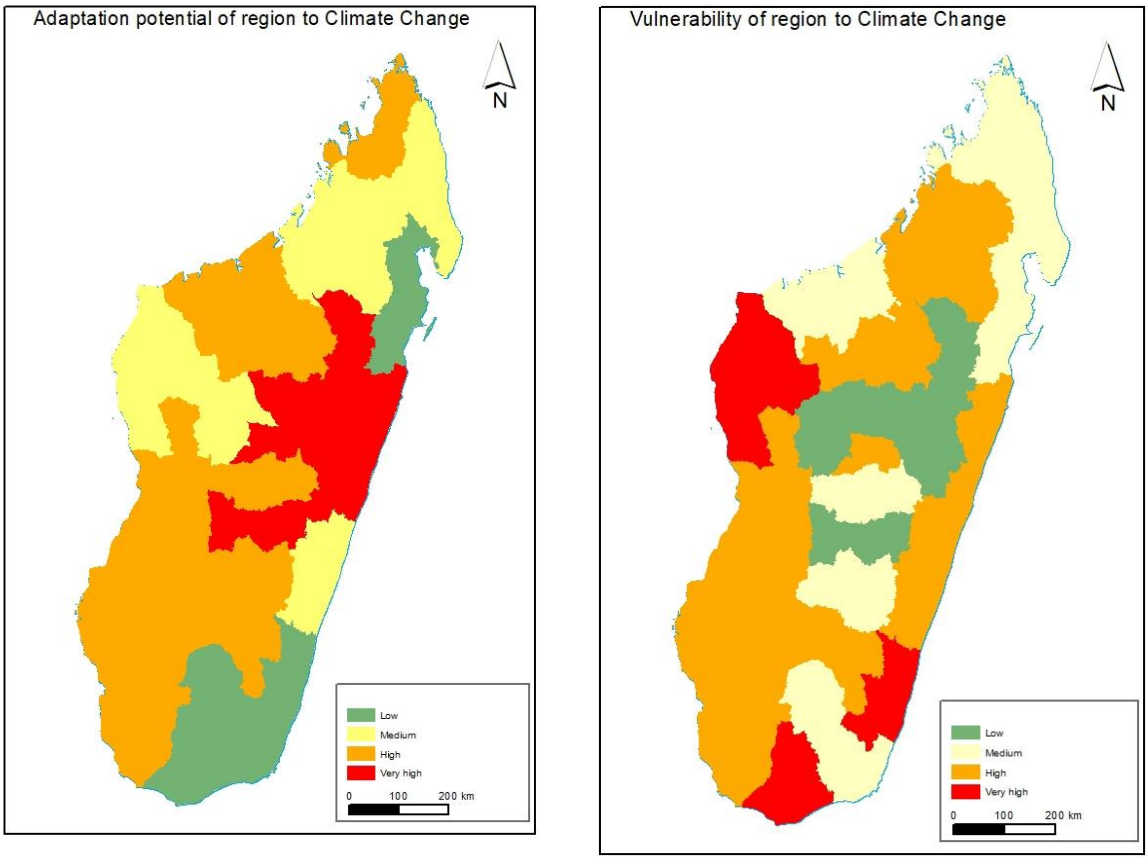

Figure 9 : Vulnerability and adaptation potential of regions to climate change. (Source: OMS 2018)

7 RESULTS

7.1. TOP 30 KBAs

The transformation of ES value into proportion coupled with the application of weighting as specified in Table 9, followed by stakeholder's appreciation, result into the identification of 30 top ranking KBAs that contributes the most to climat echange adaptation (Table 9). As the main objectives of the process is to find areas where EbA activities can be implemented, there are a few KBAs that had made it to the top of the list but were removed:

- KBAs that have no manager, project partner or any institutional infrastructure to support the implementation of EbA activities, those are
    - Rivière Mangoky
    - Lac Itasy
    - Mahatsara (Mahambo Foulpointe)
    - Rivière Ivoloina
    - Nord Pangalane
    - Zones humides Mahevatanana-Ambato-Boeni
    - Ankafina (Ambohimahasoa)
    - Rivière Mananjary
    - Station Forestière Angavokely
    - Zones humides Ambila-Lemaintso

- KBAs whose ecosystem services have been degraded beyond recovery under reasonable effort, the one that made the top of the list in this category was PK 32 Ranobe.

The map in Figure 10 gives the results of the multicriteria analysis in terms of important KBAs for climate change adaptation.

Looking generally at the Rank of each KBA, KBAs in the western coast accumulates more ES than in the East part of the Islands (always note that ES that are important for climate change adaptation were selected for the analysis). This could be explained by harsher climate in the South and West in comparison to the East.

Table 9. Top 30 KBAs with their scores based on their contribution to climate change adaptation

KBA ID#	National Name	MCA Score	Rank
MDG-199	Rivières Mangoro-Rianila	4.75	1
MDG-110	Forêt Sahafina (Anivorano-Brickaville)	4.18	2
MDG-097	Corridor Forestier Analamay-Mantadia	3.43	3
MDG-131	Zones humides Nosivolo	3.29	4
MDG-066	Amoron'i Onilahy et Rivière Onilahy	3.17	5
MDG-098	Corridor Forestier Fandriana Marolambo	3.11	6
MDG-094	Corridor Ambositra Vondrozo (COFAV)	3.11	7
MDG-179	Reserve spécial Mangerivola	2.88	8
MDG-164	Reserve Naturelle Integrale Betampona	2.80	9
MDG-095	Zahamena-Ankeniheny SAPM	2.79	10
MDG-230	Nosivolo Ramsar Site	2.61	11
MDG-027	Belalanda	2.58	12
MDG-154	Parc National Zombitse-Vohibasia	2.52	13
MDG-011	Tsinjoriake-Andatabo	2.48	14
MDG-128	Vohibe Ambalabe (Vatomandry)	2.43	15
MDG-089	Lac Complexe Delta Ihotry-Mangoky	2.42	16
MDG-072	Analavelona	2.41	17
MDG-152	Parc National Ranomafana	2.37	18
MDG-217	Faraony Headwaters	2.26	19
MDG-056	Makay	2.21	20
MDG-070	Analalava Foulpointe	2.20	21
MDG-106	Forêt classée Vohibola	2.17	22
MDG-091	Complex forestier Mangoky-Ankazoabo	2.14	23
MDG-045	Grand récif de Toliary	2.06	24
MDG-200	Rivière Namorona-Faraony	2.02	25
MDG-088	Complexe forestier Mahafaly Plateau	2.01	26
MDG-033	Complexe de trois baies	1.97	27
MDG-175	Reserve SpecialBeza-Mahafaly	1.97	28
MDG-187	Reserve spécial Pic d'Ivohibe	1.97	29
MDG-053	Lac Tseny	1.97	30

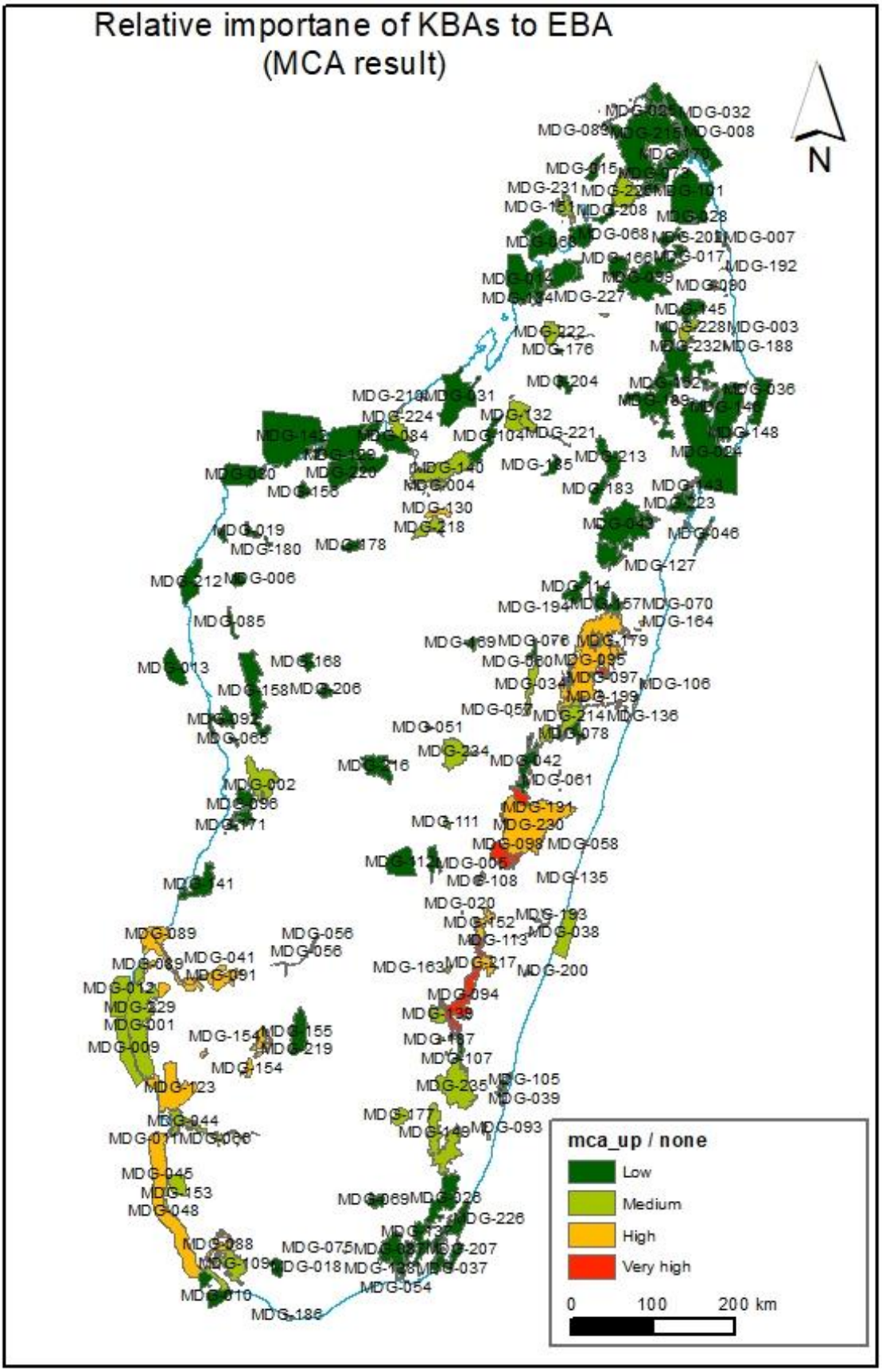

Figure 10 : Multi-criteria analysis results, showing the importance of KBAs based on ES important for climate change adaptation Low (0-1), Medium (1-2), High (2-3), Very high (3+)

The priority ecosystem services were then evaluated according to their relative importance within the KBA network by adding together the scores for each individual KBA where that ecosystem service was present. Agriculture was merged into one ecosystem service (all commodities) from each individual product (production of rice, cassava, coffee, corn, …).

