

Bigi Pan Management Plan 2013-2023

ANNEX 2 MONITORING PLAN



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Introduction to the monitoring and evaluation plan of Bigi Pan MUMA

The Monitoring and Evaluation (M&E) Plan aims at providing a regular overview of the progress of implementation of the management action plan and the business plan, in terms of input delivery, work schedule and planned outputs/targets. It involves routine information gathering, analysis and reporting activities. Evaluation will represent a systematic assessment of the management activities in terms of the design of the activities, implementation and results.

The day-to-day responsibility for implementing the M&E plan will be undertaken by the Management Foundation of the Bigi Pan MUMA. The Foundation will contract and/or work with other parties for certain monitoring activities, for which specific knowhow is needed, such as:

- a. Centre for Agricultural Research in Suriname (CELOS¹) for monitoring mangroves status, water quality and Tarpon population
- b. National Zoological Collection of Suriname (NZCS²) for monitoring Jaguar population
- c. National Laboratory (Bureau Openbare Gezondheidszorg, BOG)) for monitoring E. coli bacterium in surface water
- d. Ministry of Agriculture, Animal Husbandry and Fisheries/ Department of Fisheries for providing fishing statistics
- e. Ministry of Public Works/ Hydraulic Research Division (WLA³) for monitoring hydrological parameters
- f. Independent consultants for monitoring Scarlet Ibis populations, fish populations and other technical works
- g. Local population who will actively participate in monitoring by providing detailed information.

The Management Foundation shall prepare and submit to the Ministry of RGB financial and progress reports on activities and targets. Reporting will take place on a half yearly basis. It is the responsibility of the Management Foundation to implement the monitoring activities, to register the collected data and to establish a database. It is also the responsibility of the Management Foundation to analyze consolidated monitoring results of indicator species and water quality.

In the tables below the M&E plan is presented. The tables can also serve as a reporting format. The first X indicates the year that the activity should start. Monitoring can be done by granting a ranking to the level of output achieved in the yearly columns, according to a scale from 1 – 5, for

¹ CELOS is foundation, linked with the University of Suriname, with a focus on sustainable management and utilization of renewable natural resources through applied scientific research and services.

² NZCS, as an institute of the University of Suriname, is responsible for the development of an overview of the fauna of Suriname and the development of a reference collection for scientific and educational purposes.

³ WLA, as part of the Ministry of Public Works is responsible for water quality research and determination of water samples of creeks, canals and rivers.

which 1 represents the worst ranking and 5 represents the optimum ranking. Once the current situation has been assessed during the first management effectiveness session, a ranking on the scale should be assigned. These results should be considered as the baseline for the protected area.

For example: Management structure in place and functioning

The indicator's scale:

5= 100% effective management structure established

4= 75% achievement towards an effective management structure

3= 50% achievement towards an effective management structure

2= 25% achievement towards an effective management structure

1= no effective management structure of the area exists

The M&E Plan is divided in subsections and presented in corresponding tables, according to the recognition of eight overarching goals within the management plan. In addition to that, two overarching goals are added in response to the business plan. The overarching goals are:

1. General Management
2. Protect biodiversity
3. Increase sustainability of fisheries
4. Enhance ecotourism
5. Increase sustainability of hunting
6. Encourage research
7. Increase public participation
8. Increase education and awareness
9. Increase financial sustainability
10. Enhance socio-economic conditions

The last section of the M&E Plan provides a calculation of the monitoring costs, based on research, sampling and frequency of sampling. Also, protocols for monitoring of Scarlet Ibis colonies, Tarpon and other fish species is provided.

1. General Management

Objective BG1: To conserve and enhance the natural environment of the estuary and its surroundings

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Adopt Bigi Pan Management Plan	Management Plan adopted by Government	Legal, governance and economic arrangements that are necessary for implementation	Governmental decision regarding Management Structure	X					NCD
2	Establish Foundation management structure, develop procedure handbook and have main personnel appointed	Management structure in place and functioning	Staff recruitments	MOU RGB-Management Foundation signed, procedure handbook	X					NCD/Management Foundation
3	Have personnel trained in principles of biodiversity conservation and MUMA management practices	Management personnel trained and operational Improvements in management and practices	Increased knowledge and awareness of personnel	Training reports, results of staff appraisals	X					Management Foundation
4	Purchase equipment and perform periodic maintenance of equipment	Sufficient equipment available and in good order	Maintenance schedule	Purchase receipts		X				Management Foundation
5	Establish equipped facility/ checkpoint office at the entrance to the Bigi Pan lagoon ('sleephelling')	Checkpoint building in place with necessary equipment	Checkpoint office	Progress report	X					Management Foundation

6	Establish satellite camp at Kaaimanpolder adjacent to Zeedijk	Satellite camp in place with necessary equipment	Satellite camp	Progress report			X			Management Foundation
7	Formulate rules and regulations in regard of actions allowed and prohibited within the MUMA	Rules and regulations established	Publication of rules and regulation of the MUMA	Progress report		X				Management Foundation

Objective BPG2: To enable better overall conservation management of the MUMA through increasing and improving land maintenance activities

