UNEP/NC-W&S/PSCs/DOC-7f

Original: English

Distr.: General

07 June 2019

Third Project Steering Committee Meeting for the WIOSAP Project and First Project Steering Committee meeting for the SAPPHIRE project

25-27 June 2019
Durban, South Africa

THIRD PSC MEETING FOR WIOSAP PROJECT: SESSION Vf - PROJECT PROPOSAL ON IMPROVING MTWAPA CREEK WATER QUALITY BY USE OF CONSTRUCTED WETLAND WASTEWATER TREATMENT TECHNOLOGY IN SHIMO LA TEWA-IMCOW PROJECT.

UNITED NATIONS ENVIRONMENT PROGRAMME
NAIROBI CONVENTION

WIOSAP FULL PROPOSALS TEMPLATE

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

Submission dateline: 5th March 2019

INSTRUCTIONS

Organisation Name	Kenya Marine and Fisheries Research Institute
Project Title	Improving Mtwapa Creek water quality by use of Constructed Wetland Wastewater Treatment Technology in Shimo la Tewa'– **IMCoW Project**
Address	P.O. Box 81651-80100 Mombasa, Kenya
Website	https://www.kmfri.go.ke/
Contact Person	Stephen Mwangi Telephone: 020-8021560/1 Mobile phone: +254722796229 Email: smwangi@kmfri.go.ke; snmwangi40@yahoo.co.uk
Registration Details	Type of organisation: Government Organization Country: Kenya Year: 1979. Registration Number: State Corporation established in 1979 by the Science and Technology Act, Cap 250 of the Laws of Kenya, repealed by the Science, Technology and Innovation Act No. 28 of 2013 .

Executive Summary:
Marine and coastal ecosystems are impacted by natural and anthropogenic stressors. Discharge of domestic, industrial and agricultural wastes into marine ecosystems results in deterioration of water and sediment quality with negative impacts on ecosystem integrity, biodiversity conservation, shoreline stability, community livelihood, and revenue generation. Mtwapa Creek, an Indian Ocean inlet along the Kenya coast receives wastewater from point and non-point sources resulting in deteriorating water quality. The proposed project (IMCoW) will address the issue of wastewater management in Shimo la Tewa Prison being one of the major sources of pollution into Mtwapa Creek. The project proposes to use constructed wetland technology in managing wastewater from Shimo la Tewa prison, a correction facility administered by the Kenya Prison Service under the Ministry of Interior and Coordination of National Government. The proposed IMCoW project will redesign, rehabilitate, improve and operationalise the Shimo La Tewa wastewater treatment system into an efficient and easy to maintain constructed wetland system for the treatment of sewage and wastewater at the prison facility. This will mitigate against low water discharge into Mtwapa creek and by so doing improve the water quality of the creek. Treated water from the outlet of the system will be utilized for aquaculture and farming of horticultural crops in order to complement the nutritional requirement for the correctional facility and enhance food security. The project further intends to improve the prison sanitation by rehabilitating the sewer line and bathrooms. Once complete and operational, the project is intended to come up with an efficient and sustainable constructed wetland that can be replicated or upscaled nationally and regionally. This project responds to problem area 2 of WIOLAB TDA/SAP and is grounded on WIOSAP priority area of reducing impacts from land-based sources and activities and sustainably manage critical coastal and marine ecosystems with the support of partnerships at national and regional levels.

I. BACKGROUND AND JUSTIFICATION

Coastal and marine ecosystems provide important goods and services that when sustainably harnessed can be beneficial to communities and the nation as a whole. As a coastal state, Kenya utilises its marine resources to spur national development and improve community livelihood. However, discharge of domestic, industrial and agricultural wastes into marine and freshwater ecosystems causes deterioration of water and sediment quality. These have negative impacts on ecosystem integrity, biodiversity conservation, shoreline stability, community livelihood, and revenue generation. UNEP-GEF WIO-LaB Project identified municipal and industrial effluents as some of the main sources of land-based sources of pollution in Kenya and an area where least improvement had been observed. There is, therefore, a critical need for development of 'green infrastructure' to manage the ever increasing volumes of domestic and industrial discharge. These green infrastructure' are expected to generate significant benefits for public health, environment sustainability; and increased revenue from certain economic sectors such as fisheries, tourism and property markets which rely heavily on healthy ecosystems. One of the green infrastructure' 'for treating sewage and wastewater is through the use of constructed wetlands. Constructed wetlands are man-made engineered systems that use natural functions such as vegetation, soil, and organisms to treat municipal or industrial wastewater, greywater or storm water runoff. Healthy wetlands have capacity to maintain and improve water quality acting as filtering systems, removing sediment, nutrients and other pollutants from water. The technology has gained popularity in the recent past due to its economically and environmentally sound attributes as a wastewater management option. It is against this background that a project on wastewater treatment for Shimo la Tewa prison was initiated in 2008 and commissioned in 2010 primarily to

treat wastewater from the prison thus preventing raw wastewater discharge into the sea and by so doing improving water quality in Mtwapa Creek.

Shimo la Tewa Prison is a correction facility administered by the Kenya Prison Service under the Ministry of Interior and Coordination of National Government. It is located adjacent to Mtwapa Creek, an Indian Ocean inlet with some small marinas and fringing coastal forests that are famous for bird watching, mountain bike tours and is a starting point for deep sea fishing expeditions. Prior to 2008, wastewater from the prison was discharged directly into the Creek thus polluting the marine environment. However, a wastewater treatment facility was commissioned in 2010 under UNEP's WIOLAB project to treat wastewater released by approximately 3000 people. The facility included a sewer line for collecting the wastewater and effluents, a septic tank for primary treatment and a wetland for secondary treatment. The facility was intended to produce product water that was to be reused in flushing toilets, landscaping and for fish farming. However, the facility experienced challenges including inadequate human, technical and financial capacity to run the facility resulting in no realization of the project objectives. Other causes of the failures of the project included inadequate design, wrong choices of vegetation, overloading of the facility carrying capacity due to increase in the number of users and inadequate training of the prison personnel which compromised the sustainability aspect of the project.

