

**UNITED NATIONS ENVIRONMENT PROGRAMME  
NAIROBI CONVENTION**

**WIOSAP FULL PROPOSALS**

**Call title:** Implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land-based sources and activities (WIO-SAP)

**Participating countries:** Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa, Tanzania [and France (not project beneficiary)]

**Executing organization:** Nairobi Convention Secretariat

**Duration of demo projects:** 2 years

**Stage of the call:** Full proposals

<b>Organisation Name</b>	Department of Environment, Second Vice President's Office, Zanzibar, United Republic of Tanzania
<b>Project Title</b>	Upscaling and Amplification of the Msingini Wastewater Treatment Facility Model in Chake Chake Town, Pemba.
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<b>Registration Details</b>	Type of organisation: Government Country: Zanzibar, Tanzania

### Executive Summary:

The project seeks to utilise an existing under-performing Constructed Wetland System on Pemba Island and significantly improve its long-term management, efficiency and its benefit to the surrounding community of more than 5,500 people, both in terms of capacity and productivity. Due to its location in a low-lying coastal area its adaptive capacity to withstand effects of sea level rise and extreme climatic events is a central part of the redesign. Increasing local capacity to operate and maintain the system is emphasised to ensure long-term sustainability and the introduction of a Payment for Ecosystems Services system will help to cover these costs. Improved utilisation of the wetland plants after harvesting will increase the community's appreciation of the system and result in cost savings and/or income generation.

## I. BACKGROUND AND JUSTIFICATION

Coastal ecosystems along the Zanzibar archipelago are of great ecological and socio-economic importance. However, they are under intense pressure from land-based activities and pollution from both municipal and industrial activities. Untreated industrial effluents from the municipalities and coastal settlements have resulted in the unwanted discharge of untreated municipal waste waters, especially raw sewage, directly to the marine environment, ultimately affecting the ecological balance as well as sustainability of coastal and marine systems that support the livelihood of over 1.3 million people living on the archipelago. To offset these impacts, the UNEP Nairobi Convention, under the key objectives of the UNEP GEF WIO-LaB Project, supported the establishment of the first ever wastewater treatment facility in the Zanzibar archipelago. This facility was built on the island of Pemba along the western edge of Chake Chake Town and fully commissioned in 2011. It has been managed since inception by a consortium of the Chake Chake Town Council (CCTC), the Department of Environment (DoE) and Zanzibar Environment Management Authority (ZEMA).

**The existing facility** comprises a 1,160-metre long storm water drainage channel with an adjacent shallow sewer system and wastewater treatment system. Treatment occurs in two anaerobic ponds (in parallel), followed by two sub surface constructed wetlands (also in parallel) planted with *typha sp.* (sourced locally). Treated water discharges downstream into the storm water channel, after which it enters the creek. The system was designed to treat 350 m<sup>3</sup>/day of wastewater from approximately 900 households and is located in the lowest part of the catchment adjacent to the mangroves.

**The current treatment efficiency** of the system appears to have deteriorated due to the outlet becoming submerged by the incoming tide or by high water levels in the storm channel. This has compromised the operation of the system and led to some areas becoming blocked or bypassed. In addition, the anaerobic ponds have not been desludged regularly and are partially blocked, leading to the possibility of particles being washed through to the wetland bed and reducing treatment capacity. No regular monitoring of the system has occurred as there are no current regulations in force to govern wastewater discharges, nor DoE/ZEMA recommended laboratories that are able to analyse samples. The sewerage system and storm water channels appear to be in good condition and operating essentially as intended, but must be thoroughly assessed to confirm this.

No sewerage fees have been levied upon any users although the users within the project perimeters have contributed towards provision of their sewage plumbing equipment connecting their individual septic tanks to the project's main sewer lines. In this context, sewerage connection services are run by CCTC, at no cost from the users, apart from their contribution of the sewage pipes.

The total number of households connected to the sewer line is approximately 763 (which is in excess of the design number of 600), but actual hydraulic and contaminant loading has not been verified. CCTC has indicated that additional houses have requested connections to the sewer system and for their plots to be served by the storm

drains. This is in part due to population increase and infilling of buildings and also to cover those areas not originally included (within the original catchment area).

A critical issue facing the existing wetland system is that it was constructed close to the mangroves and the high tide line. This was as a result of topography and land availability, a situation typical of many wastewater treatment plants throughout the world and in particular SIDS (Small Island Developing States) where many coastal settlements are near the high water line. Having a low level outlet can cause problems during times of high tides, storm surges and heavy rainfall as the outlet is then underwater and treated effluent is not able to discharge freely. Should the sea water level be sufficiently high, water may be forced back up the system, preventing wastewater from undergoing complete treatment. A comparable problem is currently being experienced on Unguja (Stone Town) where combined storm water and sewer pipes do not have a free outfall into the sea during high water events, causing a mixture of this water to back up and spill out onto the streets. A necessary function of both these systems and many others like them is the ability to accommodate or adjust to a climatic or tidal event and maintain or quickly resume their primary function, a quality known as the adaptive capacity. This adaptive capacity is even more essential in consideration of sea level rise, which will push the systems to even greater limits of operation. The enhanced adaptive capacity of the pilot project at Msingini will be demonstrated by modifying the hydraulic operation of the system, installing protected outlets and introducing flow buffering/retention. The site boundaries may also be raised to prevent inundation in years to come.

A second critical factor is the absence of a regulatory framework with which to monitor the system. This has resulted in no regular monitoring or water sampling being completed. Without this valuable data it is difficult to properly manage the system. The current regulations are grossly out-dated and require modification to suit the present and future situation on the archipelago (Unguja and Pemba). The Msingini wetland represents the only sewer and wastewater treatment system on the island at present, but this is likely to change in years to come as population levels continue to rise and as the Local Government Authority begins to implement its plans to build small-scale wastewater treatment units to address public health and sanitation objectives.

Therefore, regulations will be compiled by a steering committee comprised of all partners, the DC and the community and subsequently enforced by CCTC. A list of approved laboratories for analysing wastewater samples will also be created. These mechanisms will ensure adhesion to standardised monitoring protocols, which in turn allow improved management of wastewater treatment systems throughout the archipelago. It is vital for the local partners to have an established framework to adhere to for long-term protection of the Islands' environment.

The maintenance of the system may have deteriorated partly due to lack of revenue streams but also due to the absence of institutional roles and responsibilities including regulatory framework specific for wastewater management at that time. The latter part has now since been improving but despite an initial plan to levy a charge on all users, this was never realised. At present no direct financial contribution is made by any of the sewage system users for this service. Sensitising the population afresh will increase awareness of the system and its value to the community. The creation of a revenue collection system will allow funds to be available for large maintenance jobs such as emptying the anaerobic ponds, in addition to daily operations, monitoring costs etc. The method of revenue collection may utilise local LGA approved revenue schemes (as practiced in some pilot project concerning solid waste collection and disposal in Zanzibar) or through a mobile money provider most of the community are using.