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017-2022	Key actors
1	Develop up-to-date map of the area containing issued land within and around the MUMA and extract issued land from management areas of the MUMA	Targeted MUMA management	Effective MUMA boundaries	Up-to-date map of the area	X					NCD/ Management Foundation
2	Assess possibility of establishing buffer areas around terrestrial boundaries of the MUMA	Buffer areas investigated	Report with assessed possibilities and recommendations	Map with recommendations for buffer areas		X				NCD/ Management Foundation

Objective BPG3: To engage in identification and implementation of actions to mitigate climate change within conservation and resource management activities

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017-2022	Key actors
1	Complete and implement a flood study for the MUMA and surrounding land that takes into account the latest prediction for sea level rise	Climate change risks addressed	Mitigation actions	Flood simulation report		X				Management Foundation/ WLA/ ADEK

Objective BPG4: To minimize the environmental impact of human activities in and around the MUMA (and their associated problems), and to limit the impact of external changes to the natural equilibrium of the estuary.

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Obligate a social and environmental impact assessment for major planning activities	EISA obligated for major activities within, adjoining or related to the MUMA	EISA's	Ministerial Decree		X				NCD/ Management Foundation
2	Register people and cargo moving in and out of the MUMA	Number of visitors, active fishermen etc known	Database which registers people and cargo movements	Database with quantification of people and cargo		X				Management Foundation
3	Develop and implement a waste management master plan for the lagoon	Increased waste management	Amount of plastic and other waste in the waterways reduced	Waste management plan	X					Management Foundation
4	Implement monitoring program for pesticide levels in water and biota	Pesticide threat investigated	Distribution pattern of pesticides	Database with pesticides results		X				Management Foundation/ CELOS/ ADRON
5	Formulate game wardens patrols program and facilitate patrols	Game wardens patrols conducted	Continuous game warden patrols	Patrol reports	X					Management Foundation
6	Compile crisis/disaster management protocol to deal with drastic changes in the characteristics of the MUMA, including water quality	Disaster management protocol established	Disaster possibilities listed	Disaster management protocol			X			Management Foundation/ Bigi Pan users
7	Conduct mangrove mapping	Mangrove surface area known	Regular habitat mapping	GIS layer showing mangrove status			X			Management Foundation/ NARENA

8	Regulate boat traffic on the estuary to minimize impacts, enhance safety, and reduce pollution and nuisance by permitting boats with 6 persons maximum and 15 HP engine	Decreased level of impacts related to boat traffic	Publication of boat traffic requirements	Boat traffic requirements and guidelines	X					Management Foundation
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2. Protect biodiversity

Objective BIO1: To conserve and enhance native habitats and wildlife of the Bigi Pan estuary and pay special attention to those areas which support species of conservation and /or economic importance										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Rehabilitate estuarine habitat damaged by rice cultivation activities	Damaged sites rehabilitated	Improvement in ecological health	Water quality reports				X		Management Foundation/ADEK
2	Continue process to establish Ramsar status for Bigi Pan MUMA	Ramsar status established	Documentation for Ramsar Information Sheet, including map, prepared	Correspondence between RGB and Ramsar Secretariat regarding designation of Bigi Pan for inclusion in the Ramsar List		X				NCD/ Management Foundation
Objective BIO2: To seek to improve the water quality to a level which supports both a healthy estuarine ecosystem and the local community's recreational, aesthetic and commercial needs										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Maintain water accessibility through canals and creek mouths	Brackish water characteristics maintained	Canal and creeks mouths accessible	Water quality reports		X	X	X	X	Management Foundation
2	Establish and maintain a database to track ongoing water quality monitoring programs in the estuary	Database of water quality established	Water quality database in place and updated regularly	Water quality reports, monthly results		X				Management Foundation/ CELOS / WLA
3	Compile crisis/disaster management protocol to deal with drastic changes in the characteristics of the MUMA, including water quality	Disaster management protocol established	Disaster possibilities listed	Disaster management protocol			X			Management Foundation / Bigi Pan users

Objective BIO3: To determine the impacts of external influences on the MUMA and manage their impact on biological resources

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Assess the occurrence of alien (plant and animal) species and incorporate the monitoring of these species, if any	Alien species monitoring program implemented	Baseline data of occurrence of alien species	Report on occurrence of alien species	X			X		Management Foundation / ADEK
2	Compile crisis/disaster management protocol to deal with drastic changes in the characteristics of the MUMA, including water quality	Disaster management protocol established	Disaster possibilities listed	Disaster management protocol			X			Management Foundation / Bigi Pan users

Objective BIO4: To determine impacts of oil exploration on MUMA

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Examine the impacts of explosive blasts on breeding bird colonies	Impacts of explosive blasts on breeding bird colonies assessed	Research on breeding bird colonies	Research report on impacts of explosive blasts on breeding birds colonies		X	X			Management Foundation / ADEK

