Operations and Maintenance (O&M) Plan – MI COSTA

O&M costs during project implementation will be shared by the GCF as well as the GoC, beginning in the second year of the project. O&M cost for forestry equipment, transportation equipment, fuel, monitoring equipment, laboratory equipment, ICT equipment and audiovisual equipment and spare parts will be covered by GCF (46%). The GoC through 3 national institutions will cover the O&M cost related to forestry management, monitoring execution activities, infrastructures maintenance and the salary of forestry workers and specialists (54%). From year 9-30 full OM costs will be provided by the GoC.

Table 1: Total Operation and Maintenance Costs Yrs 1-8

Act.	Cost description	Source of Finance	Total 1-8
1.1	Maintenance of ditches	MINAG	1,607,084
1.2	Forest cleaning	MINAG	986,621
1.2	Maintenance of roads (fire trails)	MINAG	229,163
1.2	Equipment maintenance service and fuel	GCF	2,093,405
1.3	Execution of environmental monitoring	CITMA	578,448
1.3	Maintenance of marine monitoring infrastructure	GCF	225,141
1.3	Vehicle and boat maintenance (CITMA)	GCF	126,797
1.3	IT and visual equipment maintenance (CITMA)	GCF	10,324
1.3	Fuel	GCF	189,733
1.4	Execution of monitoring of terrestrial waters	INRH	556,171
1.4	Fuel service,spare parts of equipment	GCF	94,315
2.1	Vehicle maintenance	GCF	286,242
2.1	Fuel for vehicles	GCF	24,615
2.1	Maintenance of Capacity Building Centers and municipal level classrooms	CITMA	35,000
2.1	Operating Capacity Building Centers	CITMA	366,656
2.1	Communication services tu support capacity building centers	GCF	92,152
2.2	Generating EBA information products and uptading them	CITMA	141,648
2.2	Operating Community Monitoring System	CITMA	118,800
2.2	Communication services and maintenance of knowledge platform	GCF	592,000
3.1	Fuel service,spare parts of equipment	GCF	125,603
3.1	Communications services	GCF	9,600
Total			8,489,518

Output 1: Rehabilitated Ecosystems for Coastal Protection and Resilience to Climate Change

In Output 1 the following are the key systems/products that will be developed through the project and will require operation and long term maintenance: 1) ecosystem restoration interventions; 2) the marine monitoring network (water quality and marine systems) including a volunteer coral monitoring network; and 3) the water conduction systems and monitoring stations.

Ecosystem Restoration Investments (Activities 1.1 and 1.2)

Ecosystem restoration will involve direct intervention in 7 key sites as detailed in the project's Feasibility Study (Annex 1 and Section 6). Direct interventions include the rehabilitation of coastal wetland hydraulic and hydrological process, planting mangroves and native plant species, removing invasive alien species, weed clearing and thinning and establishing fire control measures. These interventions will be operated by 6 forest enterprises ascribed to MINAG that will implement restoration actions within the 7 intervention areas.

Operation and maintenance costs for this product take into account the cost of maintaining the restored coastal ecosystems, including: maintaining of the hydrological works to ensure the proper hydrological flow, sanitary felling and forest thinning, forest clearing, management of natural regeneration, maintenance of fire trails and the monitoring of the rehabilitation process (monitoring of permanent plots and video and image analysis). The maintenance of the restoration actions are detailed in Annex 2 Feasibility Study Section 6.3.1.2 "Maintenance of Interventions in Mangroves, Swamp Forests Swamp Grasslands" but can be summarized in the following table:

Task	Objective
Maintaining of the hydrological works	Cleaning and maintaining channels (removing vegetation that may invade channels, sediments obstructing channels, etc.
Sanitary Felling	Santiary control of vegatation with diseases or pests for sanitary control
Forest Thinning	Tree formation to allow for light to penetrate on mangrove plantations when necessary
Forest Clearing	Selective cutting of individuals planted to stimulate growth especially in stands where the densities are very large
Management of natural regeneration	To ensure that scarce but naturally occurring species within the Swamp

	Forest are regenerated. Includes planting and weed control.
Maintenance of fire trails	Annual review of forest trails developed including control and management of vegetation that promotes fire conditions and maintenance of the skid firewall (trenches that serve as firebreaks while contributing to the forest hydrology)

OM costs also include actions and equipment to ensure that the acquired equipment is functional to provide the maintenance services that are required during the project's life time (22 years) including services, replacement of spare parts, fuel costs, etc.