Having limited equipment, funds and capacity within CCTC has also made essential maintenance such as vegetation and sludge removal a challenging task. Training on aspects of CWS including their background, applications, design & construction and Operation & Maintenance (including sludge management) will raise knowledge levels, management capacity and ability to maintain the system. Training the community in ways in which the wetland plants may be used for fodder, thatching, handicrafts and other uses will increase the desirability of the wetland and

its products. These two areas of capacity building are essential to ensure continued successful operation beyond the duration of the project.

### **Global and Regional Relevance**

The proposed action to request UNEP Nairobi Convention in the context of WIOSAP Project to support the Government of the United Republic of Tanzania improve on its efforts to widen effluent reduction measures in Zanzibar in the city of Chake Chake, Pemba, will directly feed into the Zanzibar Strategic Growth and Poverty Reduction Strategy (MKUZA-III).

A number of SDGs are also of immediate relevance as follows:

SDG6 that calls to Ensure availability and sustainable management of water and sanitation for all, in particular Target 6.3 aiming at improving water quality by increasing the proportion of wastewater undergoing treatment. Nature based systems (NBS) such as constructed wetlands are essential for achieving this target<sup>1</sup>.

SDG13 that addresses climate change - with regards to sea level rise and how this affects the existing system and operation of the future system

Target 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries – the modified system will serve as a model for adaptive capacity

Target 13B Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

SDG14 that calls for protection and conservation of our ocean ecosystems in particular Target 14.1 which calls for a significant reduction in marine pollution from land based activities.

Other regional projects include the World Bank funded Zanzibar Urban Services Project establishing a new Constructed Wetland Wastewater Treatment System in the main island of Zanzibar, showing a growing commitment to implementing these systems (CWS) throughout the region.

## **II. PARTNERSHIPS**

### **Department of Environment Zanzibar (DoE)**

The Department of Environment is the oldest environmental institution in Zanzibar. It was established in 1989 and restructured in 2015 with the coming of the new Environmental Management Act No.3. This is the leading policy institution responsible for the protection and improvement of the environment in Zanzibar. It is responsible for:

Implementation of the Zanzibar Environment Policy

Developing, coordinating and implementing national environment and climate strategies and guidelines for Zanzibar;

Preparing and managing Strategic Environmental Assessments (SEA) in Zanzibar

Preparing the State of Environment Reports, Biodiversity Strategies, implementation of the Integrated Coastal Zone Management Strategy, and engaging climate change adaptation strategic planning and programs;

Preparing and disseminating environmental research, education and awareness activities

Coordination of implementation of the multi-lateral environmental conventions in Zanzibar including regional seas programs, projects and initiatives.

**Mandate** – to promote sound and sustainable environmental management practices through provision of policy guidance, institutional strengthening and cooperation.

**Role in Project** = Project Management, Overall coordination of the project in Zanzibar in line with the National Designated Authority for the Nairobi Convention, the Vice President's Office of the United Republic of Tanzania.

### **Zanzibar Environment Management Authority (ZEMA)**

<sup>1</sup> WWAP (United Nations World Water Assessment Programme)/UN-Water. 2018. The United Nations World Water Development Report 2018: Nature-Based Solutions for Water. Paris, UNESCO

ZEMA was established under section 14(1) of the Environmental Management Act No.3 of 2015. This is the leading public body responsible for the enforcement of environment protection act in Zanzibar. ZEMA is responsible for issuing environmental permits and pollution abatement notices for controlling waste disposal and wastewater discharges, atmospheric emissions, deposits or other source of pollutants and issuing directives, procedures or warnings for the purpose of controlling noise. ZEMA has the authority to require an Environmental Assessment (EA) for proposed undertakings, is responsible for ensuring compliance with Environmental Impact Assessment (EIA) procedures and is the lead EIA decision-maker. Some of the other functions include:

Enforcement of environmental pollution controls, management and monitoring requirements

Issuing all permits and approvals concerning environmental controls.

Protection of terrestrial and marine biodiversity.

Supporting environmental awareness and education.

Enforcement of environmental regulations, guidelines, and compliance requirements.

**Role in Project** = Operational support, contribution to new discharge regulations, over-sight in achieving compliance

### **Chake Chake Town Council (CCTC)**

The CCTC is one of the Local Government Authority (LGA) institutions that are led directly from the Office of the President of Zanzibar, through an appointed Minister of State – President’s Office, Regional Administration and Local Governments ( PORALG). The Ministry is responsible for the five Regional Administrative Regions in Zanzibar and 11 District Authorities, District Councils (Halmashauris), Three Municipal Councils, Pemba Town Councils (including CCTC), Ward Councils, and Shehia Councils, in Zanzibar. Under the provisions of the Zanzibar Local Government Authority Act No.7 of 2014, the CCTC’s objectives within its administrative jurisdiction include promoting Health, Safety and Environment, Public health and environmental sanitation, maintenance of local health, construction, transportation, public markets, fish landing sites, schools, community centres, business centres, etc. services and infrastructure. Others include protection of local forests and biodiversity spots, water resources, heritage and cultural sites, disaster management and climate adaptation.

Moreover, CCTC, under the Regional Administration Act No.8 of 2014, is obligated to implement its powers and functions under the auspices of the Regional Commissioner and District Commissioner’s authorities, respectively, within their respective jurisdictional levels.

**Role in Project** = project implementation, operational support, technical support with structures and constructions. Responsible for ongoing management of system after project completion.

Resources Provided = Manpower, city engineer, training venue/meeting rooms

### **Zanzibar Water Authority (ZAWA)**

ZAWA was established under the Water Act No.4 of 2006, Zanzibar. The Authority has the jurisdiction of management of freshwater resources in Zanzibar (streams, aquifers, springs, etc.). The main functions of ZAWA include:

Protecting and conserving all water resources and sources of catchments in Zanzibar

Securing continued supply of freshwater without any risk of contamination or pollution

Protecting public health and maintaining safety standards in potable water.

Advocating for integrated fresh water resources management along with other Government policies and plans.

Implementation of water sanitation provision services.

**Mandate** = To provide cost effective and affordable quality water for the residents of Zanzibar.

**Role in Project** = In kind contribution, input to new discharge regulations, and ensuring conservation of freshwater resources and catchments.