3. Increase sustainable fisheries (marine and inland)

Objective FIS1: To encourage the conservation of native fish, shellfish and bait stocks and to minimize the environmental impact of their exploitation										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Implement baseline research on Tarpon and other large economically important fish species	Baseline for large economically fish species established	Baseline numbers of large fish species determined	Approval letter form LVV for use of 'trammelnet' Baseline report		X				Management Foundation /Consultants
2	Implement monitoring program of Tarpon and other large economically important fish species	Tarpon and other fish species regularly monitored	Numbers of Tarpon and other large fish species known	Fish monitoring reports		X				Management Foundation /Consultants
3	Implement monitoring of the fisheries harvest for each species of fish or crustacean on daily basis	Fisheries harvest database in place and updated accordingly	Weekly catch numbers	Fisheries harvesting report	X					Management Foundation /Visserijdienst
4	Determine optimum fish harvest (carrying capacity) for economically important fish	Carrying capacity for fisheries harvest determined	Database of fish harvest	Fisheries harvesting report Report on carrying capacity		X				Management Foundation /Consultants
5	Develop and implement a rehabilitation plan to restore declined fishing areas	Rehabilitation plan implemented	Rehabilitation activities	Report on declined fishing areas. Rehabilitation plan			X			Management Foundation /ADEK
6	Identify key fish habitat areas (including spawning areas) and develop management actions to protect and improve fish habitat	Key fish habitat areas identified Management actions developed to protect and improve fish habitat	Management actions to protect and improve fish habitat	Report on key fish habitat areas			X			Management Foundation/ ADEK

7	Establish ongoing monitoring program to collect information on day visitors (recreational fishermen)	Day visitors and purpose of visit registered	Register of visitors	Reports on visitors	X						Management Foundation
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Objective FIS2 To sustainably manage the fisheries and water management infrastructure for legitimate users

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Establish equipped facility/checkpoint office as at the entrance to the Bigi Pan lagoon ('sleephelling')	Checkpoint building in place with necessary equipment	Checkpoint office	Progress report	X					Management Foundation
2	Develop and implement minimal requirements for fishermen's camps	Appropriate fishermen camps established	Fishermen camps	Progress reports	X					Management Foundation
3	Develop a waste management master plan for the Bigi Pan lagoon	Increased waste management	Amount of plastic and other waste in the waterways	Waste management plan		X				Management Foundation
4	Develop and implement integrated communication strategy/system (incorporating GIS technology) which can be used for communicating complaints and other aspects of the MUMA	Effective communication system established	Communication system	User's complaints, and other information gathered		X				Management Foundation / Bigi Pan users

Objective FIS3 To reduce the incidence of poaching activities within the fisheries

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Develop and implement fisheries quota limit for	Population of economically	Quota limits	Report on quota assessments			X			NCD / Management

	economically important fish and crustacean species	important fish managed								Foundation / LVV
2	Require fishermen to comply with fishing permit rules and requirements by conducting game wardens patrols and inspection of fisheries activities	Fishing conducted according to specified rules	Fishing rules	Inspection reports Number of permits	X					Management Foundation

4. Enhance ecotourism

Objective ECT1: To accommodate and encourage managed recreational use of the estuary at a scale that is appropriate and sustainable to the estuary's environment										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Determine visitation rate. Determine and integrate tourism carrying capacity	Maximum occupancy of daily visitor established. Tourism carrying capacity determined	Carrying capacity results for tourists	Database with number of visitors Report on carrying capacity			X			Management Foundation /ADEK
2	Develop a waste management master plan for the Bigi Pan lagoon	Increased waste management	Amount of plastic and other waste in the waterways	Waste management plan		X				Management Foundation
3	Streamline Suriname tourism guidelines in accordance with the precautionary principle related to tourism activities	Tourism activities regulated	Tourism impact on ecosystem	Tourism guidelines				X		Management Foundation
4	Develop and implement minimal requirement for tourist camps/lodges and implement permits for tour operators	Tourist camps/lodges built according to requirements	Condition of tourism camps	Number of permits for tour operators				X		Management Foundation
5	Develop and implement polluters pay principle and administer fines for trespassing waste/pollution rules	Polluters pay principle implemented	Fines for trespassing waste/pollution rules	Ministerial decree on Pollution fines				X		NCD / Management Foundation
6	Compile and implement a monitoring plan for the	Visitor's impact decreased	Tourism impact on ecosystem	Yearly assessment reports on trails,	X					Management Foundation

	visitor impact on the ecosystem, including trails, trampling, canal or bank erosion, and e-coli levels			trampling, erosion and other effects						
7	Regulate boat traffic on the estuary to minimize impacts, enhance safety, and reduce pollution and nuisance by permitting boats with 6 persons maximum and 15 HP engine	Decreased level of impacts related to boat traffic	Publication of boat traffic requirements	Boat traffic requirements and guidelines		X				Management Foundation
8	Develop signage and infrastructure to maintain an approach limit of 50-60 meters for visitors to breeding bird colonies to prevent nesting disturbance and disruption	Breeding bird colonies not disturbed by visitors	Signage and infrastructure	Progress report		X				Management Foundation
9	Develop appropriate nature friendly infrastructure and facilities for visitors including wooden trails, piers, bird hides/watch towers to manage visitor activity	Visitor facilities built	Facilities for visitors	Progress report				X		Management Foundation