Table 10. Priority ecosystem services ranked by relative importance within the KBA network

Ecosystem services	Summed MCA score	Rank
Freshwater for domestic use	83.7	1
Agriculture (all commodities combined)	62.1	2
Timber for commercial use	42.8	3
Fuelwood	37.4	4
Grazing	30.3	5
Freshwater for irrigation	22.9	6
Fisheries	18.8	7
Flood protection	18.4	8
Pollination	9.2	9
Nitrogen retention	9.1	10
Timber for domestic use	8.9	11
Reef and coastal ecotourism	8.6	12
Coastal protection	6.0	13
Sediment retention	3.5	14

7.2 . SELECTED ECOSYSTEM SERVICES

Fisheries

Fisheries constitute a huge part of the population income, up to 70% of total income for (Gough et al, 2020) for person living near the coast. Also, fish may constitute up to 80% of the protein intake (Mihari, 2022). Fisheries therefore are identified as of the most important ecosystem services rural population, and the Government as well as many conservation NGOs are promoting responsible fisheries as a response and adaptation to the effect of climate change.

Data on fisheries are very sparse for the moment, and the reported annual catch may only represent 50% of the actual value (Andriamahanoro, 2009). So far, the most accurate estimation of catch are the data from Le Manach (2012). Small scale fisheries can be observed in KBAs that have lakes and rivers such as Alaotra lake, Ikopa lakes, Maevatanana-Ambatoboeni wetlands, Bombetoka/Belemboka Bay and Marovoay wetlands (Betsiboka-Tsiribihina rivers), Lake Ihotry-Mangoky Delta complex, Saint Augustin Forest, and Upper Mananara river (Figure 11)

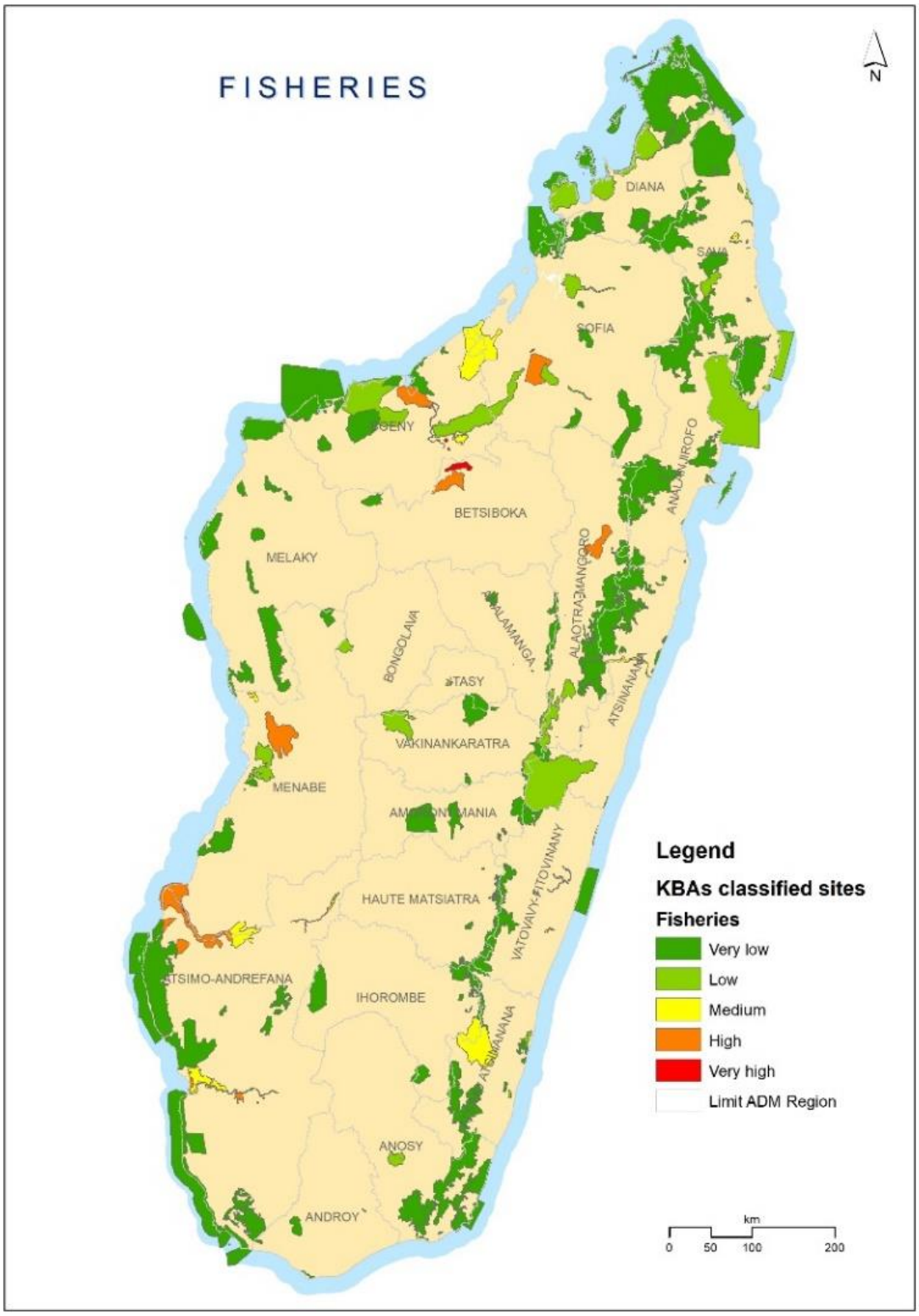

Figure 11 : Fish catch from freshwater and coastal ecosystems (source: Fedele et al. *2021)*

Agriculture

More than 80% of the Malagasy population lives off agriculture (World Bank, 2021). This makes Agriculture very important Ecosystem services for Madagascar. Moreover, Madagascar has been identified as one of the country's most vulnerable to climate change. The map in Figure 12 shows the extent of cultivated area in and around KBAs. Interestingly, the ones that have most area cultivated are those in the southwestern Madagascar where the climate is dry to arid. Then, the eastern part of Madagascar has some higher area cultivated compared to the KBAs in western Madagascar where cultivated areas are low.

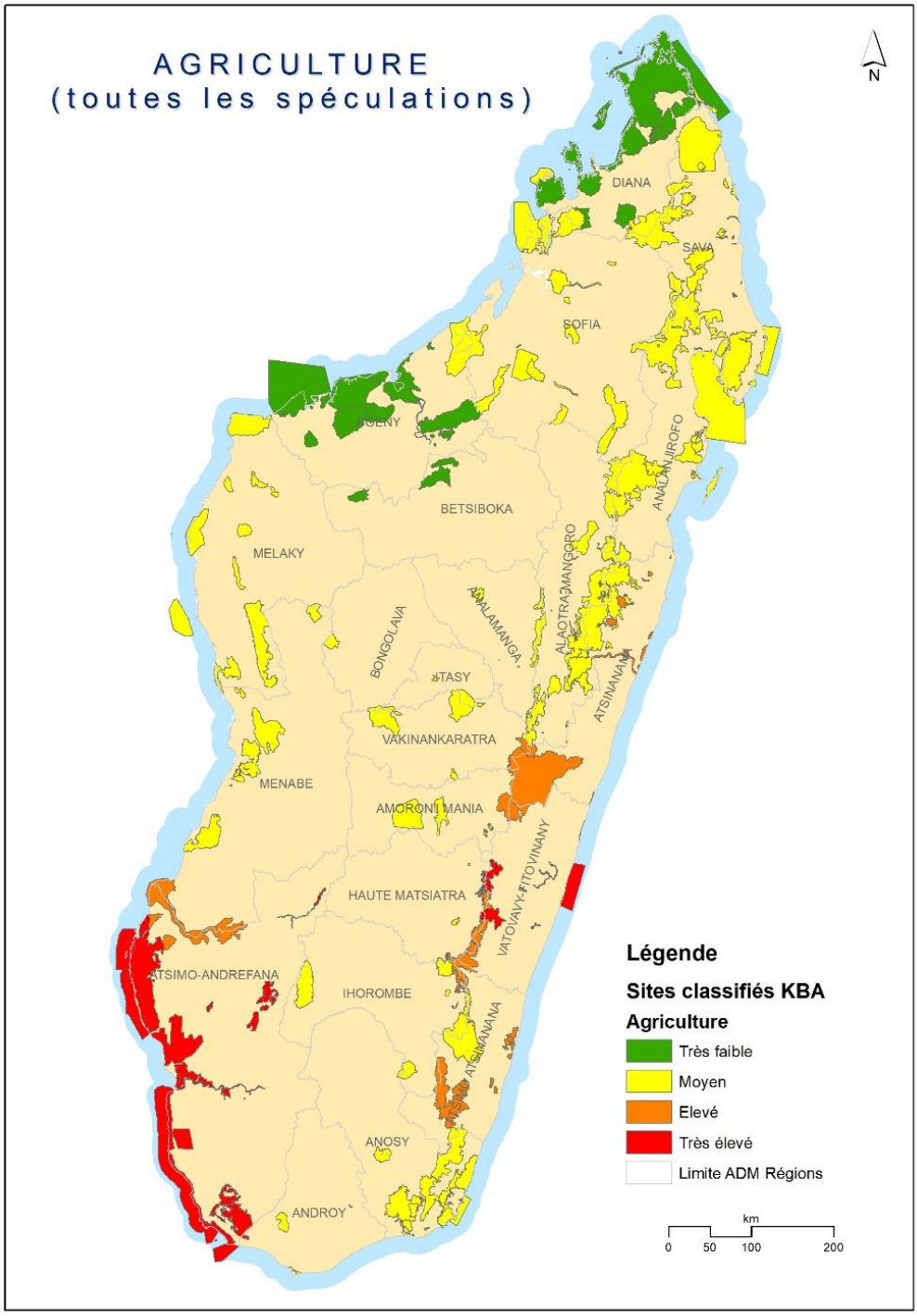

Figure 12 : Extent of cultivated area: all commodities (source: Neugarten et al. *2016)*

Fuelwood

The national need for fuelwood is estimated at around 18 million cubic meters per year (MEH, 2018) which is almost two times the production capacity of the country (9 million cubic meters). This makes the fuelwood a very important services the ecosystem provides, and very important for the adaptation to climate change. Fuelwood collection is important mostly in the eastern part of Madagascar (Figure 13). The KBAs that are mostly affected are Lokobe Integral reserve, Ankaraobolava-Agnakatriky, river Antainambalana-Andranofotsy (Antalaha), River Ankavia-Ankavanana (Antalaha), Manjakatompo-Ankaratra massif, Angavokely and Ampahona, Ankafina (Ambohimahasoa). Most of these KBAs are at the edge of a natural forest or in-between natural forest block.