For this process, the forest enterprises will develop and OM Implementation work plan that will take into account the specific maintentenance actions that will be required for the equipment provided taking into account the human resources, occupational safefty facilities and means of work for each major piece of equipment (machinery, transport and scientific equipment). Service for the equipment will be provided through the Intregral Units of Techical Services (UEBIST) that are municipal based business units responsible for providing agricultural mechanization services and technical assistance for agroforestry work. UBEIST have the technical capacity (through specialized workshops) and skill to provide these services and will do so as part of the OM costs provided by the MINAG and CITMA through this project.

Operation costs during the initial 8 years take into account the maintenance of the restoration areas (mowing, forest cleaning, fire ditches, cleaning ditches that have been cleared). These costs amount to USD 4,916,273 during the project's initial 8 years (without accounting for capital investments).

O&M costs for restoration and related equipment post the project's initial 8 years have been detailed in Table 2, will be provided by the forest enterprises (MINAG) and CITMA as stated above.

O&M investments for the restoration will decrease over time as initial capital investments of the restoration itself phase out and equipment is used for system maintenance. These will also decrease as the system begins to mature enough to provide the ecosystem benefits (years 8-9) and is able to manage itself naturally (year 10). Key investments in ecosystem maintenance are considered in years 9, 10, 15 and 20. These coincide with scheduled forest thinnings to stimulate growth and forest cleanings based on best practices. Costs related to OM of related to Activity 1.1 and 1.2 are estimated at a total of USD $ 6,249,212.00 [1] for years 9-22 and include the cost of fuel, equipment maintenance (as stated above through the UEBIST), and interventions within the ecosystems.

[1] 1 USD = 24 CUP based on UN Operational Rates of Exchange (Jan 15 2021) available at https://treasury.un.org/operationalrates/OperationalRates.php

Marine Monitoring Network (Activity 1.3)

The project will invest in a marine monitoring network to assess the impact of restoration actions in favoring the natural regeneration of marine systems. This will include 5 (one national reference lab and 4 provincial labs) enhanced labs to measure improved sea water quality and data capture equipment in 16 permanent marine stations,10 automatic weather stations, 4 wave stations and 6 sea level and terrain movement stations as well as a mobile laboratory for in situ measurements of water quality.

Monitoring systems will be developed in the first two years of the project with monitoring itself being done through experts hired for this project. This system will be managed by ICIMAR/AMA. Equipment for the monitoring system will include fixed equipment that will be placed on the hulls of boats, and fixed equipment placed on the coasts of both the island of Cuba and the keys.

All monitoring equipment will be integrated into ICIMAR/AMAs monitoring system and it will be the research institution in charge of their general management and upkeep. Total cost of tools and supplies for the assembly and maintenance of the permanent marine stations has been costed based on prior experience and technical specifications. Stations will be equipped with data capture equipment. The purchase of equipment includes a budget line for spare parts and purchase price foresees the inclusion of warranty plans. Equipment warranties in Cuba do not include access to spare parts (See Feasibility Study Section 4.5), hence these have been included within the project budget.

The life of marine equipment in local conditions with regular upkeep is estimated to last the project's full lifespan as has been demonstrated in past projects and taking into account the purchase of spare parts including replacement CTD sensors, spare batteries (further detailed in the budget notes) to ensure that monitoring is not interrupted. Biannual calibrations and cleaning of equipment is considered within labor costs included in the co-financing budget with this work being performed by ICIMAR experts and engineers. The inclusion of service support is foreseen within the equipment prices.