Currently, the prison complex has a total population of about 4,000 but may rise upto a maximum of 5,000 people drawn from Shimo la Tewa Maximum Security prison, Women prison, probation office, Shanzu court, women staff quarters and senior staff quarters. The prison currently produces about 400 m3/day of wastewater which is discharged into Mtwapa Creek when partially treated by dysfunctional facility, thus polluting and negatively impacting on the marine environment.

The proposed IMCoW project aims to redesign, rehabilitate, improve and operationalise the Shimo la Tewa wastewater treatment system. The project, once complete intends to 1) improve the water quality of Mtwapa Creek by ensuring that discharge from constructed wetland meets the NEMA standards on wastewater 2) improve the prison sanitation and 3) produce product water that can be utilized for aquaculture and farming. The proposed project will follow industry best practices such as site evaluation, limiting damage to the local landscape by minimizing excavation and surface runoff during construction, and maximizing flexibility of the system to adapt to extreme conditions.

Relevant National Development Strategies and policies; WIOSAP Priorities and relevant global commitments

The proposed project is aligned with national development blueprint, Kenya's Vision 2030, that aims to transform Kenya into "a new industrializing middle-income country providing a high quality of life to all its citizens in a clean and secure environment". To increase urban sanitation, the Vision prioritises rehabilitation, expansion and development of urban sanitation infrastructure in the satellite towns around Nairobi, Mombasa, Kisumu, Nakuru and Kisii.

The constitution of Kenya 2010 recognizes water and sanitation services as a basic right in Chapter Four (Bill of Rights). Article 43 (b) of the Constitution declares sanitation as a basic human right and guarantees the right of every person to "reasonable standards of sanitation." Article 42 also guarantees the right to a clean and healthy environment.

Kenya enacted the Environmental Management and Co-ordination Act (EMCA), 1999 (revised in 2012), which is meant to ensure that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. Section 55 of EMCA provides for development of regulations for control and prevention of pollution of the marine environment from land based sources including rivers, estuaries, pipelines and outfall structures. NEMA exercises general supervision and coordination over all environmental matters including coastal and marine environmental issues. Under the present call, NEMA will play a general over-sight role being the National Focal Point (NFP) of Nairobi Convention where WIOSAP project is anchored.

Other legislations that are relevant to coastal and marine environment and sanitation include the Water Act (2002-revised in 2012), the Public Health Act (1986-revised in 2012), the Forest Act (2005), the Physical Planning Act (2012) and the Kenya Maritime Authority Act (2012), the Agriculture Act (2012) and Science, Technology and Innovation Act (2013). Kenya also has policies that are relevant to the management of the coastal and marine environment. These include the National Environment Policy (2012), the National Oceans and Fisheries Policy (2008), the Wetland Policy (2009) and the National Land Policy (2009). Kenya recently launched the Kenya Environmental Sanitation and Hygiene Policy (2016 – 2030) as a step towards improved sanitation and a clean and healthy environment for all. All these legislations and policies have attributes relevant to 'improving water quality' that the current project wish to address.

WIOSAP Priorities

The Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region, requires State Parties, including Kenya, to take all appropriate measures to prevent, reduce and combat pollution of the region sea (article. 4); particularly pollution from ships (art. 5), dumping (art. 6), land- based sources (art. 7), exploration and exploitation of the sea bed (art. 8), and airborne pollution (art. 9). WIOSAP, being implemented through the Nairobi Convention secretariat is intended to reduce impacts from land-based sources and activities and sustainably manage critical coastal and marine ecosystems through the implementation of the agreed WIO-SAP priorities with the support of partnerships at national and regional levels'. The WIO-LaB TDA/SAP, outlined 3 problem areas and grouped the threats and impacts into three main categories, Problem Area 1: Physical alteration and destruction of habitats. Problem Area 2: Water and sediment quality deterioration due to pollution and Problem Area 3: Alteration in freshwater flows and sediment loads from rivers. This project responds to problem area 2 of WIOLAB TDA/SAP and is grounded on WIOSAP priority area of reducing impacts from land-based sources and activities and sustainably manage critical coastal and marine ecosystems with the support of partnerships at national and regional levels.

Global and regional relevance

Kenya is signatory to several global and regional treaties and conventions dealing with clean environment and healthy oceans. Implementation of IMCoW project will therefore contribute to the following treaties and conventions;

(i) United Nations Convention on the Law of the Sea (UNCLOS) that Kenya ratified in 1989

ii. Convention on Biological Diversity that Kenya ratified 1994

iii. Rio Declaration on Environment and Development of 1992

iv. Convention for the Protection; Management and Development of the Coastal Environment of the Eastern African Region (The Nairobi Convention) of 1985

v. The Ramsar Convention on wetlands – Entered into force in Kenya on 5 October 1990

vii. Convention on Persistent Organic Pollutants (POPs). Kenya ratified it on 24 September 2004

Kenya adopted the 2030 Agenda for Sustainable Development, which includes a set of 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030. Kenya is committed to meeting its obligations by committing to achieving specific targets focussing on water, sanitation and environment. Key among this is the UN Sustainable Development Goal (SDG) Target 6 that is linked to the improvement of environment and SDG Target 14.1 that aims to prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution by 2025. This goal recognises that most ocean pollution starts on land and emphasises the importance of mitigation of the effects from this pollution.