5. Increase sustainable hunting

Objective HNT1: To conserve the genetic diversity of game species and permit wildlife stock harvest of the estuary at a scale that is appropriate and sustainable to the estuary's environment										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Establish equipped facility/ checkpoint office as at the entrance to the Bigi Pan lagoon ('sleephelling')	Checkpoint building in place with necessary equipment	Checkpoint building	Progress report	X					Management Foundation
2	Develop a waste management master plan for the Bigi Pan lagoon	Increased waste management	Amount of plastic and other waste in the waterways	Waste management plan		X				Management Foundation
3	Implement monitoring of the game yield from the MUMA for each species of game on daily basis	Game yield database established	Database	Game reports	X					Management Foundation
4	Implement baseline research on Jaguar population	Baseline for Jaguar population established	Baseline number of Jaguar population	Baseline report	X					Management Foundation/ Consultants / NZCS
	Implement monitoring program of Jaguar population (every two year) and Scarlet Ibis population (every year)	Jaguar population and Scarlet Ibis regularly monitored	Numbers of Jaguar species and Scarlet Ibis population known	Jaguar and Scarlet Ibis monitoring reports	X					Management Foundation / NZCS/ Consultants
5	Determine optimum game harvest (carrying capacity) for game species	Hunting carrying capacity determined and updated accordingly	Hunting limits for species	Game reports			X			Management Foundation/ NZCS
6	Develop and incorporate game quota limit for every game species; review and	Game species populations increased	Bag inspections	Ministerial decree on hunting in Bigi Pan				X		NCD/ Management Foundation/

	adjust the hunting law for the MUMA and replace the bag limit with the quota limit									
7	Require hunters to comply with hunting permits rules by conducting regular game wardens partols	Game wardens patrols conducted	Continuous game warden patrols	Patrol reports	X					Management Foundation
8	Compile and execute awareness program concerning the effects of poaching (game and protected species) on the MUMA in relation to the international importance of the MUMA (occurrence of birds of international importance, IBA and Hemispheric Reserve)	Increased awareness on effects of poaching	Awareness program in effect	Awareness plan Decreasing number of poaching activities	X	X	X	X	X	Management Foundation

Objective HNT2: To encourage the conservation of protected species and their habitats

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Facilitate the adoption of poachers into the MUMA management system and enroll in game warden training in order to enhance their livelihoods and contribute to the overall management of the area	Poachers adopted for management of the area	Poachers trained	Number of poachers trained				X		Management Foundation
2	Establish monitoring program to carry out periodic Scarlet Ibis and Jaguar assessments	Periodic Scarlet Ibis and Jaguar population assessments started	Numbers of Jaguar species and Scarlet Ibis population known	Reports on populations	X					Management Foundation / Consultants / NZCS

6. Encourage research

Objective RES1 To encourage the highest standards of scientific research and monitoring surveys, with minimal environmental impact, that are of value to the conservation management, understanding of the estuary and/or its ecological processes

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Identify information gaps and develop research programs aimed at gathering data on biodiversity and exploited species (including carrying capacity)	Research programs developed and implemented	Research projects started	Research reports	X	X	X	X	X	NCD / Management Foundation
2	Develop and implement a rehabilitation plan to restore declined fishing areas	Declined fishing areas rehabilitated	Rehabilitation activities	Progress reports			X			Management Foundation
3	Develop and integrate volunteers program to assist in the execution of research and monitoring projects	Volunteers attracted	Volunteers at work	Progress report		X				Management Foundation
4	Execute pilot project beekeeping within the MUMA	Beekeeping started	Beekeeping activities	Progress report				X		Management Foundation

7. Increase public participation

Objective PPT1: To seek to manage the Bigi Pan MUMA in a way that is sustainable to the estuarine environment and actively involves the local community, recreational users and commercial interests of the estuary

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Develop and implement integrated communication strategy/system (incorporating GIS technology) which can be used for communicating complaints and other aspects of the MUMA	GIS communication system implemented for registering complaints and other user interaction	GIS communication	User's complaints, and other information gathered		X				Management Foundation
2	Maintain stakeholder database	Stakeholder database developed and updated	Stakeholder information available	Stakeholder database	X					Management Foundation

Objective PPT2: To involve all those with an interest in the estuary in the conservation management of its environment by their inclusion within its program of conservation – monitoring, interpretation and enhancement

	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Develop master plan to incorporate users and all others with an interest in the estuary in active management of the MUMA (including input via website)	Public participation plan/strategy implemented	Website	Public participation plan/strategy		X				Management Foundation / Stakeholders

2	Establish regular coordinating meetings with (governmental) players in the MUMA such as the water board and public works	Regular meetings with governmental stakeholders	Cooperation of governmental stakeholders	Meeting reports		X	X	X	X	Management Foundation
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8. Increase education and awareness

Objective EAA1: To increase the community's awareness regarding the Bigi Pan MUMA, its ecology and needs, and about the Management Plan itself, its aims and objectives and the responsibilities of the community towards the continued conservation of the estuarine ecosystem of the Bigi Pan MUMA										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Compose educational and informative material including signage, posters, pamphlets and relevant info to enhance visitor experience	Community awareness on importance and value of Bigi Pan raised	Posters, signage, pamphlets, literature composed and distributed	Posters, signage, pamphlets	X	X	X	X	X	Management Foundation
2	Compile booklet for general public, highlighting the importance and resources of the MUMA, the importance of conservation measures, as well as the revenues generated	Community awareness on importance and value of Bigi Pan raised	Booklets distributed with information of the importance of the MUMA, using monitoring data, published and updated every 2 years	Booklets		X		X		Management Foundation
3	Compile and execute awareness program concerning the effects of poaching (game and protected species) on the MUMA in relation to the international importance of the MUMA (occurrence of birds of international importance, IBA and Hemispheric Reserve)	Increased awareness on effects of poaching	Awareness program in effect	Awareness plan Decreasing number of poaching activities	X	X	X	X	X	Management Foundation