As part of the maintenance process, ICIMAR/CITMA will develop a work plan taking into account the specific maintentenance actions that will be required for the equipment in consideration of human resources, occupational safefty facilities and means of work for each major piece of equipment (monitoring stations, transport and scientific equipment). Service for the monitoring equipment will be provided by the Institute of Cybernetics, Mathematics and Physics with its Advanced Electronics Laboratory. CITMA also has a General Service Enterprise at a central level that provides specific service to CITMA and its ascribed agencies both centrally and locally. These technical enterprises have the technical capacity (through specialized workshops) and skills to provide these services and will do so as part of the OM costs provided by CITMA through this project. INSMET, responsible for providing technical maintenance to the national radar and meteorological

network and which is ascribed to CITMA will also provide support in the maintenance of the monitoring equipment.

After the project's initial investment period (8 years), CITMA will develop annual service plans until year 15 of the project, thse will be biannual from project years 15-30. Equipment depreciation in Cuba is estimated to take place between years 10-20. The project has included the purchase of of replacement parts (batteries,sensors, and electronics parts) and will follow a service plan that will allow the the project to make use of this equipment through its full lifetime. A phase-out schedule has been contemplated for the operation of marine monitoring beginning on year 15 as monitoring becomes streamlined, ICIMAR's general activities and service of equipment becomes less expensive (considering it will receive less use and service costs will become less expensive).

Operation costs will also include the mobilization of volunteers and of experts to project sites. These will be mobilized during an estimated 100 days a years (in various areas along the project's 2 target stretches) and will require the support of 2 4x4 vehicles to mobilize trainers and specialists (10) for information input, this expertise will come from ICIMAR/AMA who will be responsible for the use of the vehicles strictly for the support of the coral monitoring network.

The coral monitoring network will follow the Sabana Camaguey experience and will serve to monitor the state of the corals as well as to provide support in the recovery of these in extreme weather events. Operation costs include training of volunteers, monitoring equipment, and ICT costs for data input. Training will be provided by ICIMAR Specialists.

The monitoring program costs take into account fuel, service and initial insurance costs for the mobile laboratory, boat for marine expeditions and vehicles to provide mobility to the coral monitoring network as well as monitoring costs and maintenance of equipment (replacement of spare parts is considered for year 8 considering equipment use). During years 1-8 O&M costs are valued at USD 1,130,443 and do not take into account capital investments of setting up the monitoring system. Costs as detailed above, have been integrated into budgets for years 9-30 and will be covered by CITMA/ICIMAR as part of the monitoring activities. These amount to USD 3,431,926.00 [2] and take into account the depreciation of equipment and a gradual phase out of the monitoring systems beginning in year 15.

Water Conduction Systems and Monitoring (Activity 1.4)

To support in managing saline intrusion, the project through GoC funds will invest in a water conduction system that will be monitored through equipment acquired with support of the GCF.

[2] 1 USD = 24 CUP based on UN Operational Rates of Exchange (Jan 15 2021) available at https://treasury.un.org/operationalrates/OperationalRates.php

Operation of the hydraulic works required is estimated at the value below of and relies mainly in ensuring on work oversight, canal clearing and maintenance of the hydraulic system itself. Once the systems is established, general maintenance of the hydraulic works is considered and will include the maintenance of wells and water transfer from reservoirs. Maintenance of these will be performed by INRH. A detailed operations and maintenance plan will be prepared by INRH upon receiving the equipment for major equipment (water sensors and transport equipment).

The execution of monitoring of water to be performed by INRH during the project's lifetime includes the operation cost of water quality and salinity monitoring by INRH experts that will be hired or dedicated to performing this task. A phase-out schedule in terms of costs is considered taking into account the depreciation of equipment (year 16) as well as the reduced time it will take to monitor this system as it becomes integrated into INRH daily planning.

Maintenance of the infrastructure for the monitoring will be will be performed tri-annually by INRH experts through its Provincial Base Business Units that provide technical and mechanization support to transport and technical equipment within INRH's network. Costs such as fuel and service have been included in operation costs during the project's lifetime.

INRH that will be responsible through the project's lifetime of overseeing the use of this equipment has the technical capacity to maintain the equipment through the Provincial Base Business Units including workshop space, technical expertise and knowledge. O&M during the project's initial 8 years considers salaries of monitoring professionals and of performing general maintenance of hydraulic works, equipment maintenance including fuel, service and is estimated to be USD 650,486. For years 9-22 O&M is valued at USD 1,670,801.00 [3] with the majority costs being those for the water monitoring system itself and taking into account a gradual phase out beginning in year 20.