Other programmes and activities complementing the proposal
The proposed project will augment the efforts of International Atomic Energy Agency that has set up a pollution monitoring programme in a number of Member States in which Mtwapa Creek has been identified as a key ecosystem for monitoring. KMFRI is also currently giving technical support to Lafarge Ecosystems to pilot the use of mangroves to remediate effluents from its aquaculture ponds in Haller Park, Mombasa.

II. **PARTNERSHIPS**

Kenya Marine and Fisheries Research Institute (KMFRI): KMFRI's mandate is to undertake research in marine and freshwater fisheries, aquaculture, environmental and ecological studies, and marine research including chemical and physical oceanography, in order to provide scientific data and information for sustainable exploitation, management and conservation of Kenya's fisheries and other aquatic resources. The Institute is a Centre of Excellence (CoE) in Marine Research in Eastern Africa. The overall leadership of the project will be vested with KMFRI. The institute has qualified personnel and laboratories to undertake the project. Their main function will be undertaking baseline survey, monitoring of the efficiency of the wetland system and Mtwapa creek water quality.

Shimo la Tewa Prison: Institution under Kenya Prisons Service whose functions are to contain and keep offenders in safe custody, rehabilitate and reform offenders, facilitate administration of justice and promote prisoners' opportunities for social re-integration. Shimo la Tewa will provide land, manual labour, oversee daily activities during implementation and undertake repairs and maintenance of the system after EoP. The institution will also be in charge of the management of the livelihood component of the project (fish and crop farming).

GreenWater: is a consultancy firm based in Kilifi (30km from project site) specialising in the design, construction and operation of constructed wetlands. The company was incorporated in 2005 and since that time has worked on numerous projects throughout East Africa including constructed wetlands for a Mombasa housing estate serving >10,000PE, the Great Rift Valley Lodge system for 750PE and numerous eco lodges, flower farms and domestic residences. GreenWater will carry out the topographic survey, offer specialist design, construction supervision and training for the rehabilitation and augmentation of the constructed wetland system.

NEMA – Mandate is general supervision and coordination over all matters relating to the environment and to be the principal instrument of the Government of Kenya in the implementation

of all policies relating to the environment. NEMA will play an over-sight role in the project especially ensuring compliance to the relevant laws and guidelines.

III. OBJECTIVES

A. Overall objective

The project overall objective is to enhance conservation of marine resources in Mtwapa Creek through reduction of land based sources of pollution from Shimo La Tewa prison facility using constructed wetland for wastewater management.

Specific objectives

1. Redesign, rehabilitate and improve operation of existing constructed wetland.
2. Improve general sanitation in the prison facility.
3. Improve food security by utilising treated water from the wetland for fish and crop production.
4. Disseminate constructed wetlands technology for uptake by other stakeholders.

Project objectives and activities

Objective 1. Redesign, rehabilitate and improve operation of existing constructed wetland

Activities

1.1 Evaluate the design and performance of the existing wastewater treatment facility in Shimo la Tewa

1.1.1 Collect baseline water quality parameters (temperature, pH, TSS, BOD/COD, Total nitrogen, ammonia, nitrates/nitrites, soluble phosphorous, faecal coliforms) in effluent of existing plant and Mtwapa Creek. Collect data from three locations during different tidal regimes

1.2. Redesign, construct and operationalise an efficient and easy to maintain constructed wetland system for the treatment of sewage and wastewater at the prison facility

1.2.1 Conduct topographic survey and redesign the wastewater treatment system

1.2.2 Temporarily divert sewage/wastewater away from septic tank to pre-wetland septic tank

1.2.3. Desludge septic tank

1.2.4 Remove gravel from the existing horizontal flow (HF) bed after draining water from the bed.

1.2.5. Renovate/convert septic tank into anaerobic baffled reactor (ABR)

1.2.6. Renovate/convert HF bed to vertical flow (VF) bed with associated chambers/pumps

1.2.7 Construct HF bed and associated chambers/pumps. Two existing unused “lagoons” may be utilised for this (see Figure 2) and operated in parallel.

1.2.8 Commission system once all works complete, conduct training on operation and maintenance of the system and establish associated check lists

1.3. Evaluate the design and performance of the improved wastewater treatment facility in Shimo la Tewa following the commissioning of the infrastructure

1.3.1. Assess the performance of improved constructed wetland facility and suitability for reuse by measuring relevant parameters pH, TSS, BOD/COD, Total nitrogen, ammonia, nitrates/nitrites, soluble phosphorous, faecal coliforms/enterococci from samples collected at the inlet and outlet of the constructed wetland (both during dry and rainy seasons).

1.3.2. Monitor water quality in the receiving water of Mtwapa Creek and compare with baseline data (initially every two weeks for 6 months, then monthly thereafter).

Objective 2. Improve general sanitation in the prison facility

Activities

2.1 Rehabilitate sewer system feeding into the anaerobic baffled reactor (ABR) and add grease traps from kitchen outlet
2.2. Augment treatment of wastewater from the prison health centre as determined in 1.1 prior to allowing it into the main treatment system
2.3 Improve bathrooms at the prisons (including provision of sanitary receptor facilities)
2.4 Divert all rainwater/stormwater away from the wastewater drainage system
2.5 Improve solid waste management by provision of bins and recycling initiatives.

Objective 3. Improve food security by utilising treated water from the wetland for fish and crop production.
Activities
3.1 Survey, design and install water reuse infrastructure including reticulating final effluent water to the farms and fish ponds.
3.2 Operationalize irrigation of the prison farms.
3.3 Construct, stock and manage a pilot fish pond.