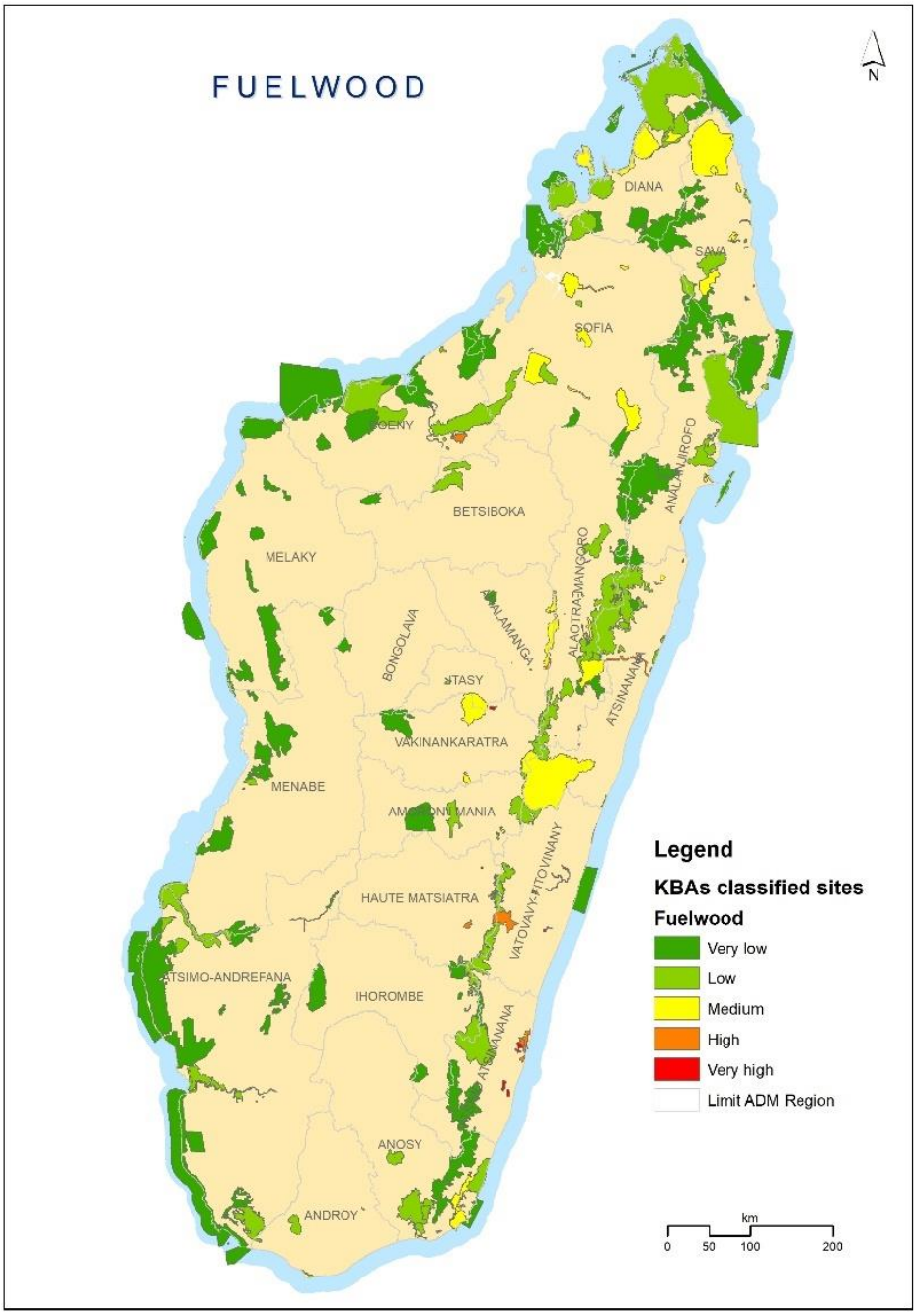

Figure 13 : Fuelwood collection (source: Fedele et al. *2021)*

Coastal protection

Reefs and Mangroves are the ecosystems that provides protection of Madagascar from the extreme weather event and climate change. Mangroves are mostly found in the western Madagascar and covering a total area of 250.000 hectares (Shapiro et al, 2018). Mangrove forest is a little fragile and its area has decreased steadily from 2000 (Shapiro et al., 2018). However, Mangrove restoration is very much encouraged by local NGO (Blueventures, WWF) and the government. For the coastal protection by mangroves, all mangroves within 2km of the coastline. KBAs having high value of coastal protection are Three Bays complex, Mahajanga Coastal Zone, Nosy Be Island Group, Nosy Varika, Nosy Be and Satellites Islands (Nosy Tanihely), Sainte Marie Island (Ambohidena), and Tolagnaro (Figure 14). The KBAs in the eastern coast mostly have higher value from reef protection, except for Ambodivahibe bay which exceptionally have mangroves.

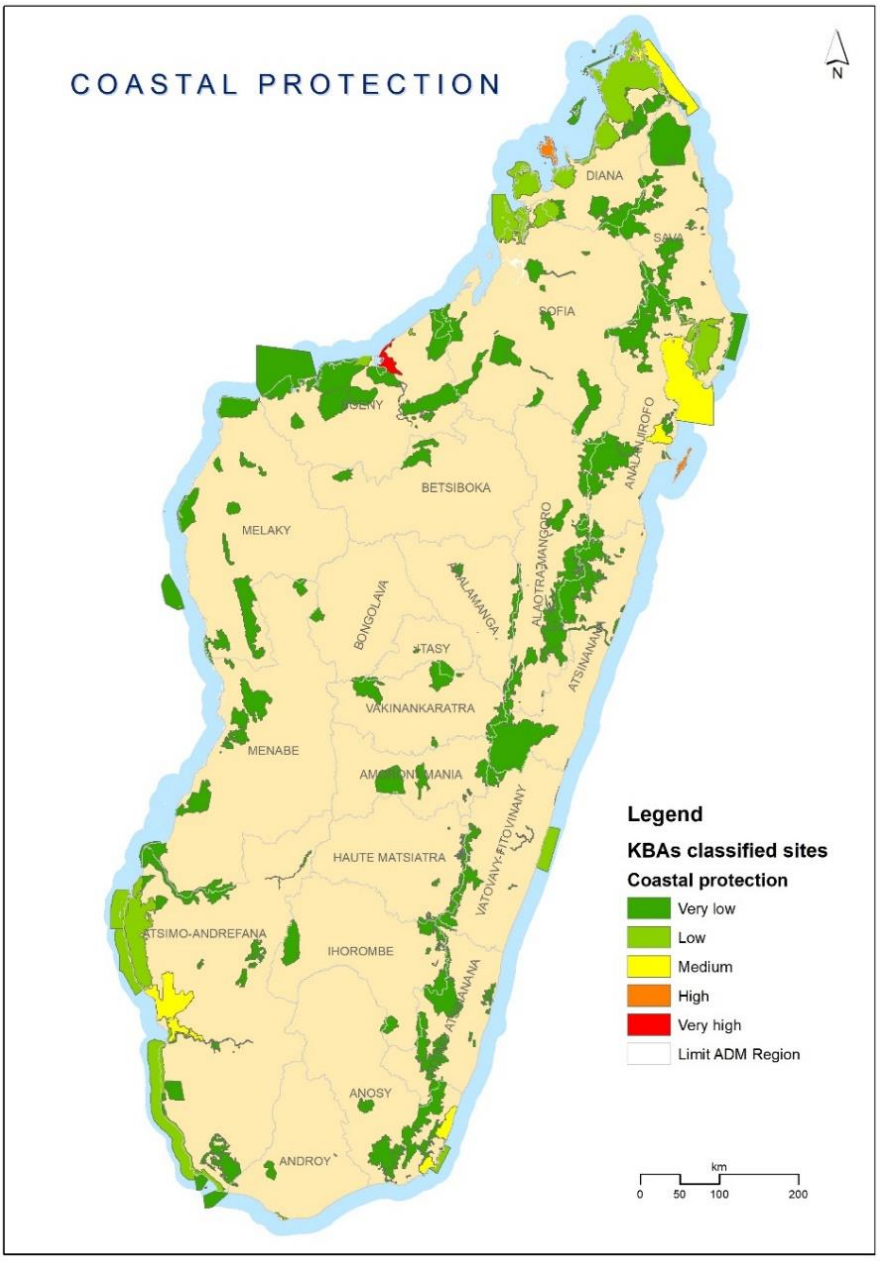

Figure 14 : Coastal protection offered by mangroves and reefs (source: Fedele et al. *2021)*

Freshwater for irrigation

Freshwater ecosystems are some of the most diverse environments in the world (Dayton, 2019). They comprise rivers, lakes, streams, and underground water. Identified ecosystem services for Madagascar include freshwater for irrigated rice cultivation, freshwater for drinking, and water for generation of energy (electricity). The importance of the Freshwater ecosystem is demonstrated by the identification of new KBAs by IUCN (Maiz-Tome et al., 2018). Freshwater for irrigation is important in Eastern Madagascar (Figure 15), and the KBAs that has been identified as providing the most services are Corridor Anjozorobe Angavo-Tsinjoarivo, Lac Tsarasaotra, Mandraka, Anjozorobe, Antoetra Ampadirana (Fohisokina), Forêt classée Zafimaniry, Station Forestière Angavokely. In the South of Madagascar where the climate is dry and water is scarce, importance of freshwater is on the low side.