Output 2: Rehabilitated Ecosystems for Coastal Protection and Resilience to Climate Change

In Output 2 the following are the key systems/products that will be developed by the project and will require long term operation and maintenance: 1) Capacity Building Centers (CBCs) with their respective capacity building programs 2) the Knowledge Management Platform for Coastal Adaptation (KMPCA) along with the community monitoring system.

Activity 2.3 foresees the creation of a network of support (through legal experts) for coastal municipalities in the enhancement of local development plans, regulations, etc. for coastal planning in the face of climate change. This network will operate during the

[3] 1 USD = 24 CUP based on UN Operational Rates of Exchange (Jan 15 2021) available at https://treasury.un.org/operationalrates/OperationalRates.php

initial lifetime of the project and its work will conclude with the operation of these local development and economic plans/regulations and their incorporation into formal local structures. Economic plans to be approved by all target municipalities and provinces (as mentioned within the project evaluation framework) will incorporate within local government responsibilities maintenance support of various costs (fuel, communication costs, general maintenance of physical spaces, and dedicated staffing) for the long term operation of CBCs, local information networks that will feed into the KPMCA, and community monitoring.

Capacity Building Centres and Communities level Classrooms (Activity 2.1)

Maintenance of Capacity Building Centres and Communities level Classrooms, will consist of the maintenance of the facilities valued at USD 35,000 during the project's first 8 years. In addition, communication services are considered with an annual cost of USD 11,519 (to be covered with GCF support during the projects initial 8 years). These indirect costs will be covered in years 9-22 by CITMA and the municipalities and provinces that will include these costs within the local economic plans that will be developed through the project.

Local governments through the Council of the Municipal Administration (Municipal Assembly of People's Power) will be responsible for the administration, payment of current accounts, energy plans, availability of communications, security, access, maintenance and repair of CCC-GCA and annexed classrooms, to guarantee its operation and sustainability, as well as the inclusion in its budgets of the municipal development plan the necessary requirements to ensure budget annually. These costs will total 175,000 for the post project period (22 years).

Costs also include the staffing of the Centres (as described within the project proposal and the Feasibility Study) and of maintaining the activities of the CCC-GCA as well as the activities with the community. These costs are valued annually at USD 14,850 and will be covered by CITMA throughout the project's full lifetime. CITMA will also cover the costs of fuel and maintenance of the microbus that will be acquired for local capacity building support, to continue to provide support at a local level. It is expected that fuel costs will decrease as the project becomes streamlined into local institutions and less direct support is required.

Operation and maintenance of CBCs during project's initial years (1-8) are USD 493,808 and are valued during years 9-22 at USD 1,830,376.00 [4] with costs being shared between CITMA and local governments.

Infrastructure of the knowledge management platform (Activity 2.2)

Maintenance of the infrastructure of the knowledge management platform covers the costs of connectivity, server support and maintenance of the equipment of the information

[4] 1 USD = 24 CUP based on UN Operational Rates of Exchange (Jan 15 2021) available at https://treasury.un.org/operationalrates/OperationalRates.php

technologies acquired for the operation of the platform. KMPCA operation and maintenance is valued annually at USD 74,000. These will be covered by CITMA/ICIMAR to maintain the informations nodes.

Capacity building support has been included within the project budget to provide tailored communication and information services and support at a local and institution level to connect the KMPCA to its various data bases and existing monitoring system. This contract includes training to local experts to ensure their capacity to maintain this system and provide IT support.

Operation and maintenance cost of the KMPCA and community monitoring during years from years 1-8 is USD 852,448 including salary costs, connectivity services and maintenance of IT equipment. CITMA will also rely on its General Service Enterprise as required and in the case of information services it will work with the support of the Institute of Cibernetics, Mathematics and Physics (ICIMAF). OM costs from year 9-22 are estimated at USD 2,252,757.00[5] consisting of staff salaries, connectivity services and maintenance of IT equipment, these take into account a gradual phase-out of the monitoring systems (from 20) and the depreciation of equipment and reduction of its use.