**Resources Provided** = Manpower

**GreenWater (GW)** is a consultancy firm based in Kilifi, Kenya, specialising in the design, construction and operation of constructed wetlands. Projects since its incorporation in 2005 include constructed wetlands for a

Mombasa housing estate serving >10,000PE, two seed farms in Arusha treating 300m<sup>3</sup>/day and numerous eco lodges, flower farms and domestic residences.

**Mandate** = to find environmental solutions to water and sanitation issues throughout the region

**Role in Project** = GreenWater will carry out the topographic survey, conduct O&M training, (re)design the constructed wetland system and oversee it's rehabilitation and augmentation

**Resources Provided** = Design

### III. OBJECTIVES

#### A. Overall objective

To reduce land based sources of pollution to the Pemba Channel Conservation Area (PECCA) and associated coastal and marine ecosystems from Chake Chake municipality using Constructed Wetland Systems.

#### B. Immediate/specific objectives

1. To provide additional wastewater and stormwater drainage capacity for Chake Chake Town to support the existing Mtoni-Msingini Wastewater Treatment System
2. To enhance effluent reduction and discharge efficiency through capacity building and improved cross-sectoral management.

3. To amplify the existing wastewater treatment system through increased adaptive capacity, modified hydraulic operation and more effective plant species.

4. To enhance enforcement and legislative framework, community awareness and payment for ecosystem services schemes by upscaling public and spatial outreach.

The above objectives are detailed within the Workplan (Annex 1) and the Logical Framework (Annex 2).

### IV. PROJECT IMPLEMENTATION AND MANAGEMENT PLAN

#### A. Expected project results and indicators

The results and indicators are detailed within the Monitoring Plan (Annex 3) and summarised below.

Result 1: A Status Report detailing all aspects of the current operation of the CWS, sewer and storm water systems (objective 1).

Description: The existing system efficiency is not well understood due to the absence of available data. Collection and analysis of data as per Activity 1.1 will allow a full assessment of the existing CWS, sewer and storm drain to be completed. The local partners will continue this data collection for future monitoring and management of the CWS.

Indicators: water analysis results, topographic map, flow measurements, CWS efficiency.

Result 2: An increased number of HH are connected to the existing sewer line and the storm drain network is extended (objective 1).

Description: Once the existing infrastructure has been assessed it will be possible to determine if there exists capacity to add additional connections and how many.

Indicators: Percentage increase of HH with a connection within the capacity of the CWS and length of additional storm drain.

Result 3: Memorandum of Understanding (objective 2).

Description: A Project Steering Committee will be formed for the creation of a MoU for the system to ensure that roles and responsibilities are clear. It will also ensure that all project partners are accountable for their tasks.

Indicators: Steering Committee formed, number of meetings and MoU accepted and signed by all partners.

Result 4: Local organisations trained to effectively run and manage the CWS (objective 2).

Description: It is valuable for the local partners to have a wider understanding of the roles that CWS can play in wastewater treatment and protection of the environment. This can be achieved through representatives attending a training course in CWS Design, Operation and Application. Specific activities relating to the operation and maintenance of the Msingini CWS will be conveyed to all project partners during a second training session once the rehabilitated system has been commissioned. A third training session will occur to specifically address utilisation of wetland plants for income generating activities.

Indicators: Number of representatives attending CWS and wetland plant utilisation training courses (all in Chake Chake, Pemba).

Result 5: CWS modified to operate with increased adaptive capacity (objective 3).

Description: Utilising the analyses from result 1, the system will be modified to operate with increased adaptive capacity. This means that despite extreme weather conditions and sea level rise, the CWS should still be able to function.

Indicator: treated water quality is within acceptable levels for discharge to the environment, no contamination of storm water

Result 6: Different aquatic vascular plants are introduced to the wetland

Description: The wetland will be planted with four different plant species to test their productivity and usability.

Indicator: Growth rate data and “usefulness” ranking by community for each species.

Result 7: Updated Wastewater Discharge Regulations (objective 4).

Description: The formulation of up to date and relevant regulations will allow for improved management of the CWS. To date, the absence of defined criteria has resulted in no monitoring occurring.

Indicator: Gazettement of regulations

Result 8: Payment for ecosystems services scheme created and introduced (objective 4).

Description: The implementation of a payment scheme will ensure that the CWS, sewer line and storm channel are correctly maintained. CCTC will oversee the scheme and replicate it for other sites in the future.

Indicator: The percentage of HHs connected to sewer (registered and/or paying)

## **B. Project activities and work plan**

Please see Annex 1 and 2 for timing, duration and responsible parties for each activity.

### **Objective 1 - To provide additional wastewater and stormwater drainage capacity for Chake Chake Town to support the existing Mtoni-Msingini Wastewater Treatment System**

#### Activities

1.1 Evaluate existing system for operational efficiency

1.1.1 Collect baseline water quality parameters (TSS, BOD/COD, Total nitrogen, ammonia, nitrates/nitrites, soluble phosphorous, faecal coliforms) in effluent of existing plant (inlet and outlet of lagoon, outlet of wetland) and Msingini Creek (three locations during different tidal regimes).

1.1.2 Produce a topographic map from survey data, including land levels around the system

1.1.3 Define the MHWS (mean high water spring) level and tidal regime and transpose onto map

1.1.4 Quantify sea level rise (SLR) from literature and apply to topographic map of system

1.1.5 Conduct pipeline survey (levels) to establish the hydraulic operation of the system

1.1.6 Define the number of households (HH) currently connected to the system (as per action point 4.2.1) and those which could potentially be added to the system given sufficient capacity - HH pay direct for connection as per new regulations formed in 4.1.3

1.1.7 Measure flow of wastewater (existing weir or in-water instruments) in m<sup>3</sup>/day

1.1.8 Produce Status Report

- 1.2 Amplify connections to sewer and storm drains
- 1.2.1 Connect additional HH to sewer if capacity of upgraded CWS is sufficient
- 1.2.2 Connect additional HH to storm drains within limitations of budget.

**Objective 2 – To enhance effluent reduction and discharge efficiency through capacity building and improved cross-sectoral management.**

Activities

- 2.1. MOU for Operation and Maintenance of the CWS
- 2.1.1 Create a PES Communication and Awareness task force to include the CCTC (with Regional, District and Shehia stakeholders), DoE, ZEMA, ZAWA and the community to produce a co-management understanding/agreement to define roles/responsibilities of running the CWS, in particular the necessary financing, requirement of land, maintenance (especially sludge management) and monitoring, and benefits of PES.
- 2.2 Enhance local management capacity through on and off-site training
- 2.2.1 Conduct onsite training to all operators and regulators for site-specific operation, maintenance and monitoring of the Msingini CWS before and after amplification.
- 2.2.2 Conduct training to operators and community members for utilisation of different species of aquatic vascular plants harvested from the CWS. This may be with fresh plants as animal fodder/compost or dried plants for handicrafts, thatching etc. Dried plants will be harvested in advance of the training sessions.