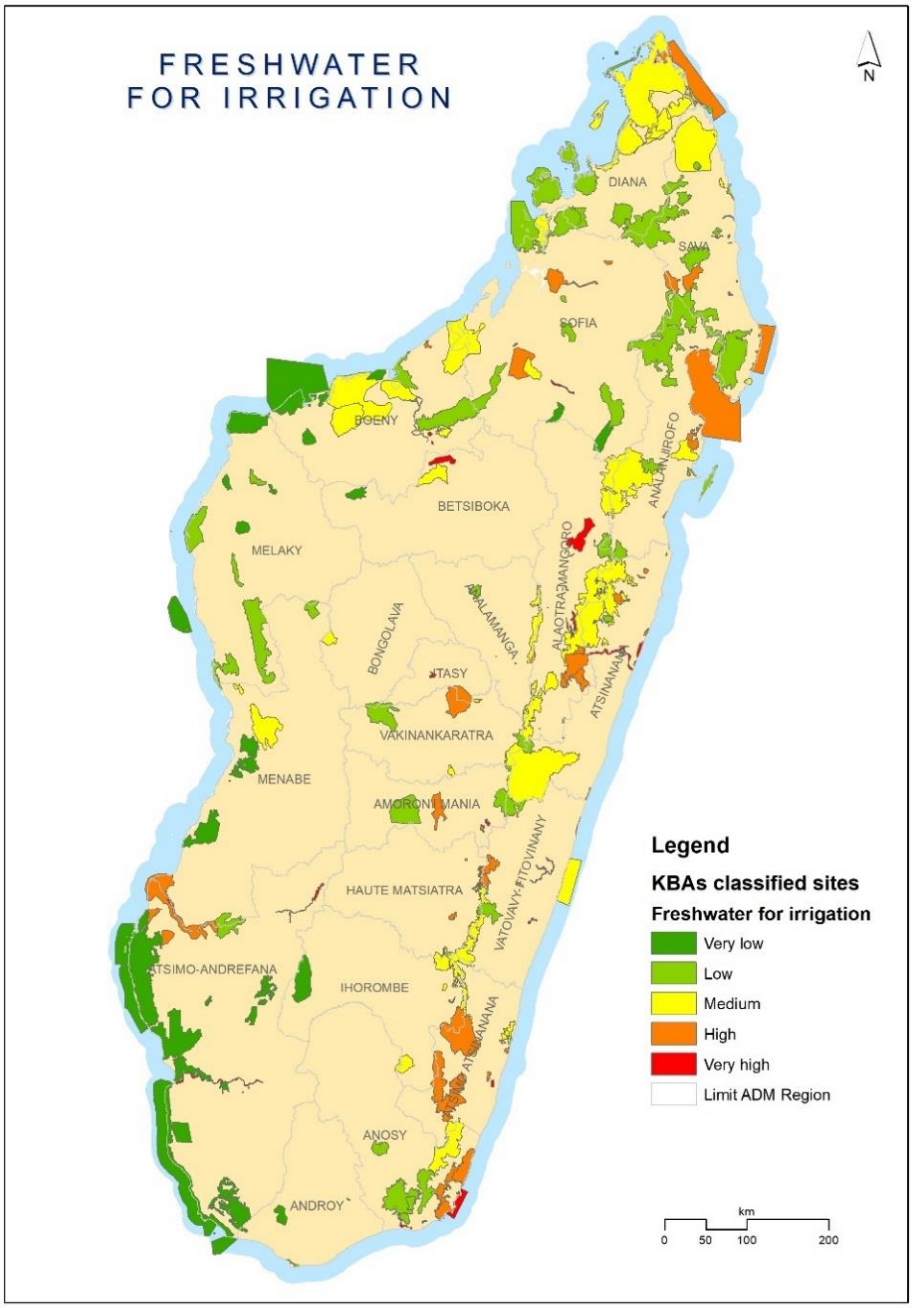

Figure 15 : Freshwater availability for irrigation (source: Neugarten et al. *2016)*

8 CONCLUSION

For Madagascar, the Work Package 1, which consists of identifying important ecosystem services and areas for EbA, was based on 235 KBAs, 212 of which were old and 23 new. The latter representing the freshwater ecosystem were identified from the IUCN new standard KBAs in 2016.

The methodological approach used in the pilot KBA exercise in 2014 has been carried over into this update.

Literature reviews, expert consultations and desktop analysis highlighted 14 ES that could be prioritized for Madagascar, because of the availability of suitable data sets and their contribution to local populations' ability to adapt to climate change. These represent provisioning, regulation and maintenance, and cultural services.

Literature reviews suggested to include in key strategy for adaptation the following:

- ✓ Improved reforestation efforts, restoration of degraded ecosystems, extension of appropriate agricultural systems, and commitment to reducing greenhouse gas emissions.
- ✓ The expansion and effective management of terrestrial and marine protected areas and the establishment of a network of corridors that link protected environments are also critical to climate change mitigation and adaptation efforts.

Through the National Plan for Adaptation on Climate Change, the Ministry in charge of the Environment prioritise the following actions that could inform the development of the Investment Priorities of the CEPF Funding Program:

- ✓ Maintain the existing forest cover and create a network of forest conservation corridors,
- ✓ Establish a large-scale restoration program for the most threatened ecosystems,
- ✓ Encourage the sustainable use of the wood resource,
- ✓ Strengthen the management of protected areas and secure land tenure in protected areas

Finally, KBAs maps and associated data on relative importance of KBAs for ES should be validated at the national level.

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ANNEX 1 List of KBAs with ES weighed value, multicriteria analysis and rank

		Provisioning								Regulation and maintenance					Cultural	EBA weighting		Multicriteria analysis		
KBA ID	KBA Name	Agriculture (all commodities combined)	Freshwater for domestic use	Freshwater for irrigation	Fuelwood	Fisheries	Grazing	Timber for commercial use	Timber for domestic use	Coastal protection	Flood protection	Nitrogen retention	Pollination	Sediment retention	Reef and coastal ecotourism	Vulnerability to Climate change	Adaptation capacity to climate change	Multicriteria analysis	**Multicriteria analysis EBA adjusted**	Rank
MDG-001	Mikea Forest	0.10	0.01	0.00	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.03	3.00	3.00	0.19	**1.73**	52
MDG-002	Ambalimbe Menabe	0.03	0.03	-	0.00	0.08	0.01	0.01	0.01	-	0.04	0.00	0.00	0.00	-	3.00	3.00	0.21	**1.89**	46
MDG-003	Ambanitazana (Antsiranana)	0.02	0.01	-	0.01	0.00	-	-	0.05	-	-	0.00	0.05	-	-	2.00	2.00	0.16	**0.62**	148
MDG-004	Ambato-Boeny	0.01	0.03	0.06	0.02	0.03	0.03	0.03	-	-	0.04	0.00	0.00	0.00	-	2.00	3.00	0.26	**1.58**	60
MDG-005	Ambatofinandrahana	0.04	0.05	-	0.01	0.00	0.02	0.01	-	-	0.01	0.01	0.00	0.00	-	1.00	4.00	0.15	**0.58**	152
MDG-006	Ambereny (Tsimembo)	0.01	0.01	-	0.00	0.00	0.03	-	0.00	-	0.00	0.00	-	0.00	-	4.00	2.00	0.07	**0.56**	158
MDG-007	Ambondrobe (Vohemar)	0.02	0.02	-	0.01	0.01	-	0.03	0.00	-	-	0.00	0.03	0.00	-	2.00	2.00	0.13	**0.51**	166
MDG-008	Ambodivahibe Bay	0.00	0.05	-	0.00	0.00	0.01	0.01	-	0.01	-	-	0.00	-	0.02	2.00	3.00	0.11	**0.68**	143
MDG-009	Salary Bay	0.10	0.00	-	0.00	0.00	-	0.03	-	0.00	-	0.00	-	-	-	3.00	3.00	0.14	**1.29**	76
MDG-010	Nosy Ve Androka	0.10	-	-	-	0.00	-	-	-	0.00	-	-	-	-	-	3.00	3.00	0.10	**0.94**	104
MDG-011	Tsinjoriake-Andatabo	0.10	0.01	-	0.00	0.08	-	0.01	-	0.00	0.03	0.00	0.00	0.00	0.04	3.00	3.00	0.28	**2.48**	22
MDG-012	Velondriake	0.10	0.00	-	0.00	0.00	0.01	0.01	-	0.00	-	0.00	0.00	-	0.01	3.00	3.00	0.15	**1.35**	70
MDG-013	Barren Islands	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	4.00	2.00	0.01	**0.11**	232
MDG-014	Iranja-Ankazoberavina-Russes bays	0.02	0.02	-	0.00	0.00	0.02	0.01	0.01	0.00	-	0.00	0.00	-	0.01	3.00	2.00	0.09	**0.53**	161
MDG-015	Mitsio Archipel	0.00	0.04	-	0.00	-	-	0.00	-	-	-	-	-	-	0.03	2.00	3.00	0.07	**0.41**	195
MDG-016	Ambompofofo	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	2.00	2.00	0.00	**0.00**	234
MDG-017	Andravory (Andrafainkona)	0.02	0.02	-	0.00	0.00	-	0.02	0.00	-	0.01	0.01	0.00	0.00	-	2.00	2.00	0.08	**0.33**	217
MDG-018	Anena (Beloha)	0.06	0.01	-	0.01	-	0.03	0.01	0.00	-	0.01	0.00	0.00	0.00	-	4.00	1.00	0.13	**0.51**	165
MDG-019	Angodoka-Ambakoa (Besalampy)	0.01	0.02	-	0.00	0.00	0.02	-	0.00	-	0.01	0.00	-	0.00	-	4.00	2.00	0.06	**0.50**	168
MDG-020	Ankafina (Ambohimahasoa)	0.05	0.04	-	0.03	0.00	-	0.02	-	-	0.01	0.03	0.00	0.25	-	2.00	3.00	0.42	**2.54**	20
MDG-021	Ankaraobolava-Agnakatriky	0.07	0.09	-	0.05	0.02	-	0.04	-	-	0.03	0.00	0.10	0.00	-	4.00	1.00	0.40	**1.58**	59