[5] 1 USD = 24 CUP based on UN Operational Rates of Exchange (Jan 15, 2021) available at https://treasury.un.org/operationalrates/OperationalRates.php

Table 2 O&M Detailed avticvities and costs post-project period (22 years)

Cost Description	Total 9-13	Total 14-18	Total 19-24	Total 25-30	Total 9-30
1.1	100,000.00	-	100,000.00	100,000.00	300,000.00
Maintenance of ditches	100,000.00	-	100,000.00	100,000.00	300,000.00
1.2	2,231,628.00	1,297,833.00	1,953,203.00	466,548.00	5,949,212.00
Forest cleaning	694,543.00	-	695,770.00	-	1,390,313.00
Forest thinning	852,213.00	796,213.00	797,213.00	-	2,445,639.00
Forestry equipment: cleaning, lubrication and replacement of expendable mechanical parts	2,674.00	1,337.00	1,203.00	541.00	5,755.00
Fuel	363,001.00	302,500.00	363,000.00	363,000.00	1,391,501.00
IT and visual equipment maintenance (MINAG)	827.00	1,339.00	506.00	327.00	2,999.00
Maintenance of roads (fire trails)	-	60,000.00	-	60,000.00	120,000.00
Vehicle and boat maintenance (MINAG)	318,370.00	136,444.00	95,511.00	42,680.00	593,005.00
1.3	936,895.00	820,059.00	880,638.00	794,334.00	3,431,926.00
Execution of environmental monitoring	482,040.00	289,224.00	289,224.00	289,224.00	1,349,712.00
Fuel	153,415.00	153,415.00	184,098.00	184,098.00	675,026.00
IT and visual equipment maintenance (CITMA)	30,972.00	20,648.00	30,972.00	30,972.00	113,564.00
Maintenance of marine monitoring infrastructure	172,608.00	258,912.00	258,912.00	172,608.00	863,040.00
Vehicle and boat maintenance (CITMA)	97,860.00	97,860.00	117,432.00	117,432.00	430,584.00
1.4	437,907.00	437,451.00	459,559.00	335,884.00	1,670,801.00

Execution of monitoring of terrestrial waters	397,265.00	397,265.00	420,954.00	307,662.00	1,523,146.00
Fuel	22,470.00	22,470.00	23,809.00	17,501.00	86,250.00
IT and visual equipment maintenance (INRH)	1,280.00	2,304.00	870.00	563.00	5,017.00
Maintenance to hydraulic monitoring infrastructure	7,157.00	12,167.00	7,879.00	5,692.00	32,895.00
Vehicle maintenance (INRH)	9,735.00	3,245.00	6,047.00	4,466.00	23,493.00
2.1	543,955.00	538,934.00	620,803.00	640,001.00	2,343,693.00
Fuel for vehicles	17,242.00	13,610.00	16,332.00	16,332.00	63,516.00
IT and visual equipment maintenance including connectivity (CITMA and municipalities)	82,285.00	121,787.00	102,692.00	86,890.00	393,654.00
Maintenance of Capacity Building Centers and municipal level classrooms	35,000.00	35,000.00	35,000.00	70,000.00	175,000.00
Operating Capacity Building Centers	229,160.00	229,160.00	274,992.00	274,992.00	1,008,304.00
Vehicle maintenance (CITMA)	122,673.00	81,782.00	122,673.00	122,673.00	449,801.00
Communication services tu support capacity building centers	57,595.00	57,595.00	69,114.00	69,114.00	253,418.00
2.2	532,780.00	532,780.00	616,225.00	570,972.00	2,252,757.00
Communication services and maintenance of knowledge platform	370,000.00	370,000.00	444,000.00	444,000.00	1,628,000.00
Generating EBA information products and uptading them	88,530.00	88,530.00	93,667.00	69,056.00	339,783.00
Operating Community Monitoring System	74,250.00	74,250.00	78,558.00	57,916.00	284,974.00
3.1	30,660.00	30,660.00	36,792.00	36,792.00	134,904.00

Fuel	30,660.00	30,660.00	36,792.00	36,792.00	134,904.00
Grand Total	**4,813,825.00**	**3,657,717.00**	**4,667,220.00**	**2,944,531.00**	**16,083,293.00**