**Objective 3 - To amplify the existing wastewater treatment system through increased adaptive capacity, modified hydraulic operation and more effective plant species.**

Activities

- 3.1 Redesign system
- 3.1.1 Utilising data from O.1.1 (Status Report), produce an updated CWS design(s) with increased adaptive capacity to ensure effective operation during high tide, storm surges and heavy runoff events. Future SLR is considered in addition to extreme temporal events. New design options shared with all project partners.
- 3.2 Construct and operationalize an efficient and easy to maintain constructed wetland system
- 3.2.1 Clear and fix existing pipework within CWS to allow unrestricted flow
- 3.2.2 Clear sludge from existing system and take to Vitongoji site (12km distant)
- 3.2.3 Improve sludge management system at Vitongoji to allow safe and efficient drying
- 3.2.4 Clear existing vegetation (*typha sp.*) from system, assess how best to use/compost
- 3.2.5 Install appropriate outlet protection devices to prevent ingress of seawater into the system (non-return flap, duck bill outlet or other), relocate outlet pipe if necessary outside storm channel.
- 3.2.6 Construct an appropriate “holding area” to absorb wastewater during times of zero outflow, this water then passes through the system once the tide has receded and the outlet is free draining. The holding area may comprise “in line storage” in the form of large diameter (volume) pipes laid upstream of the CWS beneath the existing open space. Capacity required is a function of future flow volumes and duration of holding and will be assessed in the Status Report.
- 3.2.7 Raise boundary embankment as needed to withstand future MHWS as a result of sea level rise. Stabilise with Vetiver Grass (a system already being utilised on Pemba)
- 3.2.8 Replant CWS with four (or more) plant species, one species in each quarter of the area. Plants to potentially include typha latifolia, Vetiver Grass, Napier grass and one other.
- 3.2.9 Commission system & monitor water quality within the CWS and the receiving water of Msingini Creek. Monitor plant growth within CWS.
- 3.2.10 Wetland plants will be harvested six months after system commissioning for CCTC and community training where they will be assessed for usability (fodder, compost, thatching, weaving etc). Based on these results, the CWS will be replanted with the species of choice.

**Objective 4 – To enhance enforcement and legislative framework, community awareness and payment for ecosystem services schemes by upscaling public and spatial outreach**

## Activities

- 4.1 Create up to date wastewater discharge regulations
  - 4.1.1 Evaluate existing wastewater discharge regulations (rules created during colonial times are still currently in use and not in line with present and future activities)
  - 4.1.2 Formulate a Drafting Task Force to include LGA, DoE, ZEMA, CCTC, ZAWA and community
  - 4.1.3 amend/rewrite regulations accordingly to include management of wastewater and payment for such services and gazette/publish once complete.
  - 4.1.4 assess and designate recommended laboratories for wastewater analyses
- 4.2 Create and implement a Payment for Ecosystem Services (revenue collection) scheme to allow sustained maintenance and operation of the system
  - 4.2.1 Document all present and future users using GIS mapping, to include number of inhabitants, contact name and contact number (mobile money transfer enabled). (CCTC and PES expert).
  - 4.2.2 Create a payment system (connection charges, standing charges, revenue collection, non payment penalty) for CCTC to manage. CCTC committed to use revenue for specific activities as per point 4.1.3.
  - 4.2.3 Conduct training to CCTC for implementation and operation of payment system (PES expert).
  - 4.2.4 Participatory planning with present and future users about the sewer and storm water systems. Sensitisation campaign to include public awareness, media campaign and tour of facilities
  - 4.2.5. Introduction of Payment for Ecosystem Service (PES).
  - 4.2.6 Evaluate uptake of payment system once operational

## **C. Project Beneficiaries**

The key beneficiaries in this project are the communities in Chake Chake Town, notably in the areas around the Mtoni – Msingini valley and additional areas that are potentially viable for the proposed amplification of the project e.g. Lower Madungu, Madungu Police Flats and Madungu Shamiani localities, Madungu ZSTC line, etc. It is envisaged that the community participation is critical to the success of this proposed amplification project. Members of the community will therefore be involved in the awareness, consultations, support and construction of the CWS modifications, largely as part of PES and an in-kind contribution by the community. They will also participate in training to utilise wetland plants which will particularly benefit secondary users, notably livestock keepers, local communities e.g. women involved in thatching or handicraft, etc (depending on the nature of the species to be used on the wetland bed).

The entire Zanzibar archipelago will benefit directly from the implementation of proposed drafting of wastewater discharge and management regulations governing management of wastewater, as no functional regulations are currently in place.

Additional beneficiaries are the users of the adjacent marine ecosystem. Coastal tourism and Chake Chake Bay fisheries will see an improvement in water quality, leading to increased sustainable livelihoods to the local communities.

In addition, the DoE, ZEMA, ZAWA and local authorities such as Chake Chake Town Council will also be involved in the implementation and operation of various aspects of the project. They will benefit from site specific and general training that will be transferable to other sites developed in the future, which in turn will benefit users in those locations.

The Msingini CWS will be used as a model to influence use of constructed wetlands for wastewater treatment in the region. Different stakeholders will therefore have access to this demonstration site on application of innovative technology that can be disseminated and replicated elsewhere in the country or region. The adaptive capacity of the system and its ability to function with a low lying outlet will be increasingly applicable to other sites throughout the WIO region as rising sea levels encroach on previously unaffected land.

#### **D. Implementing agency management of project**

DoE will be the lead institution in the overall management of this proposed project. DoE will be responsible for project administration, financial management, monitoring & evaluation and reporting. There will be a Project Coordinator appointed at DoE to run day to day activities of the project. DoE, supported by ZEMA as an enforcement authority, will play a lead role in organizing the stakeholder and community consultations and in communication, awareness and outreach. The role of the Project Management Unit at DoE shall be to:

- i. ensure smooth running of the project and reporting
- ii. check that project is on schedule and that costs incurred are according to the agreed budget.
- iii. undertake financial management and approval of expenditures.
- iv. coordinate and provide quality control for all activities done under the contract.
- v. organize stakeholder and community consultations.
- vi. Design of communication, awareness and outreach materials and
- vii. Prepare reports (technical and financial).