MDG-022	North Antanifotsy (Diana)	0.00	0.04	-	0.01	0.00	0.02	0.04	-	-	0.01	0.00	0.02	0.00	-	2.00	3.00	0.14	**0.85**	115
MDG-023	South Antanifotsy (Diana)	0.00	0.04	-	0.00	0.00	-	0.07	-	-	-	0.00	0.00	0.00	-	2.00	3.00	0.12	**0.72**	138
MDG-024	Antogil Bay	0.05	0.05	-	0.00	0.02	-	0.00	0.03	0.01	-	0.00	0.00	-	0.00	2.00	1.00	0.18	**0.36**	204
MDG-025	Diego Bay	0.00	0.03	-	0.01	0.00	0.02	0.02	-	0.00	-	0.00	0.00	-	0.00	2.00	3.00	0.09	**0.52**	162
MDG-026	Beampingaratsy (Midongy du Sud-Andohahela Corridor)	0.06	0.04	0.03	0.00	0.00	-	0.05	0.00	-	0.02	0.00	0.00	0.00	-	2.00	1.00	0.20	**0.40**	199
MDG-027	Belalanda	0.10	0.10	-	0.00	0.04	0.04	0.00	-	-	-	0.00	0.00	0.00	-	3.00	3.00	0.29	**2.58**	18
MDG-028	Bobakindro (Salafaina)	0.02	0.02	-	0.01	0.00	-	0.06	0.00	-	0.01	0.00	0.01	0.00	-	2.00	2.00	0.15	**0.58**	153
MDG-029	Cap d'Ambre	0.00	0.03	-	0.01	0.00	-	0.11	-	-	-	0.00	0.00	-	-	2.00	3.00	0.15	**0.93**	105
MDG-030	Cape St. Andre	0.01	0.01	-	0.00	0.00	0.01	0.01	0.00	0.00	-	0.00	-	0.00	-	4.00	2.00	0.06	**0.45**	185
MDG-031	Mahajamba Anjajavy complex Bay	0.02	0.03	-	0.00	0.02	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	-	2.00	3.00	0.12	**0.74**	137
MDG-032	Rigny Complex Bay (Antsiranana)	0.00	0.04	-	0.00	0.00	0.04	0.02	-	0.00	-	0.00	0.00	-	0.02	2.00	3.00	0.12	**0.75**	134
MDG-033	Three Bays complex	0.00	0.07	-	0.00	0.00	0.02	0.00	-	0.10	-	0.00	0.01	-	0.12	2.00	3.00	0.33	**1.97**	38
MDG-034	Anjozorobe Angavo-Tsinjoarivo Corridor	0.04	0.04	0.10	0.01	0.00	0.02	0.08	0.00	-	0.03	0.01	0.00	0.00	-	1.00	4.00	0.34	**1.35**	71
MDG-035	East coast of Antsiranana	0.02	0.02	-	0.00	0.00	-	0.00	-	0.00	-	-	-	-	-	2.00	2.00	0.04	**0.18**	229
MDG-036	Antalaha-Mahavelona coast	0.02	0.04	-	0.00	0.01	-	-	0.02	0.00	-	0.00	0.00	-	-	2.00	2.00	0.10	**0.38**	202
MDG-037	Lokaro, Cap Antsirabe, Baie de Gallions, Cap Malaimpioka, littoral Cap Sainte Marie coast	0.04	0.07	-	0.00	0.00	-	0.00	-	0.00	-	-	-	-	0.12	2.00	1.00	0.24	**0.49**	172
MDG-038	Mananjary coast	0.12	0.04	-	0.00	-	-	0.01	-	0.00	-	-	0.00	-	-	3.00	2.00	0.18	**1.05**	91
MDG-039	Efatsy (Farafangana)	0.07	0.04	-	0.03	0.00	-	0.05	-	-	-	0.00	0.01	0.00	-	4.00	1.00	0.20	**0.79**	123
MDG-040	Fanambana (Vohemar)	0.02	0.03	0.02	0.01	0.01	-	0.07	-	-	0.01	0.00	0.04	0.00	-	2.00	2.00	0.22	**0.89**	110
MDG-041	Mangoky River	0.06	0.09	0.01	0.01	0.13	0.02	0.01	-	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.35	**3.12**	6
MDG-042	Onive Classified Forest	0.03	0.04	0.02	0.01	0.02	-	0.07	0.00	-	0.03	0.01	0.00	0.00	-	1.00	4.00	0.22	**0.88**	111
MDG-043	Bidia-Bezavona Classified Forest	0.05	0.04	0.00	0.00	0.00	-	0.04	0.00	-	0.02	0.01	0.00	0.00	-	2.00	1.00	0.16	**0.32**	218

MDG-044	Saint Augustin Forest	0.10	0.01	-	0.01	0.04	-	0.01	-	0.01	0.03	0.00	0.00	0.00	-	3.00	3.00	0.22	**1.96**	42
MDG-045	Grand Reef Toliary	0.10	0.01	-	0.00	0.00	0.08	0.01	-	0.00	-	0.00	0.00	0.00	0.02	3.00	3.00	0.23	**2.06**	34
MDG-046	Sainte Marie Island (Ambohidena)	0.05	0.02	-	0.00	-	0.00	0.01	-	0.04	-	0.00	-	-	0.08	2.00	1.00	0.21	**0.42**	192
MDG-047	Ilevika (Matsaborilava)	0.00	0.03	-	0.01	0.02	-	0.03	-	-	0.04	0.00	0.00	0.00	-	2.00	3.00	0.14	**0.84**	119
MDG-048	West Itampolo Mahafaly	0.10	0.00	-	-	-	0.09	-	-	0.00	-	0.00	0.00	0.00	-	3.00	3.00	0.20	**1.79**	49
MDG-049	Lake and river Andranomalaza (Maromandia)	-	-	-	-	0.02	-	-	-	0.00	-	-	-	-	-	3.00	2.00	0.02	**0.10**	233
MDG-050	Lake Andrapongy and Anjingo River	0.02	0.05	-	0.01	0.01	0.04	0.00	0.02	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.16	**0.98**	96
MDG-051	Lake Itasy	0.05	0.10	0.01	0.01	0.01	0.05	0.01	-	-	0.01	0.01	0.00	0.00	-	3.00	4.00	0.26	**3.09**	9
MDG-052	Tsarasaotra Lake	0.05	-	0.10	-	0.13	0.10	-	-	-	0.04	0.02	0.00	0.01	-	1.00	4.00	0.45	**1.82**	48
MDG-053	Lake Tseny	0.02	0.09	-	0.01	0.15	-	0.02	-	-	0.00	0.00	0.04	0.00	-	3.00	2.00	0.33	**1.97**	41
MDG-054	Lakes Anony and Erombo	0.04	0.07	-	0.01	0.03	0.04	0.02	-	-	-	0.00	0.01	0.00	-	2.00	1.00	0.22	**0.44**	188
MDG-055	Mahatsara (Mahambo Foulpointe)	0.06	0.05	-	0.02	0.08	0.01	0.03	-	-	-	0.00	0.00	-	-	3.00	4.00	0.25	**3.05**	10
MDG-056	Makay	0.10	0.07	-	0.00	0.03	0.01	0.03	-	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.25	**2.21**	28
MDG-057	Mandraka	0.03	0.04	0.10	0.02	0.00	-	0.07	-	-	0.01	0.01	0.01	0.00	-	1.00	4.00	0.31	**1.23**	77
MDG-058	Nankinana (Ambodibonara-Masomeloka)	0.07	0.05	-	0.01	-	-	0.01	-	0.01	-	0.00	0.00	-	-	3.00	4.00	0.15	**1.84**	47
MDG-059	Allee de Baobab	0.03	0.06	-	0.00	0.00	-	-	0.01	-	0.00	0.00	-	-	-	3.00	3.00	0.11	**0.97**	98
MDG-060	Ambakoana/Analabe	0.02	0.05	0.08	0.01	0.00	-	0.03	-	-	0.01	0.01	-	0.00	-	1.00	4.00	0.22	**0.86**	113
MDG-061	Ambatofotsy (Anosibe An'Ala)	0.02	0.03	-	0.01	0.00	-	0.04	-	-	0.01	0.00	0.01	0.00	-	1.00	4.00	0.13	**0.51**	167
MDG-062	Ambatotsirongorongo	0.04	0.03	-	0.03	-	-	0.02	-	-	-	0.00	0.05	-	-	2.00	1.00	0.16	**0.33**	215
MDG-063	Ambohidray	0.02	0.08	-	0.01	0.00	-	0.02	0.00	-	0.02	0.00	0.00	0.02	-	1.00	4.00	0.18	**0.71**	139
MDG-064	Ambohipiraka	0.00	0.03	-	0.02	0.01	-	0.02	-	-	0.02	0.01	0.00	0.00	-	2.00	3.00	0.13	**0.75**	128
MDG-065	Ambondrombe (Belo sur Tsiribihina)	0.03	0.03	-	0.00	0.04	-	-	0.01	-	0.00	0.00	-	0.00	-	3.00	3.00	0.11	**0.97**	99
MDG-066	Amoron'i Onilahy et Onilahy River	0.10	0.09	-	0.01	0.05	0.07	0.01	-	-	0.02	0.00	0.00	0.00	-	3.00	3.00	0.35	**3.17**	5
MDG-067	Ampananganandehibe-Beasina (Andilanatoby)	0.02	0.03	-	0.01	-	0.02	0.01	-	-	0.01	0.01	0.00	0.00	-	1.00	4.00	0.11	**0.44**	186

MDG-068	Ampasindava/Rigny Bay (Est)	0.00	0.02	-	0.01	0.02	0.02	0.01	0.01	0.00	0.03	0.00	0.01	0.00	0.03	2.00	3.00	0.15	**0.93**	106
MDG-069	Anadabolava-Betsimalaho NPA (Anosy)	0.04	0.02	0.03	0.00	0.01	0.02	0.03	-	-	0.02	0.00	-	0.00	-	2.00	1.00	0.17	**0.34**	210
MDG-070	Analalava Foulpointe	0.07	0.04	-	0.02	-	-	0.05	-	-	-	0.00	0.00	0.00	-	3.00	4.00	0.18	**2.20**	29
MDG-071	Analalava-Analabe-Betanantanana (Ambatosoratra)	0.02	0.03	-	0.01	0.00	0.02	0.01	-	-	0.02	0.01	0.00	0.00	-	1.00	4.00	0.12	**0.47**	180
MDG-072	Analavelona	0.10	0.01	0.09	0.00	-	0.01	0.03	-	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.27	**2.41**	25
MDG-073	Andrafiamena	0.00	0.04	0.00	0.01	0.01	0.04	0.03	0.00	-	0.01	0.00	0.00	0.00	-	2.00	3.00	0.14	**0.85**	114
MDG-074	Andreba	0.05	0.04	-	0.00	0.00	-	0.01	-	-	-	0.00	0.00	-	-	2.00	1.00	0.11	**0.21**	227
MDG-075	Angavo Androy	0.06	0.01	0.08	0.01	-	-	0.02	-	-	0.01	0.00	-	0.00	-	4.00	1.00	0.19	**0.78**	127
MDG-076	Anjozorobe	0.04	0.03	0.10	0.01	0.00	-	0.04	-	-	0.02	0.01	0.00	0.00	-	1.00	4.00	0.25	**1.00**	94
MDG-077	Ankafobe	0.05	0.02	-	0.00	-	0.01	0.01	-	-	0.01	0.00	0.00	0.00	-	1.00	4.00	0.10	**0.42**	191
MDG-078	Ankeniheny-Lakato Future SAPM	0.03	0.04	0.04	0.00	0.00	-	0.08	0.00	-	0.02	0.00	0.00	0.00	-	1.00	4.00	0.23	**0.91**	108
MDG-079	Ankodida (Anosy Future SAPM)	0.04	0.02	-	0.01	0.00	-	0.02	-	-	0.00	0.00	0.00	0.00	-	2.00	1.00	0.10	**0.19**	228
MDG-080	Ankorabe (Antadonkomby)	0.02	0.04	-	-	0.04	-	-	-	-	-	-	-	-	-	1.00	4.00	0.10	**0.40**	198
MDG-081	Antoetra Ampadirana (Fohisokina)	0.04	0.05	0.10	0.01	0.00	-	0.07	-	-	0.02	0.00	-	0.00	-	1.00	4.00	0.30	**1.19**	79
MDG-082	Antrema	0.01	0.01	-	0.00	0.00	0.01	0.01	-	0.00	-	0.00	0.00	-	0.03	2.00	3.00	0.07	**0.41**	197
MDG-083	Cap Anorontany Archipel	0.00	0.02	-	-	0.00	-	0.00	-	-	-	-	-	-	-	2.00	3.00	0.02	**0.14**	231
MDG-084	Bombetoka/Belembo ka Bay and Marovoay wetlands (Betsiboka-Tsiribihina rivers)	0.01	0.04	-	0.00	0.08	0.02	0.01	-	0.00	0.00	0.00	0.00	0.00	-	2.00	3.00	0.16	**0.98**	97
MDG-085	Beanka	0.01	0.01	-	0.00	0.00	0.02	-	0.00	-	0.00	0.00	0.00	0.00	-	4.00	2.00	0.06	**0.48**	174
MDG-086	Bemanevika (Ankaizina wetlands)	0.02	0.05	-	0.02	0.00	0.03	0.00	0.06	-	0.01	0.00	0.01	0.00	-	3.00	2.00	0.19	**1.16**	82
MDG-087	Ifotaky Complex Future SAPM	0.04	0.02	0.00	0.01	0.01	0.02	0.04	-	-	0.03	0.00	0.00	0.00	-	2.00	1.00	0.16	**0.31**	222
MDG-088	Mahafaly Plateau forest complex	0.10	0.01	-	0.00	0.00	0.09	0.01	0.00	-	0.00	0.00	0.00	0.00	-	3.00	3.00	0.22	**2.01**	37
MDG-089	Lake Ihotry-Mangoky Delta complex	0.08	0.04	0.03	0.01	0.06	0.02	0.02	0.00	0.00	0.01	0.00	0.00	0.00	-	3.00	3.00	0.27	**2.42**	24