Objective 4. Disseminate constructed wetlands technology for uptake by other stakeholders
Activities
4.1 Publicise/disseminate through visits, print and electronic media, briefs, brochures and scientific publications

IV. PROJECT IMPLEMENTATION AND MANAGEMENT PLAN

A. Expected project results and indicators

Result 1: Improved wastewater treatment (indicator: discharge water with measured water quality parameters below the allowed limits defined in the third schedule of NEMA water quality guidelines)
Results 2: Improved water quality of Mtwapa Creek (indicator: At least 80% reduction in nutrients and microbes (in comparison to the baseline) in the areas adjacent to the sewage outfall.
Results 3: Improved sanitation of Shimo La Tewa (indicator: (i) At least 4 bathrooms rehabilitated; (ii) At least 20 sanitary bins installed in the facility and (iii) dedicated line constructed for hospital waste)
Results 4: Increased food production at the facility (Indicator (i) At least 300% increase in in crop production (above the baseline) and (ii) Fish production of at least 400 kg per year.

B. Project activities and work plan

Refer to ANNEX 1

C. Project Beneficiaries

1. About 60,000 inhabitants of Mtwapa and 1500 tourists will benefit from clean beaches and clean environment free from pollution originating from Shimo la Tewa wastewater.
2. Over 5000 fishermen will benefit from increased fish population and income due to improved ecosystem health and biodiversity
3. Mombasa Marine Park and Reserve will benefit from improved water quality
4. 5,000 Shimo la Tewa residents will benefit from improved sanitation and increased food production (over 500 acres of arable land available)
5. At least 10 universities and research institutions in Kenya will have the opportunity for learning and conducting research

6. Shimo la Tewa Prison site will be used as a model to influence use of constructed wetlands for wastewater treatment in the region. Different stakeholders will therefore have pilot demonstration site on application of innovative technology that can be disseminated and replicated elsewhere in the country or region.

D. Implementing agency management of project

It is envisaged that during the implementation and sustenance of this project, there will be enhanced collaboration among partners to ensure that each partner performs assigned role as per agreed arrangement. Each partner will fill a specific complementary role and contribute to a project output based on their mandates, strengths and experiences. The project will be implemented and coordinated under the overall supervision of KMFRI who will host the project management unit. KMFRI will be responsible for project administration, financial management, monitoring and evaluation and reporting. There will be a Project Coordinator appointed at KMFRI to run day to day activities of the project. KMFRI 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 KMFRI 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).

V. PROJECT METHODOLOGY

Objective 1. Redesign, rehabilitate and improve operation of existing constructed wetland.

A site investigation will be completed to quantify and qualify the existing wastewater drainage and treatment system. This will include:

i. a topographic survey of the land and mapping of the structures
ii. a water budget analysis to indicate the existing water sources, uses and disposal
iii. water analyses

This information will allow the project engineer to amend as necessary the proposed improved wastewater treatment system within the constraints of the budget, available space and slope. The existing and proposed systems are indicated on Figures 1& 2 below. The existing system structures will be utilized where possible to save costs. The proposed design is based on a well tested arrangement of combination reed beds (vertical and horizontal flow), with sizing calculated using existing data, industry loading rates and the “Kickuth method”.

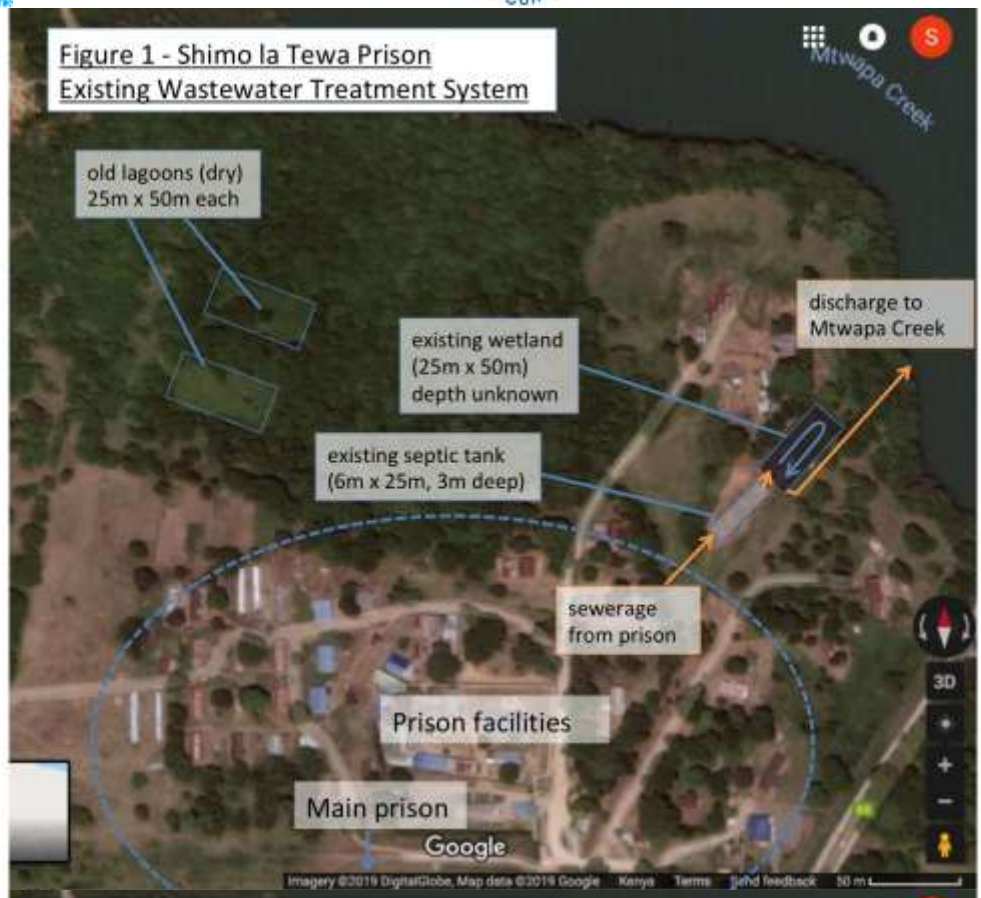
Figure 1 - Shimo la Tewa Prison
Existing Wastewater Treatment System
Mtwapa Creek
old lagoons (dry)
25m x 50m each
discharge to
Mtwapa Creek
existing wetland
(25m x 50m)
depth unknown
existing septic tank
(6m x 25m, 3m deep)
sewerage
from prison
Prison facilities
Main prison
Google