4	Make MUMA information and data readily available to the general public through information management system and internet	MUMA information easily available for general public	Website established and updated regularly	Website	X	X	X	X	X	Management Foundation
5	Promote World Wetlands Day as a public event and organize special activities on this day which highlight the importance of the Bigi Pan MUMA	Awareness on importance and values of wetlands raised	Activities executed on wetlands day every year	World Wetland Day reports		X	X	X	X	Management Foundation
6	Mark boundaries of MUMA and generate billboards/signage communicating the size, importance, resources and revenue	Boundaries and other important information of Bigi Pan displayed	Signage with information of the MUMA	Billboards, signage	X					Management Foundation
7	Encourage field excursions by local schools, community groups and other stakeholder groups	Bigi Pan regularly visited by schools and other educational groups	Field excursions facilitated	Number of field excursions	X	X	X	X	X	Management Foundation

9. Increase financial sustainability

Objective FIN: To increase the financial sustainability for the longterm management of the Bigi Pan MUMA										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Adopt the longterm financing plan	Increased financial sustainability	Sufficient funds for optimum management	Progress report	X					NCD/ Management Foundation
2	Identify the goods and services of the MUMA (including carbon sink) and develop and implement an action plan for fundraising	Justification of the existence of the MUMA established	Goods and services produced by the MUMA identified and valued	Valuation report	X					NCD / Management Foundation
3	Establish income generation mechanisms that are consistent with national and institutional laws and policies, according to Business plan	Optimum management established	Existence of policies that will guarantee the availability of funds generated by the area itself	Amount of income generation		X	X	X	X	Management Foundation
4	Set up a endowment fund with the help of Suriname Conservation Foundation (SCF)	Endowment fund for financing of management activities established	Sufficient funds for optimum management	Arrangement with SCF			X			NCD / Management Foundation
5	Develop and implement marketing strategy	Marketing strategy implemented	Existence of a marketing strategy	Marketing plan		X				NCD / Management Foundation

10. Enhance socio-economic conditions

Objective SEC: To increase the contribution of the Bigi Pan MUMA to a mixed economy by generating employment and income to local populations										
	Activity	Output	Key indicator	Means of Verification	2013	2014	2015	2016	2017 - 2022	Key actors
1	Increase mixed economy with satisfactory number of jobs related to the MUMA	Increased income generation possibilities for local communities	Number and type of jobs for local communities related to the MUMA	Local interviews and surveys (Updates every 3 years)	X	X	X	X	X	Management Foundation
2	Enable commercial activities that contribute to conservation objectives, with a financial return for the protected area	Increased income generation possibilities for local communities	Commercial activities established such as visitor accommodations, sale of local products using traditional knowledge and techniques	Progress report		X	X	X	X	Management Foundation
3	Support activities to increase fishermen's income	Increased income for fishermen	Catch per effort	Number of fishing permits		X	X	X	X	Management Foundation

Monitoring costs

Parameter	Frequency of monitoring	Time period	1 st year due to baseline development	2 nd year	3 rd year	4 th year	5 th year
WATER QUALITY measured at 8 locations			USD 53,000	USD 53,000	USD 53,000	USD 53,000	USD 53,000
Temperature	Monthly						
pH	Monthly						
Salinity	Monthly						
Turbidity	Monthly						
Dissolved oxygen (DO)	Monthly						
Surface water nutrients nitrogen (N), Potassium (K) (Kalium) and phosphorus (P)	2x per year	1x dry season 1x rainy season					
Biological oxygen demand (BOD)	Monthly						
Chemical oxygen demand (COD)	Monthly						
Sediment analysis CEC	Monthly						
Heavy metals	Once per year						
E. coli bacteria, measured at 2 locations (USD 260/sample)	Monthly		USD 6,240	USD 6,240	USD 6,240	USD 6,240	USD 6,240
MANGROVES and Mudbanks Activities: Remote sensing, fieldwork and analysis	Once per 2 years		USD 160,000⁴	-	USD 160,000		USD 160,000
Areal extent							
Density							

⁴ Mangrove monitoring costs is USD 160,000 for every 2 years

CARNIVORES							
Jaguar	Once per 2 years		USD 10,000		USD 13,000		USD 13,000
BIRDS							
Scarlet Ibis	Once per year	In June ⁵	USD 3,000	USD 3,000	USD 3,000	USD 3,000	USD 3,000
FISH measured at 4 locations							
Tarpon	2x per year	1x dry season 1x rainy season	USD 27,500 ⁶	USD 15,000	USD 15,000	USD 15,000	USD 15,000
TOTAL COSTS			USD 259,740	USD 77,240	USD 250,240	USD 77,240	USD 250,240

⁵ June is the best time of the year to count the population of Scarlet Ibis (according to A. L. Spaans, ornithologist, who has done extensive long term research on the presence of Scarlet Ibis in the Guianas)

⁶ The first year a baseline research has to be done, during 4 seasons.