DoE shall implement operational responsibilities of the project alongside ZEMA. The implementation of the proposed project on a daily basis will be operationalized by the Engineering Division of the CCTC. Zanzibar Water Authority (ZAWA) will also be involved in the context of its legal mandate to oversee macro-management of wastewater discharge. Local Communities and NGOs, as applicable, will aid in the dissemination and promotion of the proposed amplification process.

#### **V. PROJECT METHODOLOGY**

Major activities will follow the program as detailed in Annex 2 and are explained below.

**Objective 1** – Amplify number of sewer connections and storm water drainage. It is essential to collect water flow, water quality, user numbers and system operation data (amongst others) in order to accurately assess the system prior to any modifications or addition of further users. Project partners, guided by GW, will produce the Status report that will determine the degree of additional capacity that may exist.

**Objective 2** – To enhance local capacity for management of the CWS.

The creation of a Steering Committee with a MOU will formalise all activities relating the project so that they are completed within the proposed time and budget. In relation to the technical aspects of operating the CWS, training will be given prior to works (to highlight existing issues) and after commissioning the new system (to emphasise correct practices and procedures). Training on the utilisation of wetland plants will be provided in order to raise awareness of the CWS with the nearby community, particularly with a view to obtaining usable products from the system.

**Objective 3** – Redesign and Construct the CWS.

The existing structures will be utilised and enhanced to result in a robust system which is easy to operate and resilient to the effects of sea level rise and extreme climatic events. The Status Report will allow the wetland expert to redesign the system within the constraints of the budget, available space and slope. The existing and proposed systems are indicated in plan view on Figures 1 and 2. Figure 3 details the section view of the intended (original), existing and proposed systems.

**Objective 4** – Create Wastewater Regulations and Payment for Ecosystem Services System

To ensure continual successful operation of the upgraded CWS, relevant regulations must be in place with which to monitor the treated water. A Task Force comprising project partners will create and gazette these regulations. To finance the operation of the rehabilitated CWS in the long term a PES system will be introduced to the community by a PES expert. Replicating successful PES models will be vital in ensuring a wide acceptance and uptake by the community.

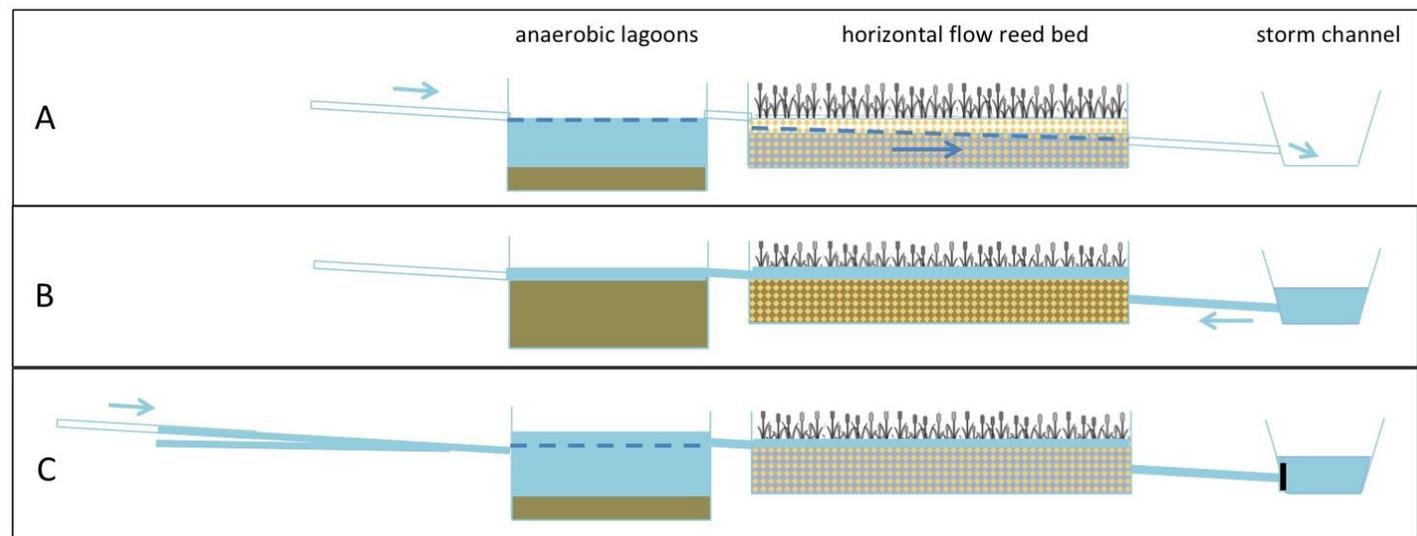


**A – Intended Operation**  
Flow through system to outlet in storm channel is unrestricted

**B – Present Operation**  
Lagoon and reed bed full of sludge, high tide and/or high storm runoff restricts outlet. Hydraulic operation compromised.

**C – Proposed Operation** (during extreme events) (Excess sludge has been removed). Outfall protection prevents backflow. Beds and pipes have increased capacity to hold flow until outlet is clear, excess water then discharged and normal operation resumes (A)

Figure 3 (below – text above)



## VI. SUSTAINABILITY AND REPLICABILITY

The UNEP Supported Mtoni-Msingini Wastewater Treatment unit has shown a significant degree of success, calling for more efforts in enhancing and amplifying the existing model in effluent reduction measures. The existing pattern of collaboration between ZEMA and CCTC has demonstrated a higher level of commitment and responsibility for the running, conservation and maintenance of the current project infrastructure. However, this collaboration must be formalized to ensure that all activities essential to the successful running of the system are completed. This will partly be achieved through the creation of a MoU between project partners with clear roles and responsibilities. In addition, training of all partners will ensure greater levels of understanding in managing the CWS, in particular trouble shooting and critical analysis of the system. Monitoring and reporting will ensure efficient system operation during the two-year period, after which adequate legislation will be in place to track the system operation.

Works planned during the project cycle include removal of sludge and vegetation from the system and their subsequent management. Training will be completed with project partners and the community to ensure these materials are managed safely and effectively. Where possible, usable products will be produced. As these will be ongoing operation & maintenance tasks it is vital to ensure appropriate equipment, finance and expertise are in place to achieve sustainable CWS performance.

The adaptive capacity of the system (its response to extreme events and sea level rise) will be highlighted during training with the partners. They will be able to translate this experience to other sites around the archipelago that suffer from restricted discharge during periods of high water levels, such as in Stone Town (Unguja) during high tides. These lessons will also be valid for other SIDS and coastal areas within the WIO region or in the wider LDC/SIDS outreach.

The partners have already engaged in the following activities:

1. Empowering of the local communities around Chake Chake Town to participate at all levels of the project cycle, thereby raising ownership.
2. Mobilizing resources (human and materials) to actively manage the project.
3. Continuing in sharing experiences with other stakeholders at the regional and international level.