MDG-090	Makirovana-Ambatobiribiry-Anjombolava-Tsihomanaomby Complex	0.02	0.02	0.01	0.01	0.02	-	0.02	0.01	-	0.02	0.01	0.00	0.00	-	2.00	2.00	0.14	**0.57**	155
MDG-091	Complex Mangoky-Ankazoabo Forest	0.06	0.02	0.06	0.00	0.03	0.01	0.03	0.00	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.24	**2.14**	32
MDG-092	Manambolomaty Wetland Complex and Tsimembo Classified Forest/Bemamba wetland	0.01	0.02	-	0.00	0.00	0.02	-	0.01	0.00	0.00	0.00	-	0.00	-	4.00	2.00	0.07	**0.56**	156
MDG-093	Vohipaho complex	0.07	0.05	0.01	0.03	0.01	-	0.02	0.03	-	0.03	0.00	0.04	0.00	-	4.00	1.00	0.27	**1.09**	87
MDG-094	Ambositra Vondrozo Corridor	0.09	0.04	0.09	0.01	0.00	-	0.07	0.00	-	0.04	0.01	0.00	0.00	-	3.00	3.00	0.35	**3.11**	8
MDG-095	Zahamena-Ankeniheny SAPM	0.06	0.03	0.01	0.00	0.00	0.02	0.08	0.00	-	0.02	0.01	0.00	0.00	-	3.00	4.00	0.23	**2.79**	14
MDG-096	Menabe-Antimena/corridor Kirindy-Ambadira/Upper Tsiribihana and Tsiribihana	0.03	0.01	-	0.00	0.01	0.01	0.00	0.01	-	0.02	0.00	0.00	0.00	-	3.00	3.00	0.08	**0.75**	133
MDG-097	Analamay-Mantadia Corridor	0.07	0.02	-	0.00	0.00	-	0.15	-	-	0.03	0.01	0.00	0.00	-	3.00	4.00	0.29	**3.43**	3
MDG-098	Fandriana Marolambo Corridor	0.08	0.03	0.03	0.01	0.01	0.04	0.02	0.01	-	0.02	0.01	0.00	0.01	-	3.00	4.00	0.26	**3.11**	7
MDG-099	Tsaratanana-Marojejy Future SAPM	0.02	0.02	-	0.00	0.00	0.02	0.00	0.00	-	0.03	0.01	0.00	0.00	-	2.00	2.00	0.11	**0.44**	187
MDG-100	Cratere de Nosy Be (Lac Mont Passot)	0.00	0.03	-	0.01	-	-	-	0.06	0.01	-	0.00	0.00	-	0.15	2.00	3.00	0.26	**1.58**	61
MDG-101	Daraina-Loky Manambato SAPM	0.02	0.03	0.00	0.01	0.00	0.03	0.03	0.00	-	0.01	0.00	0.01	0.00	-	2.00	2.00	0.16	**0.63**	146
MDG-102	Fierenana	0.02	0.07	0.01	0.01	0.00	0.01	0.05	-	-	0.01	0.00	0.00	0.02	-	1.00	4.00	0.21	**0.83**	120
MDG-103	Andavakoera Classified Forest	0.00	0.04	-	0.01	0.00	0.04	0.02	0.00	-	0.02	0.00	0.00	0.00	-	2.00	3.00	0.14	**0.85**	116
MDG-104	Bongolava Classified Forest (Marosely)	0.02	0.02	-	0.01	0.01	0.03	0.03	-	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.14	**0.83**	121
MDG-105	Manombo Classified Forest	0.07	0.04	0.05	0.02	0.01	0.02	0.03	0.00	0.00	-	0.00	0.00	0.00	-	4.00	1.00	0.24	**0.96**	101
MDG-106	Vohibola Classifed Forest	0.07	0.05	-	0.01	0.00	-	0.04	-	-	-	0.00	0.00	-	-	3.00	4.00	0.18	**2.17**	31

MDG-107	Vondrozo Classified Forest and surrounding areas	0.05	0.04	0.04	0.00	0.00	-	0.03	0.00	-	0.05	0.01	0.00	0.00	-	4.00	1.00	0.23	**0.92**	107
MDG-108	Zafimaniry Classified Forest	0.04	0.07	0.10	0.01	0.00	-	0.11	-	-	0.02	0.00	0.00	0.00	-	1.00	4.00	0.36	**1.43**	65
MDG-109	Menarandra Forest/Vohidefo	0.10	0.00	-	0.00	0.00	0.05	0.01	0.00	-	0.00	0.00	0.00	0.00	-	3.00	3.00	0.18	**1.64**	56
MDG-110	Sahafina Forest (Anivorano-Brickaville)	0.07	0.03	-	0.01	0.03	-	0.09	-	-	0.03	0.02	0.00	0.06	-	3.00	4.00	0.35	**4.18**	2
MDG-111	Ibity Future SAPM	0.05	0.04	-	0.01	0.00	0.04	0.01	0.01	-	0.01	0.01	0.00	0.01	-	2.00	3.00	0.18	**1.09**	86
MDG-112	Itremo Vakinakaratra Future SAPM	0.04	0.01	-	0.00	-	0.02	0.01	0.00	-	0.00	0.00	0.00	0.00	-	1.00	4.00	0.08	**0.33**	214
MDG-113	Kianjavato	0.12	0.06	-	0.02	0.01	-	0.07	-	-	0.02	0.01	0.01	0.00	-	3.00	2.00	0.32	**1.90**	45
MDG-114	Lake Alaotra	0.02	0.07	0.00	0.00	0.07	0.02	0.01	-	-	0.02	0.00	0.00	0.01	-	1.00	4.00	0.24	**0.94**	103
MDG-115	Lake Sahaka/Analabe	0.02	0.10	-	-	0.01	0.02	-	-	-	-	0.00	0.07	-	-	2.00	2.00	0.22	**0.89**	109
MDG-116	Mahabo-Mananivo	0.07	0.05	-	0.02	0.00	-	0.04	-	0.00	-	0.00	0.02	0.00	-	4.00	1.00	0.20	**0.79**	125
MDG-117	Mahialambo	0.02	0.03	0.04	0.01	-	-	0.02	-	-	0.01	0.01	-	0.00	-	1.00	4.00	0.14	**0.56**	157
MDG-118	Mandena	0.04	0.04	-	0.02	0.00	-	0.07	-	-	-	0.00	0.00	-	-	2.00	1.00	0.18	**0.36**	206
MDG-119	Mangabe-Ranomena-Sasarotra	0.02	0.03	0.09	0.00	0.01	-	0.08	-	-	0.02	0.01	0.00	0.00	-	1.00	4.00	0.26	**1.03**	93
MDG-120	Manjakatompo-Ankaratra Massif	0.05	0.04	0.09	0.04	0.00	-	0.04	-	-	0.03	0.02	0.00	0.00	-	2.00	3.00	0.33	**1.95**	43
MDG-121	Montagne des Francais	0.00	0.03	-	0.01	0.00	-	0.06	-	-	-	0.00	0.01	-	-	2.00	3.00	0.11	**0.66**	144
MDG-122	Oronjia Forest	0.00	0.03	-	0.00	0.00	0.02	0.02	-	0.00	-	0.00	-	-	0.08	2.00	3.00	0.16	**0.95**	102
MDG-123	PK32-Ranobe	0.10	0.01	0.03	0.00	0.01	0.02	0.03	0.00	0.01	0.03	0.00	0.00	0.00	0.06	3.00	3.00	0.31	**2.78**	15
MDG-124	Pointe ÃLarree	0.05	0.02	-	0.01	0.01	0.01	0.06	-	0.00	-	0.00	0.00	-	-	2.00	1.00	0.16	**0.32**	221
MDG-125	Sainte Luce/Ambato Atsinanana	0.04	0.04	-	0.00	0.00	0.02	0.01	-	0.00	-	0.00	0.00	0.00	-	2.00	1.00	0.12	**0.24**	224
MDG-126	Seven Lakes	0.10	0.01	-	0.01	0.05	-	0.02	-	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.21	**1.91**	44
MDG-127	Tampolo	0.05	0.06	-	0.02	0.02	-	0.02	-	0.00	-	0.00	0.01	-	-	2.00	1.00	0.17	**0.35**	209
MDG-128	Vohibe Ambalabe (Vatomandry)	0.07	0.06	-	0.01	-	-	0.04	0.00	-	0.01	0.00	0.00	0.00	-	3.00	4.00	0.20	**2.43**	23
MDG-129	Mahavavy Kinkony Future SAPM Wetlands	0.01	0.04	-	0.01	0.02	0.01	0.03	0.00	0.00	0.01	0.00	0.00	0.00	-	2.00	3.00	0.12	**0.75**	135
MDG-130	Maevatanana-Ambato-Boeni Wetlands	0.00	0.08	0.02	0.01	0.12	0.03	0.01	-	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.28	**2.55**	19