Protocol for Scarlet Ibis monitoring

Counting of breeding colonies should be performed from a low-flying plane operating in an altitude of 500 -700 feet (150 – 210 m). At these altitudes, the breeding colonies of scarlet ibises, egrets and other herons could easily be detected. They can be distinguished from non-breeding assemblages of these birds, because they do not leave their nests when the plane circles around the colony.

The counting should take place each year, during the first half of June.

Numbers obtained from aerial surveys are nearly always underestimates and have to be multiplied by 1.5 to get the real numbers (Spaans, A. L., 1975).

Protocol for monitoring of Tarpon and other fish species

The monitoring of Tarpon and other commercially significant fishes (such as Tilapia and Snoek) should be done by counting the catch/unit effort. For monitoring purposes the ‘trammel’ fishing nets with a length of 50 meters, should be used. The nets should be placed for a period of 24 hours, after which the catch per species is counted and the weight per species is determined.

ANNEX 1 Background document

A. Introduction

What is Monitoring & Evaluation

A management plan and business plan require its main actors (stakeholders, governmental institutions, NGO's etc) to be informed of its effectiveness. This means that the effects of the management plan and business plan have to be measured and assessed continuously through a Monitoring & Evaluation (M&E) plan that is part of the operational management.

Monitoring is also relevant when performance of the management authority needs to be assessed and agreements between the Government and the management authority need to be evaluated. The definition of monitoring is⁷: “Collection of specific information for management purposes in response to hypotheses derived from assessment activities, and the use of these monitoring results for implementing management”.

Monitoring for management of Bigi Pan MUMA

Bigi Pan is endowed with diverse communities of organisms and it provides ecological functions with significant value to society. It is important to preserve and protect functions such as the provision of fish and wildlife habitat, flood storage, protection from shoreline erosion, and opportunities for research and recreation. In this hydrological basin, water streams are interconnected and any activity or alteration will have its impact on the functioning of the ecosystem. Monitoring provides essential information about the condition of the Bigi Pan area and how natural resources change over time. It is needed to understand cumulative impacts to the wetland condition, which result from land-use changes, water fluctuations, fishing, loss of protective buffers, fragmentation, and other factors. Collection of data is necessary as it provides knowledge of the consequences of fishing, agriculture and other human interventions in Bigi Pan. However, monitoring of data only have makes sense if analyzed and transformed into strategic information, analysis and scientific advice that can be used by decision makers. Information gathered by systematic monitoring is also useful to evaluate management decisions for Bigi Pan and to improve protection efforts.

⁷ Ramsar Framework for Wetland Inventory

Ecological, socioeconomic and financial monitoring

The M&E plan consists of both ecological and socioeconomic monitoring. Ecological monitoring provides information on natural resources. Through ecological monitoring, data are collected periodically and used to evaluate whether or not management measures are indeed contributing to improved conditions.

Socio-economic and financial monitoring provides information for the business plan of Bigi Pan. Through socioeconomic and financial monitoring, chances for successful implementation of the business plan are assessed. It provides information that will help improve understanding of the link between the condition of the ecological status of Bigi Pan and its impacts on the socio-cultural and economic wellbeing of individuals, households, communities, groups, and organizations connected to the Bigi Pan area.

In 2003/2004 the World Wildlife Fund Guianas introduced the toolkit Monitoring and Assessment with Relevant Indicators of Protected Areas of the Guianas (MARIPA G) for assessing effectiveness of protected areas management in the Guianas. The methodology was assessed through local workshops, adapted to Surinamese conditions and generally accepted by stakeholders in Suriname as a monitoring tool for protected areas. This MARIPA G toolkit provided a basis for the underlying M&E plan.

How the Monitoring & Evaluation plan for Bigi Pan MUMA was prepared

The objectives of monitoring as well as the indicators and methods to measure these indicators were discussed and agreed upon by stakeholders through discussions and interviews held during November 2012 – January 2013. The following strategic questions were asked:

1. Which data need to be gathered for monitoring?
2. Which information about the ecological condition might help do your job better and help improve management?

The M&E plan is based on the experiences and lessons learned from the Ministry of RGB as well as through discussions with local stakeholders, CELOS, WLA, NZCS and expert consultations such as mr. A.L. Spaans.

B. Objectives of Monitoring & Evaluation of Bigi Pan

In general, the monitoring objectives reflect the goals outlined in the management plan.

The general objectives for Monitoring & Evaluation are:

1. To maintain the Bigi Pan ecosystem in a sustainable condition in order to continue desired evolutionary and ecological processes.
2. To (rebuild and) accommodate populations and species at high levels of productivity so as to not interfere a range of goods and services from the ecosystem while providing food, revenues and recreation for humans.
3. To assess limits of the natural resources and conditions for its maintenance by research, in order to regulate the extractive capacity of the fishery and to maintain critical ecosystem processes and structures.
4. To provide baseline data and assist with reporting and accountability.
5. To evaluate the effectiveness of the wetland management and the progress on the business plan.

Information gathered from consultations with stakeholders resulted in more specific objectives for short and medium term. Short-term objectives are intended to be met in a 1-3 year timeframe and medium term objectives are to be met in 3-5 years timeframe.