## VII. PROJECT MONITORING AND EVALUATION

The objective of monitoring and evaluation (M & E) is to assess project performance and impact. The monitoring of this project will be organized according to the WIOSAP reporting schedule. Monitoring of the implementation and evaluation of the efficiency and impact of activities will be the responsibility DoE supported by ZEMA as an environmental enforcement authority. Concise (but accurate) Quarterly Progress Reports shall be submitted to the WIOSAP Project Management Unit (PMU) in Nairobi. These reports shall contain a summary of progress achieved since the previous report; and detail any foreseen impediments to Project implementation and actions taken and/or proposed for their remediation.

The Annual Report will report, among others, on the achievements of objectives and outputs of the project, as defined in the Project log frame. At half-yearly intervals, the Quarterly Progress Reports shall be accompanied by Expenditure Statements providing up-to-date financial information. A project evaluation will be conducted at the half-way point (Mid-term Review) as a well as at the end/terminal point (Terminal Evaluation) of the project implementation. The Mid-term Review will be undertaken jointly by the WIOSAP PMU and the Project implementation team, where needed assisted by an independent Consultant. The Terminal Evaluation will be conducted by an independent Consultant, appointed by the WIOSAP PMU. A Final Report shall be submitted to the WIOSAP PMU within 45 days of the completion of the Project. The Final Report shall provide the basis for the independent Terminal Evaluation. Monitoring Indicators are detailed in the Monitoring Plan (Annex 3)

## VIII. BUDGET

The budget is displayed by category in Annex 4 and by activity in Annex 2.

**Annex1: Workplan**

Task	Responsible	Year 1												Year 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
<b>Overall objective: Protect the environment from untreated wastewater discharge</b>																									
General Project Management - DoE		■		■			■			■			■				■			■				■	
<b>Outcome 1.0 Additional HH wastewater directed to the CWS</b>																									
O.1.1 Status report on current operation of the CWS																									
A.1.1.1	CCTC/DoE/ZEMA	■	■	■																					
A.1.1.2	CCTC/GW/ZEMA	■																							
A.1.1.3	CCTC/GW/ZEMA		■																						
A.1.1.4	DoE/GW/ZEMA																								
A.1.1.5	CCTC/GW	■																							
A.1.1.6	CCTC/ZEMA/ZAWA/DoE			■																					
A.1.1.7	CCTC/GW/ZAWA	■																							
A.1.1.8	GW/DoE/ZEMA				■																				
O.1.2 Amplification of connections to sewer and storm drains																									
A.1.2.1	CCTC/DoE/ZEMA																	■			■			■	
A.1.2.2	CCTC/DoE/ZEMA																		■	■	■				
<b>Outcome 2.0 Enhanced local capacity to sustainably operate the CWS</b>																									
O.2.1 MOU for Operation and Maintenance of the CWS																									
A.2.1.1	CCTC/ZEMA/ZAWA/DoE/Community		■																						
O.2.2 Training																									
A.2.2.1	CCTC/ZEMA/ZAWA/DoE/Community/GW						■											■							
A.2.2.2	CCTC/ZEMA/ZAWA/DoE/Community/GW																			■					
<b>Outcome 3.0 No uncontrolled discharge of untreated wastewater</b>																									
O.3.1 Modified CWS design																									
A.3.1.1	GW, CCTC, DoE, ZEMA					■	■																		
O.3.2 CWS modification construction																									
A.3.2.1	CCTC/DoE/ZEMA					■																			

Task	Responsible	Year 1												Year 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A.3.2.3	CCTC/ZEMA/DoE																								
A.3.2.4	CCTC/ZEMA/DoE/community																								
A.3.2.5	CCTC/GW/ZEMA																								
A.3.2.6	CCTC/GW/DoE/ZEMA																								
A.3.2.7	CCTC/DoE/ZEMA/GW																								
A.3.2.8	CCTC/DoE/ZEMA/GW																								
A.3.2.9	CCTC/DoE/ZEMA/GW																								
A.3.2.10	CCTC/DoE/ZEMA/GW																								
<b>Outcome 4.0 CWS environmentally compliant and financially sustainable</b>																									
O.4.1 New Regulations																									
A.4.1.1	CCTC/ZEMA/DoE																								
A.4.1.2	CCTC/ZEMA/ZAWA/DoE/Community/District Commissioner																								
A.4.1.3	ZEMA/DoE/CCTC																								
A.4.1.4	DoE/ZEMA/CCTC																								
O.4.2 Creation & Implementation of a Payment for Ecosystem Services System																									
A.4.2.1	CCTC/ZEMA/DoE																								
A.4.2.2	DoE/ZEMA/CCTC + consultant																								
A.4.2.3	DoE/ZEMA/CCTC/external consultant																								
A.4.2.4	ZEMA/CCTC/DoE/community																								
A.4.2.5	CCTC/ZEMA/CCTC/DoE/community																								
A.4.2.6	CCTC/ZEMA/DoE/External Consultant																								

## Annex 2: Logical Framework

	<b>Project title:</b> Upscaling and Amplification of the Msingini Wastewater Treatment Facility Model in Chake Chake Town, Pemba			
	<b>Project overall objective:</b> To contribute to the protection and management of Pemba Channel Conservation Area (PECCA) coastal and marine ecosystem from discharge of untreated municipal wastewater with a view of improving the quality of coastal livelihoods and biodiversity			
Project Results	Outputs	Activities	Activity budget (US\$)	Costs /output (US\$)
<b>Outcome 1.0 Additional HH wastewater directed to the CWS</b>	O.1.1 Status report on current operation of the CWS	A.1.1.1 Collect baseline water quality and quantity data	5,500	27,900
		A.1.1.2 Produce topographic map of CWS and environs	7,550	
		A.1.1.3 Transpose MHWS and tidal regime onto map	450	
		A.1.1.4 Determine local sea level rise and add to map.	650	
		A.1.1.5 Survey pipeline levels	1,350	
		A.1.1.6 Survey of HH in catchment area	7,750	
		A.1.1.7. Measure flow of wastewater (existing weir or in-water instruments) in m <sup>3</sup> /day	2,900	
		A.1.1.8 Produce Status Report	1,750	
	O.1.2 Amplification of connections to sewer and storm drains	A. 1.2.1 Connect additional households if capacity allows	15,000	30,750
		A. 1.2.2 Construct additional storm drains	15,750	
<b>Outcome 2.0 Enhanced local capacity to sustainably operate the CWS</b>	O.2.1 MOU for Operation and Maintenance of the CWS	A.2.1.1 Produce an agreement to define roles/responsibilities of running the CWS with all project partners and communities	8,900	8,900
	O.2.2 Training	A.2.2.1 General CWS Training (Chake Chake) x 2 A.2.2.2 CWS Vegetation utilisation training (Chake Chake)	14,000 5,200	19,200
<b>Outcome 3.0 No uncontrolled discharge of untreated wastewater</b>	O.3.1 Modified CWS design	A.3.1.1 utilising data from O.1.1 (Status Report), produce an updated CWS design with increased adaptive capacity	7,950	7,950
	O.3.2 CWS Modification Construction	A.3.2.1 Clear and fix existing pipework within treatment area of system	5,000	187,500
		A.3.2.2 Clear sludge from existing system – take to Vitongoji	23,080	