MDG-131	Nosivolo Wetland	0.07	0.06	-	0.02	0.01	-	0.03	0.00	-	0.01	0.01	0.04	0.02	-	3.00	4.00	0.27	**3.29**	4
MDG-132	Port Berge Wetlands	0.02	0.05	-	0.01	0.05	0.05	0.02	-	-	0.01	0.00	0.01	0.00	-	3.00	2.00	0.23	**1.40**	67
MDG-133	Nosy Foty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	3.00	-	**-**	235
MDG-134	Sahamalaza Bay Wetlands	0.02	0.03	-	0.00	0.00	0.01	0.01	0.01	0.00	-	0.00	-	0.00	-	3.00	2.00	0.08	**0.47**	178
MDG-135	Nosy Varika	0.12	0.04	-	0.02	0.01	-	0.02	-	0.05	-	0.00	0.00	0.00	-	3.00	2.00	0.27	**1.63**	57
MDG-136	North Pangalane	0.07	0.09	-	0.00	0.01	-	0.02	-	-	0.03	0.00	0.00	-	-	3.00	4.00	0.22	**2.63**	16
MDG-137	Andohahela National Park - Parcel I	0.04	0.02	0.02	0.00	0.00	0.00	0.04	0.00	-	0.02	0.01	0.00	0.00	-	2.00	1.00	0.17	**0.34**	212
MDG-138	Andohahela National Park - Parcel II	0.04	0.02	-	0.01	0.00	0.02	0.05	-	-	0.02	0.00	0.00	0.00	-	2.00	1.00	0.16	**0.33**	216
MDG-139	Andringitra National Park	0.02	0.03	-	0.00	0.00	0.02	0.04	0.00	-	0.02	0.00	0.00	0.01	-	3.00	3.00	0.15	**1.39**	68
MDG-140	Ankarafantsika Strict Nature Reserve, National Park, and Ampijoroa Forestry Station	0.01	0.02	0.01	0.00	0.01	0.01	0.08	0.00	-	0.03	0.00	0.00	0.00	-	2.00	3.00	0.19	**1.17**	81
MDG-141	Kirindy Mite National Park and surrounding areas	0.03	0.01	-	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-	3.00	3.00	0.06	**0.58**	154
MDG-142	Baie de Baly National Park	0.01	0.01	-	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	-	2.00	3.00	0.05	**0.30**	223
MDG-143	Mananara-North National Park	0.05	0.04	-	0.01	0.00	-	0.07	0.01	0.00	0.02	0.00	0.00	0.00	-	2.00	1.00	0.21	**0.42**	193
MDG-144	Mantadia National Park and Analamazaotra Special Reserve	0.02	0.04	-	0.01	0.00	0.01	0.15	-	-	0.04	0.01	0.00	0.01	-	1.00	4.00	0.28	**1.13**	83
MDG-145	Marojejy National Park	0.02	0.02	-	0.01	0.00	-	-	0.02	-	0.03	0.01	0.00	0.01	-	2.00	2.00	0.12	**0.47**	176
MDG-146	Masoala National Park	0.03	0.02	-	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.03	2.00	2.00	0.09	**0.38**	203
MDG-147	MasoalaNationalPark - Section II	0.02	0.02	-	0.01	0.01	-	-	0.03	-	-	0.00	0.01	-	-	2.00	2.00	0.10	**0.39**	201
MDG-148	MasoalaNationalPark - Section III	0.02	0.03	-	0.01	0.01	-	-	0.03	0.00	-	0.00	0.00	-	-	2.00	2.00	0.10	**0.39**	200
MDG-149	Midongy Sud National Park	0.07	0.05	0.08	0.00	0.00	-	0.05	0.00	-	0.02	0.01	0.00	0.00	-	4.00	1.00	0.29	**1.17**	80
MDG-150	Nosy Mitsio National Park	0.00	0.06	-	0.00	-	-	0.00	-	-	-	0.00	-	-	0.02	2.00	3.00	0.08	**0.49**	171

MDG-151	Nosy Be and Satellites Islands (Nosy Tanihely)	0.00	0.02	-	0.02	-	-	0.00	0.06	0.05	-	0.00	0.00	-	0.13	2.00	3.00	0.28	**1.69**	54
MDG-152	Ranomafana National Park	0.11	0.05	0.04	0.01	0.00	-	0.14	0.00	-	0.03	0.01	0.00	0.01	-	3.00	2.00	0.39	**2.37**	26
MDG-153	Tsimanampetsotse National Park	0.10	0.00	-	0.00	0.00	0.06	0.00	0.00	-	0.00	0.00	0.00	0.00	-	3.00	3.00	0.17	**1.53**	63
MDG-154	Zombitse-Vohibasia National Park	0.10	0.01	0.07	0.00	-	0.01	0.06	-	-	0.02	0.01	0.00	0.00	-	3.00	3.00	0.28	**2.52**	21
MDG-155	Isalo National Park	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	-	0.00	0.00	0.00	0.00	-	3.00	3.00	0.06	**0.50**	170
MDG-156	Tsingy de Namoroka National Park	0.01	0.01	-	0.00	-	0.03	0.02	0.00	-	0.00	0.00	-	0.00	-	2.00	3.00	0.07	**0.41**	196
MDG-157	Zahamena National Park and Strict Reserve	0.04	0.02	-	0.00	0.00	-	0.03	0.00	-	0.01	0.01	0.00	0.00	-	2.00	1.00	0.12	**0.23**	225
MDG-158	Tsingy de Bemaraha National Park and Strict Nature Reserve	0.01	0.02	-	0.00	0.01	0.01	-	0.00	-	0.00	0.00	0.00	0.00	-	4.00	2.00	0.06	**0.51**	164
MDG-159	Montagne d'Ambre National Park and Special Reserve	0.00	0.03	-	0.01	0.00	-	0.07	0.00	-	0.00	0.00	0.00	0.00	-	2.00	3.00	0.13	**0.75**	131
MDG-160	Ambre Forest	0.00	0.03	-	0.01	0.00	-	0.07	0.00	-	0.00	0.00	0.00	0.00	-	2.00	3.00	0.13	**0.75**	132
MDG-161	Torotorofotsy Wetlands	0.02	0.04	0.01	0.02	-	-	0.09	-	-	0.02	0.00	0.00	0.00	-	1.00	4.00	0.20	**0.79**	124
MDG-162	Makira	0.05	0.03	-	0.00	0.01	0.04	-	0.01	-	0.03	0.00	0.00	0.00	-	2.00	1.00	0.16	**0.32**	219
MDG-163	Anja communuty Reserve	0.05	0.07	-	0.02	0.00	-	0.03	-	-	0.02	0.04	0.00	0.00	-	2.00	3.00	0.22	**1.32**	72
MDG-164	Betampona Strict Nature Reserve	0.07	0.05	-	0.01	0.00	-	0.09	-	-	-	0.00	0.00	0.00	-	3.00	4.00	0.23	**2.80**	13
MDG-165	Lokobe Strict Nature Reserve	0.00	0.01	-	0.05	-	-	-	0.15	0.00	-	0.00	0.00	-	-	2.00	3.00	0.22	**1.31**	74
MDG-166	Tsaratanana Strict Nature Reserve and adjacent areas	0.00	0.02	-	0.00	0.00	-	0.00	0.00	-	0.04	0.00	0.00	0.00	-	2.00	3.00	0.07	**0.45**	184
MDG-167	Ambatovaky Special Reserve	0.05	0.03	-	0.00	0.00	-	0.04	0.00	-	0.02	0.00	0.00	0.00	-	2.00	1.00	0.16	**0.32**	220
MDG-168	Ambohijanahary Special Reserve	0.02	0.02	-	0.00	0.00	0.01	0.02	0.00	-	0.00	0.00	0.00	0.00	-	3.00	3.00	0.07	**0.66**	145
MDG-169	Ambohitantely Special Reserve	0.05	0.02	0.02	0.00	-	0.01	0.01	-	-	0.01	0.00	0.00	0.00	-	1.00	4.00	0.12	**0.48**	173
MDG-170	Analamera Special Reserve	0.01	0.03	-	0.00	0.00	0.03	0.02	0.00	-	0.00	0.00	0.00	0.00	-	2.00	3.00	0.10	**0.62**	149
MDG-171	Andranomena Special Reserve	0.03	0.01	-	0.00	0.00	-	-	0.01	-	-	0.00	-	0.00	-	3.00	3.00	0.05	**0.48**	175