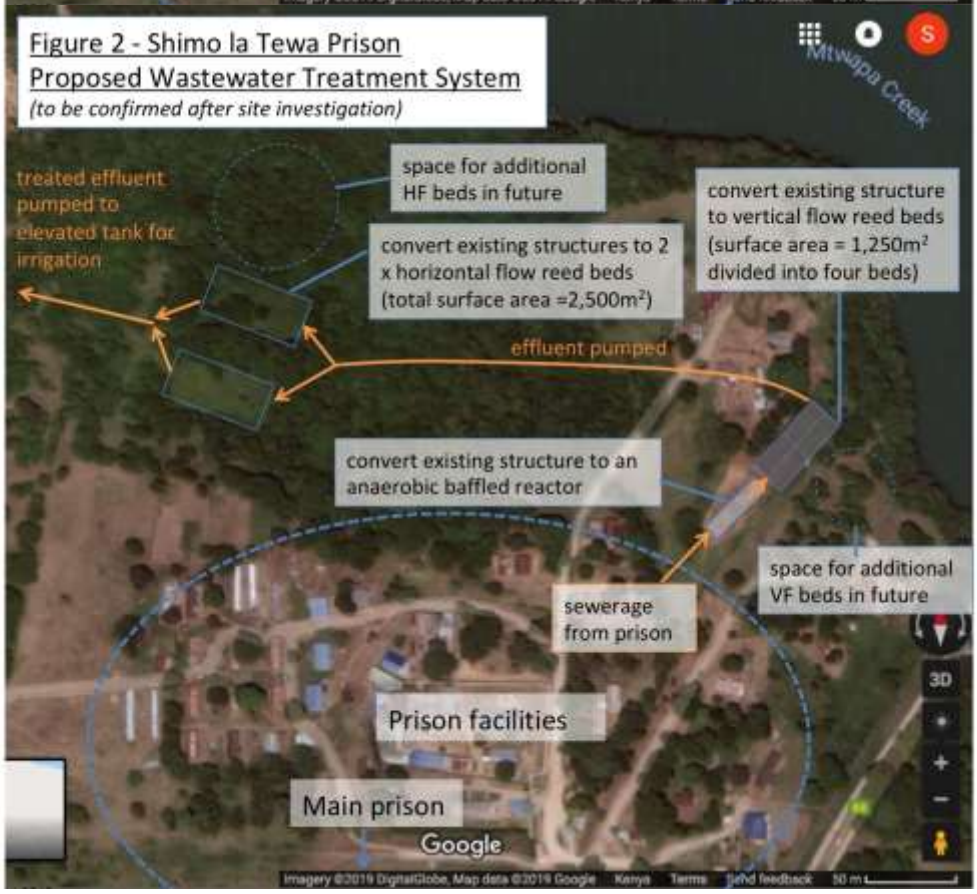
Figure 2 - Shimo la Tewa Prison
Proposed Wastewater Treatment System
(to be confirmed after site investigation)
Mtwapa Creek
treated effluent
pumped to
elevated tank for
irrigation
space for additional
HF beds in future
convert existing structure
to vertical flow reed beds
(surface area = 1,250m²
divided into four beds)
convert existing structures to 2
x horizontal flow reed beds
(total surface area =2,500m²)
effluent pumped
convert existing structure to an
anaerobic baffled reactor
space for additional
VF beds in future
sewerage
from prison
Prison facilities
Main prison
Google

The proposed system components for the total prison population of 5,000 are as follows:

1. primary treatment = anaerobic baffled reactor (ABR) of capacity 150m^3 (hydraulic residence time of 10hours). If possible, convert the existing septic tank into an ABR to produce an improved quality effluent (an ABR may remove 70% of organic matter as opposed to 30% from a septic tank).
2. secondary treatment = vertical flow reed bed (VFRB) of surface area 1,250m^2 –convert the existing "wetland" structure to a VFRB. Flow will be periodically introduced onto the bed surface via a passive dosing device and perforated pipes. Effluent will infiltrate downwards through sand and gravel layers. Plants will be introduced on the surface. Removal processes will include reduction of BOD, conversion of ammonia to nitrates and nitrites, filtration of particles and aeration of water.
3. Tertiary treatment = horizontal flow reed bed (HFRB) of surface area 2,500m^2 – VFRB effluent will be pumped to the two former lagoons which will be converted to HFRBs. The beds will be lined with 1mm HDPE to ensure no discharge to the environment. Flow will be divided in two, introduced at one end of each gravel filled bed and allowed to flow through in a horizontal manner. Water will be collected at the distal end of each bed and combined before pumping to the next stage. The gravel will be permanently saturated creating an anaerobic environment in which the nitrates and nitrites can be transformed to nitrogen gas, pathogens are destroyed and BOD further reduced.

Plants used in the VFRB and HFRB may include (but are not limited to) Typha grass (*typha latifolia),* Cattail (*carex/scirpus/sceleria species*), Flat sedge (*cyperus involucratus*) and Vetiver Grass (*chrysopogon zizanoides),* all of which are available in the local area and have been used successfully by GW in comparable settings. These plants must be periodically harvested to maintain vigorous growth and prevent release of nutrients back into the water when they die and disintegrate. Typha and vetiver are useful plants when dried for handicrafts and thatching, alternatively they may be used as feed for livestock. All other plant waste may be shredded and composted.