		A.3.2.3 Improve management of sludge at Vitongoji to allow for effective drying and potential re-use	8,000	
		A. 3.2.4 Clear vegetation ( <i>typha sp.</i> ) from existing system - assess how best to utilise biomass	3,000	
		A.3.2.5 Modify outlets/hydraulics of system	23,500	
		A.3.2.6 Construct holding/buffer storage (in line storage). 500mm diameter pipes laid at shallow depth beneath football field with connecting pipes, manholes and flow controls 300-800m length dependent on flow.	105,700	
		A.3.2.7 Raise embankments and stabilise with Vetiver Grass	5,720	
		A.3.2.8 Replant CWS with four plant species 25% of area each ( <i>typha latifolia</i> , Vetiver Grass, Napier grass + one other)	4,000	
		A.3.2.9 Commission and monitor	5,500	
		A.3.2.10 After 6 months assess four trial plants for growth rate, palatability, usability (i.e. value within A 2.2.2), replant CWS with best option(s)	4,000	
<b>Outcome 4.0 CWS environmentally compliant and financially sustainable</b>	O.4.1 New Regulations	A.4.1.1 Evaluate existing regulations	1,850	17,250
		A.4.1.2 Form a Task Force for creation of new regulations	850	
		A.4.1.3 Amend/rewrite regulations	2,550	
		A.4.1.4 Authenticate laboratories	12,000	
	O.4.2 Creation & Implementation of a Payment for Ecosystem Services System	A.4.2.1 Map (GIS) present/future households contributing to the CWS	Included in A.1.1.6	34,150
		A.4.2.2 Create payment system	11,950	
		A.4.2.3 Conduct training to ZAWA for implementation and operation of payment system	6,700	
		A.4.2.4 Sensitise users, participatory planning, media campaign	8,550	
		A.4.2.5 Introduce Payment for Ecosystem Services	4,950	
		A.4.2.6 Evaluate uptake/payment	2,000	
<b>PROJECT MANAGEMENT</b>		contract, administration, establishing personnel (admin, accounts), reporting, form Steering Committee with all partners, community and DC and PS	20,000	20,000

### Annex 3: Project Monitoring Plan

<b>Project Title:</b> Upscaling and Amplification of the Msingini Wastewater Treatment Facility Model in Chake Chake Town, Pemba			
<b>Project overall objective:</b> To contribute to the protection and management of Pemba Channel Conservation Area (PECCA) coastal and marine ecosystem from discharge of untreated municipal wastewater with a view of improving the quality of coastal livelihoods and biodiversity			
Project Results	Indicator	Target/baseline	Method
<b>Outcome 1.0</b> <b>Additional HH wastewater directed to the CWS</b>	IND.1.1 Number of Water Samples Analysed in the CWS and receiving water	Target: 30 samples analysed from the CWS and the receiving water of the creek  Baseline: No water analyses available	Collect baseline water quality parameters (TSS, BOD/COD, Total nitrogen, ammonia, nitrates/nitrites, soluble phosphorous, faecal coliforms) in effluent of existing plant (inlet and outlet of lagoon, outlet of wetland) and Msingini Creek (three locations during different tidal regimes). Dependent on location of sampling. compared with industry standards, samples after the outlet within acceptable levels
	IND.1.2. Number of topographic maps with 0.2m contours	Target: Topographic map produced with 0.2m contours showing present and future MHWS  Baseline: Existing map with 1m contours. MHWS indicated on shipping chart (bathymetric map)	Utilising GIS and dumpy level, GW and CCTC to complete mapping. Extent of mapping to include approximately 200m upstream and downstream of CWS (or further if deemed necessary during survey)  SLR effect on MHWS calculated from literature and transposed onto the map for future (+10yrs and +20yrs)
	IND.1.3. Number of flow measurements (wastewater and storm water)	Target: 72 flow readings for wastewater  Baseline: No data	Utilising flow gauging instruments, GW and CCTC will monitor wastewater flow over 3 x 24hr periods and generate a flow hydrograph. The existing weir will be assessed for suitability of flow gauging and data logging recorders used where possible. Water level in the storm channel adjacent to the CWS will be measured during and after storm events and compared with rainfall measurements from the nearest weather station.
	IND.1.4. Percentage of HH connected to the system	Target: 100% of HH within immediate area connected to the sewer  Baseline: Approximately 763 (% unknown)	Utilising GIS all houses will be mapped with their sewer lines

<b>Outcome 2.0</b> <b>Enhanced local capacity to sustainably operate the CWS</b>	IND.2.1 Steering committee formed and MOU for Operation and Maintenance of the CWS created	Target: All partners sign document <hr/> Baseline: None existing	
	IND. 2.2 Training	Target: 12 local partners in both CWS training sessions, 30 in wetland plant training. <hr/> Baseline: None existing	CWS Operation & Maintenance course will be run in Chake Chake before and after rehabilitation. Wetland plant harvesting and utilisation techniques training will be run 6 months after replanting CWS.
<b>Outcome 3.0</b> <b>No uncontrolled discharge of untreated wastewater</b>	IND.3.1 Water Quality	Target: Treated effluent samples within discharge to environment levels <hr/> Baseline: None existing	TSS, BOD/COD, Total nitrogen, ammonia, nitrates/nitrites, soluble phosphorous, faecal coliforms analysed at CWS inlet and outlet
	IND.3.2 New plant species trialled in CWS	Target: Four species tested <hr/> Baseline: One	Alternative aquatic vascular plants (AVPs) will be planted, monitored for growth rate and then harvested. They will be tested for usefulness when fresh (such as for fodder, mulching, compost making) and dried (such as weaving and thatching). The community will determine which is the most useful.
<b>Outcome 4.0</b> <b>CWS environmentally compliant and financially sustainable</b>	IND.4.1 New Regulations	Target: Comprehensive regulations that are internationally recognized. At least one laboratory identified to perform full analyses <hr/> Baseline: Existing standards are from the colonial period and out dated. No known laboratories.	The Drafting Task Force will meet to decide on new regulations
	IND.4.2 Creation & Implementation of a Payment for Ecosystem Services System	Target: All HH within original catchment area sensitised. 75% of HH sign up to pay <hr/> Baseline: No HH paying at present	At present no HH are paying for the sewer and storm water drainage services they are receiving. A media campaign and sensitisation of the community will aim to raise awareness of the service they are utilising and show them it is necessary to pay for this in order for successful operation to continue. This will occur after amplification works.