Short-term objectives

1. Assess progress on management effectiveness of Bigi Pan and progress on business plan
2. Maintain viable populations of native species in situ
3. Accommodate human usage, human requirements and occupancy without disturbing the ecological equilibrium.
4. Improve research to better understand complexity, dynamics and interrelated factors of the ecosystem.
5. Develop a database of information necessary to evaluate trends in wetland condition.

Long-term objectives

1. Identify causes and sources of wetland degradation including cumulative impacts to the wetland condition.
2. Identify program and policy changes needed to improve overall wetland condition.

These objectives need to be updated regularly in the light of the results of monitoring and research activities.

C. Threats and impacts

The Bigi Pan MUMA is used for a wide range of human consumptive and non-consumptive uses, such as recreation, food source and livelihood. Diverse threats to and impacts on the ecosystem are a result from human usage of the area.

The most common threats and related impacts are presented in Table 1.

Table 1: Common treats and impacts within Bigi Pan MUMA

	Threats	Impacts
1	Agriculture: Transformation of land for agriculture. Transformation could be physical (e.g. by adding artificial structures) or chemical (e.g. through injection of nutrients, pesticides).	Habitat loss. Dams and drying-up of streams affect the quality of habitats and alter or interrupt the reproductive migration processes of species. Pesticide runoff from agricultural lands towards Bigi Pan can become a threat to marine ecosystem, affecting the favorable conditions for the reproduction of fish.
2	Excessive fresh water withdrawals for irrigated agriculture.	Leads to less fresh water availability inland, and to less fresh water flow to coastal areas from rivers impacting coastal ecosystems and their functioning.
3	Fishing: Destructive fishing techniques e.g. inadequate fishing practices, dumping of plastic debris that can entangle marine animals, lack of selectivity (affecting associated and dependent species, resulting in wasteful discarding practices.	Species like fish, sea birds and marine mammals can be affected by discarded gear (entanglement). Reduces the abundance of the population, reduces spawning potential and possibly, population parameters (growth, maturation etc).
4	Poaching	Loss of key organisms
5	Waste discards and nutrient loading: through agricultural runoff with pesticides and fertilizers (nitrogen, phosphorous) and through poorly treated human wastes	Contamination of water quality. Oxygen depletion due to excessive organic waste. Excessive algal growth and resulting reduction in other species.
6	Oil exploration	Subsurface and seismic explorations are a threat to breeding bird colonies, dolphins and manatees (in the coast) because of the high noise levels and seismic movements.
5	Climate change and sea level rise: changes in rainfall intensity and variability are expected to increase flooding and drought in other areas. Mangroves are especially vulnerable to climate change because they have limited capacity to adapt to change.	High water temperatures and extreme weather events (such as floods and droughts) affect water quality and intensify several forms of water pollution (pollutants such as high nutrient levels, pathogens, pesticides, salt etc. Destruction of natural coastal defense system.

D. Monitoring aspects and related factors

Use of sampling protocols

In the past, research activities have taken place with regards to the Big Pan MUMA, for example research on water quality and migrating birds has been documented. However, there has been no systematic and continuous system in place in order to establish a reliable baseline and database regarding the status of the biodiversity and/or the use of the protected area resources by fisheries, hunting, and other anthropogenic activities. For systematic monitoring, use of defined sampling protocols and notification of geographic position of the sampling is essential to produce consistent data which can be compared. Only research results of Scarlet Ibis done in the past qualifies as a baseline, see chapter 6, because of the consistent methodology used for surveys of these migratory birds. In 2008⁸ an extensive study done in the Bigi Pan MUMA resulted in quantification of the mangrove surface area, which can also be used as a baseline, since mangrove quantification is a rather standard process.

The absence of a baseline and a database calls for a formalized process for generating, analyzing and applying information, in order to:

manage the risks to biodiversity associated with increased natural resource,
increase the ability for informed decision-making, and
pursue opportunities to generate sustainable revenues.

Therefore, for systematic monitoring sampling protocols will be used in a consistent way.

Use of indicators

The M&E system is based on an efficient, effective, and low-cost approach to protected areas monitoring. It is cost efficient, which places limits to the selection of species and parameters to be monitored.

In the project document “Coastal Protected Areas Management” certain indicator species and parameters have already been identified. The selection of indicator species has been based on correlation between indicator status and changes in environmental variables.

For ecological monitoring the following indicators⁹ have been identified:

1. Water quality: (pH, temperature, salinity, turbidity, COD, BOD, DO, N, P, K, heavy metals E-coli and CEC)
2. Mangrove status
3. Migratory birds: Scarlet Ibis
4. Carnivores: Jaguar
5. Fish: Tarpon *Atlanticus* (Trapoen)

⁸ Final report Biodiversity and Economic Valuation of Bigi Pan MUMA 2008

⁹ These indicators and parameters will be further explained in Table 2

For socio-economic monitoring examples have been given in the project document:

1. Visitor numbers
2. Revenue generation
3. Subsistence and commercial use of biological resources

E. General data which will be monitored

Table 2 provides information on indicators and parameters that will be monitored and the frequency of monitoring.