A maintenance team will be provided by the prison that GreenWater will train and supervise throughout the first year of operation. The team will follow a site specific maintenance schedule which will indicate daily, weekly and monthly activities to ensure continual operation of the system and early detection of issues.

Baseline water quality samples will be collected at inlet and outlet of the existing wetland. Water analyses at each stage outlet will determine efficacy as compared with design. Specifically, after commissioning, inlet and outlet samples for water quality assessment will be collected for each stage of treatment. This will be carried out once every two weeks for the first 3 months during dry season and first 3 months during wet season after which sampling will be monthly. Water quality parameters that will be determined will include pH, temperature, total suspended solids (TSS), nutrients (ammonium, nitrates, phosphates), BOD, COD, microbes (total and faecal coliforms and *E. coli*.) The collected data will be used to assess the efficiency of the treatment plant by comparing baseline, commissioning and monitoring water quality data to determine percentage reduction in pollutants load. Mtwapa creek water quality within the vicinity of the outlet will be assessed for baseline and monitored to document to what extent this intervention is effective. Based on the normality of the dataset, t- test will be used to determine if there is any significant improvement of water quality that is processed by the wetlands.

Objective 2. Improve general sanitation in the prison facility
The existing sanitation facilities are inadequate, causing a hazard to health of on and off site users. This may be reflected in the incidence rate of gastro intestinal diseases such as diarrhoea. Improving the drainage systems, sanitation facilities and solid waste management will help reduce disease pathways, vectors and incidence rates.

This will be achieved by a site visit as per 1.1 with the following activities:
i. Identify missing components of an effective drainage system
ii. Amend existing structures and add new ones where required e.g. grease traps, raised toilets (Asian style)
iii. Assess clinic in line with Ministry of Health "The National Health Care Waste Management Plan 2008-2012" including disposal of biohazardous waste, sharps etc.
iv. Amend existing clinic structures and add new ones where required e.g. separate bins, incinerator, sharps containers
v. Assess all areas for solid waste disposal, particularly the bathrooms, kitchens and workshops and implement an improved Solid Waste Management Plan.
vi. Identification of NEMA approved waste handlers, transporters and recyclers in the nearby area
vii. Augment areas with necessary bins and conduct training with staff. Follow up training and monitoring every month for six months to ensure adherence to Plan.

Objective 3. Improve food security by utilising treated water from the wetland for fish and crop production.
A suitable reticulation system will be constructed to utilise treated water once the wetland has been constructed and the water deemed satisfactory for use (as per NEMA Water Quality Regulations, Eighth Schedule), consisting of:
i. Design (KMFRI) and construct a fish pond
ii. Construct a holding chamber of 5,000 litres containing a submersible recirculation pump
iii. Lay a pipeline to supply the fish pond and an elevated holding tank
iv. Establish a reticulation system to irrigate farmland from the elevated tank
v. Provide through flow of water for fish pond
vi. KMFRI to provide training to prison staff in pond management (stocking, feeding, operation, maintenance and harvesting of fish from the ponds).
vii. Water and fish samples from the pond will be continuously analysed to ensure suitability of the water for aquaculture and the fish for human consumption.

Objective 4. Disseminate constructed wetlands technology for uptake by other stakeholders
The high number of prisons in Kenya, many with similar conditions to those of Shimo la Tewa, will allow transfer of this technology to other sites. Uptake by other public and private stakeholders will be encouraged. This will be achieved through:
i. dissemination of results via print and electronic media, briefs, brochures and scientific publications
ii. invitation of parties for site visits

Further details regarding replicability are covered in the following section "Replicability".

VI. SUSTAINABILITY AND REPLICABILITY

Sustainability of this project is a key element in ensuring that the project is beneficial not only to the direct beneficiaries but also to the wider stakeholders such as educational and research institutions, neighbouring communities and the environment in general. In line with this, Kenya Prison Service (KPS) commits to avail a budget for the maintenance of the facility once completed and operational. Once the project is complete and operational, KPS will avail several staff members for training in the operations and maintenance of the facility including safety. Annual running costs are anticipated to be 7,000USD which includes the wetland team, pump maintenance/replacement and sludge removal. It does not include the cost of electricity as these will be absorbed by the general prison budget. A committee will also be constituted to govern the project including development and implementation of a maintenance schedule for the project and annual audits. Being a correctional institution, there is adequate labour that is key in undertaking some aspects of operations of the facility. A monitoring programme will be put in place to ensure that the facility operates at an optimum level. KMFRI commits to develop a programme for undertaking regular sampling wastewater at different stages of treatment, the effluent/or water ready for reuse to ensure efficiency and compliance. KMFRI will also develop a programme for sampling and analyses of water quality in Mtwapa Creek. This programme will be embedded within the institute water quality monitoring programme.
The proposed system will allow the prison to complete the whole water treatment cycle on site producing nearly 110,000m^3/yr of treated effluent suitable for use as agricultural irrigation. This water has a value of 20,000USD based on the equivalent value of utilising groundwater (pumping from depth costs 20UScents/litre). This quantity of water is adequate to irrigate 110acres of farmland that may be planted with horticultural crops. The fish pond is anticipated to initially generate about 300kg in seven months but the annual production is expected to rise.

Flow through the system will be by gravity, materials locally sourced and maintenance performed by in-house personnel as much as possible. Where pumping is essential, a backup pump will be on hand in case of breakdown. The design will be modified after activity 1.1. to ensure that it is appropriate, sustainable and replicable.