#### Annex 4: Detailed budget

	Category	Year 1					Year 2				
		Quantity	Unit Cost (US\$)	Total Cost (US\$)	WIOSAP Support	Co-financing	Quantity	Unit Cost (US\$)	Total Cost (US\$)	WIOSAP Support	Co-financing
<b>1</b>	<b>Personnel</b>										
	i. Project Coordinator (man days) DoE	40	200	8000		8000	12	200	2400		2400
	ii. Assistant Project Coordinator (man days) ZEMA	40	100	4000		4000	12	100	1200		1200
	iii Wetland expert (design &supervision)-man days - GW	69	350	24150	24150		2	350	700	700	
	iv. Project supervisor (man days) – CCTC	136	100	13600		13600	92	100	9200		9200
	v. Project staff (man days) – DoE/ZEMA	59	100	5900		5900	37	100	3700		3700
	vi. Project staff (man days) -CCTC	14	100	1400		1400	12	100	1200		1200
	vii. Community members (man days)	25	30	750	750		250	30	1500	1500	
	viii. Daily labourers (man days)	1620	10	16200	16200		370	10	3700	3700	
	ix. PES consultant	15	350	5250	5250						9200
	<i>sub-total =</i>			<b>79250</b>	<b>46350</b>	<b>32900</b>			<b>23600</b>	<b>5900</b>	<b>17700</b>
<b>2</b>	<b>Equipment</b>										
	i. Various mapping gear (survey equipment, level, GPS, GIS software, computer)			3000	3000						
	ii. Tablet for HH survey	4	750	3000	3000						
	iii. Flow gauging meter, data logger			2000	2000						
	iv. Maintenance equipment (rods, shovels, wheelbarrows, machetes, safety equipment, nets etc.)	10	100	1000	1000		20	100	2000	2000	
	v. Tools for utilising plant material, crafting, weaving, drying, composting	25	40	1000	1000						
	vi. PES system software and hardware			5000	5000						
	vii. Marketing and media material for PES promotion						20	100	2000	2000	
	viii. Laboratory equipment and chemicals			10000	10000						

	to facilitate full wastewater analyses									
	<i>sub-total =</i>			25000	25000				4000	4000
<b>3</b>	<b>Operating costs</b>									
	i. Fuel for vehicle to/from Vitongoji (km)	1440	2	2880	2880					
	ii. Venue for meetings/training	16	350	5600	1100	4500	3	350	1050	1050
	iii. Training materials			2500	2500				150	150
	iv. Stationery (printing papers, toners field books)			500	500					
	v. Monitoring and Evaluation			3000	3000				2000	2000
	<i>sub-total =</i>			14480	9980	4500			3200	3200
<b>4</b>	<b>Contract Services</b>									
	i. Internal meetings and workshops	5	300	1500	1500					
	ii. Replacing broken pipework in CWS	200	10	2000	2000					
	iii. Removal of sludge	100	100	10000	10000					
	iv. Modification of sludge drying area	50	100	5000	5000					
	v. Removal of vegetation	1	1000	1000	1000					
	vi. Outlet modification (purchase of flap valve including import or re-construction of outlet)	1	10000	10000	10000					
	vii. Emplacement of large diameter pipes for flow control	800	120	96000	96000					
	viii. Vetiver Grass for embankments	3600	0.2	720	720					
	ix. Various aquatic vascular plants	14000	0.2	2800	2800		14000	0.2	2800	2800
	x. Laboratory testing	150	30	4500	4500		150	30	4500	4500
	xi. HH connections						75	100	7500	7500
	xii. Storm channel construction						25 (shallow) 65 (deep)	500 50	15750	15750
	xiii. media campaign and materials						50	100	5000	5000
	<i>sub-total =</i>			133520	133520				35550	35550

<b>5</b>	<b>Travel</b>										
	i. Internal travel (local transport and DSA)	700	7	4900	4900		700	2	1400	1400	
	ii. External travel (tickets and DSA)	2500	4	10000	10000		2500	2	5000	5000	
	iii. External travel (tickets and DSA)	2450	2	4900	4900						
	iv. Internal travel VIP (local transport and DSA)						680	10	6800	6800	
	v. Internal travel handicrafts (local transport and DSA)						250	8	2003	2003	
	<i>sub-total =</i>			<b>19800</b>	<b>19800</b>				<b>15200</b>	<b>15200</b>	
	<b>Grand Total =</b>			<b>272,050</b>	<b>234,650</b>	<b>37,400</b>			<b>81,550</b>	<b>63,850</b>	<b>17,700</b>

**Annex 4.1: Budget Summary** (Total budget for the Output applied for MUST NEVER exceed the ceiling given in the background document)

	Category	Quantity	Unit Cost (US\$)	Total Cost (US\$)	WIOSAP Support	Co-financing
1.	Personnel			102,850	52250	50600
2.	Equipment			29,000	29,000	0
3.	Operating costs			17,680	13180	4500
4.	Contract Services			169,070	169,070	0
5.	Travel			35,000	35,000	0
			<b>Grand total=</b>	<b>353,600</b>	<b>298,500</b>	<b>55,100</b>

**Annex 4.2: Budget justification**

	Category	Justification
1.	Personnel	Project Coordinator, professionals and technical staff required at different stages of implementation. Constructed wetland expert/engineer is key for design, overall supervision and training. PES expert is key for successful revenue method.
2.	Equipment	Sludge and submersible pump, desktop computer required for operations and monitoring during implementation and after commissioning. Dumpy level and GPS needed for topographic/CWS mapping. Flow gauging equipment needed to quantify loading. Mapping tablets and software needed for HH surveys and PES scheme.
3.	Operating costs	These costs are necessary to meet the day to day activities during implementation
4.	Contract Services	CCTC will undertake all construction works. Suppliers for various materials will be competitively sourced. Laboratory analyses are required for monitoring.
5.	Travel	Internal and external travel will be necessary to co-ordinate activities, formulate the MOU, collect data for evaluation, supervise construction and share experiences. As a LDC/SIDS, transport is a premium.