Table 2: Description of indicators and parameters to be monitored

Indicator / Parameter	Description of parameter	Frequency of monitoring
Temperature	Measure of ambient water temperature	Monthly
pH	Measure of acidity of water	Monthly
Salinity	Measure of concentration of mineral salts in water. Is highly dependent on water temperature.	Monthly
Turbidity	Measure of light scattering by suspended particles in water, providing an indirect measure of light penetration	Monthly
Dissolved oxygen (DO)	Measure for the concentration of oxygen in mg/l and recalculated using temperature to return percentage saturation.	Monthly
Surface water nutrients nitrogen (N), Potassium (K) (Kalium) and phosphorus (P)	N, K and P in surface indicates runoff from agricultural land, as these nutrients mostly come from fertilizer application	Monthly
Biological oxygen demand (BOD)	Indicates the amount of water-dissolved oxygen consumed by micro organisms. The higher the BOD, the higher the amount of biological pollution in the water.	Monthly
Chemical oxygen demand	Indicates the amount of organic pollutants in surface water.	Monthly
Sediment analysis Cation exchange capacity (CEC)	The net ability of a soil to hold, retain and exchange cations such as calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), sodium (Na^+) and ammonium (NH_4^+) and prevent them from leaching. The higher a soil's CEC, the more cations it can retain.	Monthly
E. coli bacteria	<i>Escherichia coli</i> (called <i>E. coli</i>), refers to a group of bacteria that is commonly found in the intestines of humans and animals. High levels of <i>E. coli</i> found in the water indicate a high concentration of faeces, or stool, of humans or animals. <i>Measure coliform, faecal coliform and e-coli</i>	Monthly
Heavy metals	Heavy metals, mostly coming from tailwater, can accumulate in lakes or reservoirs, they are not degradable. At high concentrations they can become toxic for aquatic organisms.	Once per year

Indicator / Parameter	Description of parameter	Frequency of monitoring
MANGROVES and Mudbanks	Mangroves interact with mudflats, fresh and saltwater, leading to a highly productive ecosystem. Its existence is important to maintain the shoreline protection and preserve biodiversity.	
Areal extent	Monitoring with remote sensing combined with ground thruthing.	Once in two years
Density	A measure of the condition of the mangrove habitat. Mangroves >40% crown density are dense (closed forest), 10-40% crown density are sparse (open forest), <10% crown density are degraded mangroves.	Once in two years
CARNIVORES	Indicator species	
Jaguar	A sign of a healthy ecosystem. Is common in coastal protected areas of Suriname.	Once in two years
BIRDS	Indicator species	
Scarlett Ibis	Is a migratory bird. Breeds in a narrow zone along the coast of northern and eastern South America. The Scarlet Ibis nest predominantly in young black mangrove forests. <i>Measure abundance by counting breeding colonies during low-altitude aerial surveys</i>	Once per year In June ¹⁰
FISH	Indicator species	
Tarpon <i>Atlanticus</i> (Trapoen)	Tarpon is a predator fish species. Its presence indicates the availability of freshwater ¹¹ . <i>Measure abundance, biomass and density.</i> Abundance can be characterized as numbers sampled per site and lifestage. Biomass is characterized by biomass and lifestage at each site. Density is reported as numbers and biomass per kilometer or hectare.	Half yearly

¹⁰ June is the best time of the year to count the population of Scarlett Ibis (A. L. Spaans, ornithologist and who has done extensive long term research on the presence of scarlet ibis in the Guianas.

¹¹ Comment made by local fisherman

F. Baseline

The establishment of baseline values is useful to evaluate future changes in levels of contamination in the Bigi Pan area, the status of the biodiversity and to evaluate results from a change in management.

Only for the indicators Scarlet Ibis colonies and mangrove surface area there is an useful baseline, see results below.

For all other parameters and indicators a baseline still needs to be established.

Baseline Scarlet Ibis

Long term aerial surveys along the coastline of the Guianas (Frederick et al, 1990) demonstrate that numbers of active colonies and occupied nests of Scarlet Ibis fluctuate strongly between years, resulting in the conclusion that the Scarlet Ibis regularly omits breeding for one or more years, probably in relation to fluctuations in local ecological conditions for nesting and/or feeding.

From the early seventies till 1986 regular aerial surveys were performed to count breeding colonies of Scarlet Ibis along the coastline of the Guianas. The data obtained did not distinguish between areas, so it is not possible to use these data as a baseline for Bigi Pan MUMA.

More recent research data of Bigi Pan MUMA, obtained by A.L. Spaans, date from 2006 till 2011 and demonstrate no presence of breeding colonies of Scarlet Ibis:

Presence of Scarlet Ibis

Coordinates	Year	Number of nests (without correction)	Number of nests (after correction)
56.55 W 56.42 W 56.38 W	2006	-	-
05.57 N, 57.03 W 05.59 N, 56.44 W	2009	-	-
05.57 N, 57.03 W 05.59 N, 56.44 W	2011	-	-

Baseline mangroves surface area

In an extensive study of the Bigi Pan MUMA in 2008 (Naipal et al, 2008) the total mangrove surface area was calculated at 43.8% of the total surface area of the Bigi Pan MUMA.

A distinction was made in the following categories:

Young mangroves	: 13.8% of total Bigi Pan area
Dead mangroves	: 2.7% of total Bigi Pan area
Mature mangroves	: 25.9% of total Bigi Pan area
Dying mangroves	: 1.4% of total Bigi Pan area

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