VII. PROJECT MONITORING AND EVALUATION

The project will be subject to standard WIOSAP Monitoring and Evaluation procedures for demonstration projects. Progress Reports shall be prepared and submitted to the WIOSAP. For effective M&E, the following actions will be undertaken and reports submitted;

1. Periodic Site Visits

The Project Management Team (PMT) and other technical and supervisory Committees will conduct periodic visits to project sites based on an agreed schedule. These schedules will form part of the M&E plan and will also be factored in the annual Work Plans of the project. The purpose of site visits will be to assess the progress in the implementation of specific project activities in the field and also undertake beneficiary contact monitoring and assessments. A field visit report will be prepared after the site monitoring visit. Ad hoc site visits and verification visits may also be carried out.

2. Quarterly Project Reports

Quarterly narrative and financial progress reports will be prepared by describing progress made during the reporting period. The quarterly report will include details on the progress made toward achievement of project objectives, outcomes, outputs and planned activities; challenges; lessons learned, financial expenditure, risk and risk mitigation/management among others. The quarterly progress report will be guided by indicators and targets set out in the results framework and the work plan. All expenditure accounts shall be submitted to the WIOSAP PMU within 30 days of the end of the three-month period to which they refer, duly certified by an authorized official of KMFRI.

3. Annual Progress Reports

The annual progress reports which will cover the financial year, will be developed by Project Management Team and submitted by the Project Manager to WIOSAP PMU. The report will provide information on the performance of the project against planned activities and set targets. It will also provide details on the project achievements, evidence of success during the reporting period, constraints during implementation and how they were addressed. The report will also include a compilation of lessons learned and financial expenditure statement. Just like the quarterly progress report, the annual report will also be guided by indicators and targets set out in the results framework and the annual work plan and all expenditure accounts shall be submitted to the WIOSAP PMU within 30 days of the end of the year, duly certified by an authorized official of KMFRI.

4. End of Project (EoP) Evaluation

An independent end of project evaluation will take place preferably three (3) months prior to the project closing date. This evaluation will focus on key achievements and will also examine indications of project impact and sustainability of results, including the contribution to achievement of the overall objective. The EoP Evaluation will be conducted by an independent Consultant, appointed by WIOSAP PMU. Based on the results of the EoP Evaluation, a EoP Evaluation Report will be prepared and submitted to the WIOSAP PMU. Standard terms of references and reporting format for this evaluation shall be provided by WIOSAP PMU.

5. Final Report

A final report shall be filed within 45 days of the completion of the Project. The format of this report will be provided by the WIOSAP PMU.

Annex1: Project activities and 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
	Overall objective:																								
Outcome 1.0	Improved water quality in Mtwapa Creek using constructed wetland.																								
Output 1.1	Operational constructed wetland																								
Activity 1.1.1	GW KMFRI SHIMO NEMA																								
Activity 1.1.2	GW KMFRI SHIMO																								
Output 1.2	Effective pollution monitoring programme																								
Activity 1.2.1	GW KMFRI SHIMO NEMA																								
Activity 1.2.2	KMFRI SHIMO																								
Outcome 2.0	Improved general sanitation in the prison facility																								
Output 2.1	Improved sanitation infrastructure																								
Activity 2.1.1	GW KMFRI SHIMO																								
Activity 2.1.2	GW KMFRI SHIMO																								

Activity 2.1.3	GW KMFRI SHIMO	
Outcome 3.0	Improved food security by utilising treated water from the wetland for fish and crop production	
Output 3.1	Operational Irrigation system and fish pond	
Activity 3.1.1	KMFRI Shimo	
Activity 3.1.2	KMFRI Shimo	
Activity 3.1.3	KMFRI Shimo	
Outcome 4.0	Increased awareness on use of constructed wetland technology for wastewater treatment	
Output 4.1	Awareness materials produced and shared	
Activity 4.1.1	KMFRI SHIMO	
Project Management		
Reporting	KMFRI Shimo	

Annex 2: Logical Framework

Project title: Improving Mtwapa Creek water quality by use of Constructed Wetland Technology in Shimo la Tewa'– **IMCoW Project**			
Project overall objective: To enhance conservation of marine resources in Mtwapa Creek through reduction of land based sources of pollution from Shimo La Tewa using constructed wetlands for wastewater management.			
Project Results	**Outputs**	**Activities**	**Costs /output (US$)**
Outcome 1: Improved water quality in Mtwapa Creek using constructed wetland.	O.1.1 Operational constructed wetland	A.1.1.1 Evaluate the design and performance of the existing wastewater treatment facility in Shimo la Tewa A.1.1.2 Redesign, construct and operationalise an efficient and easy to maintain constructed wetland system for the treatment of sewage and wastewater at the prison facility	**Sub - total** 2625 184825
	O.1.2 Effective pollution monitoring programme	A.1.2.1 Assess the performance of improved constructed wetland facility and suitability for reuse A.1.2.2 Monitor water quality in the receiving water of Mtwapa Creek	**Sub - total** 6660 17840
Outcome 2.0 Improved general sanitation in the prison facility.	O.2.1 Improved sanitation infrastructure	A.2.1.1 Rehabilitate sewer system feeding the septic tank A.2.1.2 Separate wastewater from prison health Centre from the new wastewater treatment system A.2.1.3 Improve bathrooms at the prisons (including provision of sanitary receptor facilities)	**Sub – total** 5500 6000 15000
Outcome 3.0 Improved food security by utilising treated water from the wetland for fish and crop production	O.3.1 Operational Irrigation system and fish pond	A.3.1.1 Survey, design and install infrastructure for reticulating treated water from effluent to the farms and operationalize irrigation of the prison farms. A.3.1.2 Construct, stock and manage a pilot fish pond.	**Sub – total** 12000 5000