MDG-172	Anjanaharibe Sud-Marojejy Future SAPM	0.02	0.06	-	0.01	0.00	-	-	0.01	-	0.02	0.01	0.00	0.01	-	2.00	2.00	0.15	**0.60**	150
MDG-173	Ankarana Special Reserve	0.00	0.04	-	0.01	0.00	0.02	0.06	-	-	0.00	0.00	0.00	0.00	-	2.00	3.00	0.14	**0.84**	118
MDG-174	Bemarivo Special Reserve	0.01	0.01	-	0.00	0.00	0.02	-	0.00	-	0.00	0.00	-	0.00	-	4.00	2.00	0.04	**0.34**	211
MDG-175	Beza-Mahafaly Special Reserve	0.10	0.02	-	0.01	0.03	-	0.03	-	-	0.03	0.00	-	0.00	-	3.00	3.00	0.22	**1.97**	39
MDG-176	Bora Special Reserve	0.02	0.03	-	0.00	0.00	0.04	-	0.01	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.11	**0.68**	142
MDG-177	Kalambatritra Special Reserve	0.02	0.03	0.06	0.00	0.00	0.03	0.01	0.00	-	0.02	0.00	0.00	0.00	-	3.00	3.00	0.17	**1.50**	64
MDG-178	Kasijy Special Reserve	0.00	0.01	-	0.00	0.00	0.01	0.01	-	-	0.01	0.00	0.00	0.00	-	3.00	3.00	0.05	**0.43**	190
MDG-179	Mangerivola Special Reserve	0.07	0.06	-	0.00	0.00	-	0.07	0.00	-	0.02	0.01	0.00	0.01	-	3.00	4.00	0.24	**2.88**	12
MDG-180	Maningoza Special Reserve	0.01	0.01	-	0.00	0.00	0.02	0.01	0.00	-	0.00	0.00	-	0.00	-	4.00	2.00	0.07	**0.54**	159
MDG-181	Manombo Special Reserve	0.07	0.03	-	0.02	0.00	-	0.06	-	0.00	-	0.00	0.00	0.00	-	4.00	1.00	0.19	**0.74**	136
MDG-182	Manongarivo Special Reserve	0.01	0.02	-	0.00	0.00	-	0.00	0.00	-	0.03	0.00	0.00	0.00	-	2.00	3.00	0.07	**0.41**	194
MDG-183	Marotandrano Special Reserve	0.02	0.01	-	0.00	0.00	-	0.01	0.00	-	0.01	0.00	-	0.00	-	3.00	2.00	0.06	**0.34**	213
MDG-184	Nosy Mangabe Special Reserve	0.05	0.03	-	0.00	0.03	-	-	0.06	-	-	-	-	-	-	2.00	1.00	0.17	**0.35**	208
MDG-185	Tampoketsa-Analamaitso Special Reserve	0.02	0.01	-	0.00	0.01	0.03	0.00	0.00	-	0.01	0.00	0.00	0.01	-	3.00	2.00	0.09	**0.51**	163
MDG-186	Cap St Marie Special Reserve	0.06	0.02	-	0.00	-	0.03	0.00	-	0.01	-	0.00	0.00	-	-	4.00	1.00	0.12	**0.47**	179
MDG-187	Pic d'Ivohibe Special Reserve	0.01	0.03	-	0.00	-	0.04	0.09	-	-	0.03	0.00	0.00	0.00	-	3.00	3.00	0.22	**1.97**	40
MDG-188	Ankavia-Ankavana River (Antalaha)	0.02	0.10	-	0.04	0.03	-	-	0.09	-	0.06	0.00	0.05	0.00	-	2.00	2.00	0.39	**1.57**	62
MDG-189	Antainambalana-Andranofotsy River (Antalaha)	0.05	0.10	-	0.04	0.12	-	-	0.13	0.00	0.08	0.01	0.00	0.00	-	2.00	1.00	0.53	**1.07**	89
MDG-190	Bermarivo River	0.02	0.09	-	0.03	0.08	-	0.06	-	-	0.02	0.00	0.01	-	-	2.00	2.00	0.33	**1.31**	75
MDG-191	Maevarano River	0.02	0.06	-	0.01	0.01	-	0.05	-	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.16	**0.96**	100
MDG-192	Mahanara River	0.02	0.07	0.03	0.02	0.01	-	0.08	-	0.00	-	0.01	0.00	0.00	-	2.00	2.00	0.25	**1.00**	95
MDG-193	Mananjary River	0.12	0.10	-	0.03	0.04	-	0.03	-	-	0.02	0.00	0.02	0.00	-	3.00	2.00	0.36	**2.18**	30

MDG-194	Mangarahara-Amboamboa River	0.02	0.05	-	0.00	0.06	0.02	0.03	-	-	0.02	0.00	0.00	0.00	-	1.00	4.00	0.20	**0.81**	122
MDG-195	Sambava River	0.02	0.07	-	-	0.02	-	-	-	-	-	-	-	-	-	2.00	2.00	0.11	**0.45**	183
MDG-196	Sofia River	0.02	0.08	-	0.01	0.01	0.04	0.03	0.01	-	0.01	0.01	0.00	0.01	-	3.00	2.00	0.23	**1.37**	69
MDG-197	Ivoloina River	0.07	0.05	-	0.02	0.01	-	0.07	-	-	0.00	0.01	0.02	0.01	-	3.00	4.00	0.25	**3.00**	11
MDG-198	Mananara South River	0.01	0.10	-	0.00	0.00	-	0.01	0.00	-	0.02	0.00	0.00	0.00	-	3.00	3.00	0.16	**1.41**	66
MDG-199	Mangoro-Rianila rivers	0.07	0.07	-	0.02	0.05	-	0.07	-	-	0.03	0.01	0.01	0.07	-	3.00	4.00	0.40	**4.75**	1
MDG-200	Namorona-Faraony River	0.12	0.09	-	0.03	0.02	-	0.03	-	-	0.02	0.01	0.01	0.00	-	3.00	2.00	0.34	**2.02**	35
MDG-201	Sahafary (Andranomena Antsiranana)	0.00	0.03	-	0.01	0.00	-	0.03	-	-	-	0.00	0.00	-	-	2.00	3.00	0.08	**0.47**	181
MDG-202	Sorata	0.02	0.03	0.02	0.00	0.00	-	0.03	0.00	-	0.02	0.01	0.00	0.00	-	2.00	2.00	0.13	**0.53**	160
MDG-203	Angavokely Forestry Station	0.05	0.06	0.10	0.03	-	-	0.03	-	-	0.15	0.10	0.02	0.00	-	1.00	4.00	0.53	**2.13**	33
MDG-204	Anjiamangirana Forest Station	0.02	0.02	-	0.01	0.00	0.03	-	0.03	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.13	**0.75**	130
MDG-205	Tarzanville (Moramanga)	0.02	0.02	-	-	0.00	-	-	-	-	-	-	-	-	-	1.00	4.00	0.04	**0.17**	230
MDG-206	Tsinjoarivo	0.05	0.03	-	0.00	0.01	0.02	-	0.00	-	0.00	0.00	0.00	0.00	-	1.00	2.00	0.11	**0.21**	226
MDG-207	Tsitongambarika Classified Forest	0.04	0.04	-	0.01	0.00	-	0.05	0.01	-	0.02	0.00	0.00	0.00	-	2.00	1.00	0.18	**0.36**	205
MDG-208	Ambavanankarana Wetland	0.00	0.03	-	0.01	0.01	0.01	0.03	-	0.00	0.00	0.00	0.01	0.00	-	2.00	3.00	0.11	**0.63**	147
MDG-209	Ambila-Lemaitso Wetland	0.07	0.07	-	0.00	-	-	0.02	-	-	-	0.00	0.00	-	-	3.00	4.00	0.17	**2.01**	36
MDG-210	Ankobohobo Wetlands	0.01	0.05	-	0.00	0.00	-	0.07	-	0.00	-	0.00	0.00	0.00	-	2.00	3.00	0.14	**0.87**	112
MDG-211	Southwestern Coastal Wetlands and Nosy Manitse Future SAPM Marine	0.10	0.01	-	0.00	0.00	0.05	0.00	-	0.00	-	0.00	0.00	0.00	-	3.00	3.00	0.18	**1.62**	58
MDG-212	Tambohorano Wetlands	0.01	0.02	-	0.00	0.00	0.02	-	0.01	0.00	0.00	0.00	0.00	0.00	-	4.00	2.00	0.07	**0.59**	151
MDG-213	Amboaboa Catchment	0.02	0.02	-	0.01	0.00	0.03	0.00	0.02	-	0.01	0.01	0.00	0.01	-	3.00	2.00	0.13	**0.79**	126
MDG-214	Andasibe	0.02	0.04	0.03	0.01	0.00	0.01	0.11	-	-	0.03	0.00	0.00	0.01	-	1.00	4.00	0.27	**1.07**	88
MDG-215	Antsiranana	0.00	0.03	-	0.01	0.00	0.03	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.01	2.00	3.00	0.14	**0.85**	117
MDG-216	Mahajilo River	0.05	0.02	-	0.00	0.01	0.02	0.00	0.00	-	0.01	0.00	0.00	0.00	-	2.00	3.00	0.13	**0.75**	129

MDG-217	Faraony Headwaters	0.12	0.03	0.06	0.02	0.00	-	0.08	0.00	-	0.02	0.01	0.01	0.02	-	3.00	2.00	0.38	**2.26**	27
MDG-218	Ikopa Lakes	0.00	0.03	0.01	0.01	0.07	0.02	0.01	-	-	0.03	0.00	0.00	0.00	-	3.00	3.00	0.19	**1.75**	51
MDG-219	Isalo National Park	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	-	0.00	0.00	0.00	0.00	-	3.00	3.00	0.06	**0.50**	169
MDG-220	Kinkony Lake	0.01	0.03	-	0.00	0.00	0.03	0.03	-	-	0.01	0.00	0.00	0.00	-	2.00	3.00	0.12	**0.70**	141
MDG-221	Lake Tseny Basin	0.02	0.04	-	0.01	0.02	0.05	0.03	0.00	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.18	**1.10**	85
MDG-222	Lower Ankofia	0.02	0.04	-	0.01	0.02	0.05	0.00	0.02	-	0.01	0.00	0.00	0.00	-	3.00	2.00	0.18	**1.10**	84
MDG-223	Lower Anove	0.05	0.03	0.00	0.01	0.01	-	0.10	0.00	0.01	0.01	0.00	0.00	0.00	-	2.00	1.00	0.23	**0.46**	182
MDG-224	Mahajanga Coastal Zone	0.01	0.02	-	0.00	0.00	0.02	0.01	-	0.10	0.00	0.00	0.00	0.00	0.11	2.00	3.00	0.28	**1.67**	55
MDG-225	Mahavavy Delta	0.00	0.04	-	0.01	0.02	0.03	0.02	-	0.00	0.02	0.00	0.02	0.00	-	2.00	3.00	0.17	**1.05**	92
MDG-226	Manambato South	0.04	0.05	-	0.01	0.00	0.02	0.02	0.00	0.01	0.02	0.00	0.00	0.00	-	2.00	1.00	0.17	**0.35**	207
MDG-227	Manongarivo Catchment	0.02	0.03	-	0.00	0.00	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	-	3.00	2.00	0.12	**0.70**	140
MDG-228	Marojejy National Park	0.02	0.02	-	0.01	0.00	-	-	0.02	-	0.03	0.01	0.00	0.01	-	2.00	2.00	0.12	**0.47**	177
MDG-229	Mikea National Park	0.10	0.01	0.00	0.00	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.03	3.00	3.00	0.19	**1.73**	53
MDG-230	Nosivolo Ramsar Site	0.07	0.03	0.00	0.01	0.01	-	0.03	0.01	-	0.02	0.01	0.02	0.01	-	3.00	4.00	0.22	**2.61**	17
MDG-231	Nosy Be Island Group	0.00	0.02	-	0.01	-	-	0.00	0.06	0.06	-	0.00	0.00	-	0.13	2.00	3.00	0.29	**1.76**	50
MDG-232	Southern Upper Lokoho River	0.02	0.05	-	0.01	0.01	-	-	0.03	-	0.03	0.03	0.01	0.11	-	2.00	2.00	0.30	**1.20**	78
MDG-233	Tolagnaro	0.04	0.06	-	0.02	0.00	0.02	0.06	-	0.02	-	0.00	0.00	0.00	-	2.00	1.00	0.22	**0.44**	189
MDG-234	Upper Kitsamby River	0.05	0.04	0.02	0.01	0.00	0.04	0.01	-	-	0.01	0.01	0.00	0.01	-	2.00	3.00	0.22	**1.32**	73
MDG-235	Upper Mananara river	0.06	0.05	0.01	0.01	0.03	0.03	0.01	0.01	-	0.03	0.01	0.00	0.01	-	4.00	1.00	0.27	**1.06**	90