Outcome 4.0 Increased awareness on use of constructed wetland technology for wastewater treatment	0.4.1 Awareness materials produced and shared	A.4.1.1 Publicise/disseminate success stories through policy brief, documentaries, meetings/conferences and scientific publications	**Sub – total** 44400

Annex 3: Project Monitoring Plan

Project Title: Improving Mtwapa Creek water quality by use of Constructed Wetland Wastewater Treatment technology in Shimo la Tewa'– **IMCoW Project**			
Project overall objective: To enhance conservation of marine resources in Mtwapa Creek through reduction of land based sources of pollution from Shimo La Tewa using constructed wetlands for wastewater management.			
Project Results	**Indicator**	**Target/baseline**	**Method (Means of verification)**
Outcome 1.0 Improved water quality in Mtwapa Creek using constructed wetland.	IND.1.1 Number of Wetland output water quality parameters below the allowed limits defined in the third schedule of NEMA water quality guidelines	Baseline: 0 Target: 5 (nutrients, BOD, COD, pH, turbidity and microbes)	1. Water quality technical reports 2. Laboratory test reports 3. Maintenance activity sheets
	IND.1.2 % reduction in creek water quality pollution indicator parameters (nutrients, BOD, COD, pH, turbidity and microbes) at Mtwapa bridge and Moorings hotel sampling stations	Baseline: 100% Target: 80% reduction in levels of water quality parameters (nutrients, BOD, COD, pH, turbidity and microbes)	1. Water quality technical reports 2. Laboratory test reports

Outcome 2.0 Improved general sanitation in the prison facility.	IND.2.1. Number of rehabilitated sewer system feeding the septic tank	Baseline: 0 Target: 1	1. Project progress reports
	IND.2.2 Number of independent wastewater containment systems	Baseline: 1 Target: 2	1. Project progress reports
	IND.2.3 Number of Improved bathrooms with sanitary receptor facilities.	Baseline: 0 Target: 20	1. Project progress reports
Outcome 3.0 Increased food production at the facility	IND.3.1. % increase in the amount of crops produced	Baseline: 100% Target: 300%	1. Crop production records
	IND.3.2 Increase in the amount of fish produced	Baseline: 0 kg Target: 300kg/ Year	1. Fish production records
Outcome 4.0 Disseminate constructed wetlands technology for uptake by other stakeholders	IND.4.1 Number of awareness materials produced and shared with other stakeholders	Baseline: 0 Target: 1 policy brief, 1 documentaries and 1 scientific publication	1. Dissemination/ document sharing records

Annex 4: Budget (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**					
	i. Project Coordinator(man days)	192	100	19200		19200
	ii. Assistant Project Coordinator (man days)	192	100	19200		19200
	iii Project engineer/wetland expert (design &supervision)-man days	42	325	13650	13650	
	iv. Project supervisor (man days)	120	30	3600	3600	
	v. Technical staff (4 prison officers)-man days	768	33	25344		25344
	vi. Scientist (3 KMFRI scientists)-man days	288	50	14400		14400
	vii. Technical staff (3 KMFRI officers)-man days	144	30	4320		4320
	viii. Unskilled labour (30 for 3 months)-man days	1800	5	9000		9000
2	**Equipment**					
	i. Sludge pump	2	1800	3600	3600	
	ii. Submersible pump	1	1200	1200	1200	
	ii. Desktop computer	1	800	800	800	
3	**Operating costs**					
	Fuel (for boat and vehicles)	1	5000	5000	5000	
	Chemicals and consumables	1	7000	7000	7000	
	Field allowances	1	6000	6000	6000	
	Stationery (printing papers, toners field books)	1	3000	3000	3000	
	Airtime	1	2000	2000	2000	
	Administrative costs	1	15000	15000	6000	9000
	Monitoring and Evaluation	5	1000	5000	5000	
4	**Contract Services**					
	i. Desludging septic tank	1	9000	9000	9000	
	ii. Modification of septic tank to anaerobic baffled reactor(ABR)	1	9000	9000	9000	

	iii. Gravel removal from old bed	1	9000	9000	9000	
	iv. Modification of current HF bed to VFRB	1	9000	9000	9000	
	v. Construction of HFRB	2	40300	80600	80600	
	vi. Liners for VFRB and HFRB	2	13000	26000	26000	
	vii. Dosing, flow control, level and pump chambers	10	500	5000	5000	
	viii. Grease trap	1	1500	1500	1500	
	ix. Separation of rainwater/storm water from wastewater drainage	1	4000	4000	4000	
	x. Renovation of toilets, piping manhole renovations and covers	50	300	15000	15000	
	xi. Health care waste management (incinerator, hazardous waste, septic tank, soakpit)	1	6000	6000	6000	
	xii. Irrigation infrastructure (water tank, tower and piping)	1	12000	12000	12000	
	xiii. Pond construction and training	1	5000	5000	5000	
	xiv. Internal meetings and workshops	15	500	7500	7500	
	xv. Production of dissemination materials and dissemination	1	10000	10000	10000	
5	**Travel**					
	i. Internal travel (local transport and DSA)-6persons 4 times	24	600	14400	14400	
	ii. External travel (tickets and DSA)-4 persons 2 trips	8	2500	20000	20000	
	Total			**400,314.00**	**299,850.00**	**100,464**

Annex 4.1: 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 and overall supervision
2.	Equipment	Sludge and submersible pump, desktop computer required for operations and monitoring during implementation and after commissioning.
3.	Operating costs	These costs are necessary to meet the day to day activities during implementation
4.	Contract Services	NEMA approved contractors will be competitively procured for desludging the septic tank and safely disposing. Contractors will also be procured for removal of gravel from existing horizontal flow bed and conversion of septic tank to anaerobic baffled reactor. Suppliers for various materials will also be competitively sourced .

5.	Travel	Internal and external travel will be necessary to share experiences and disseminate results