

# Improving Mtwapa Creek water quality by use of Constructed Wetland Wastewater treatment Technology in Shimo la Tewa Prison - IMCoW Project



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3<sup>rd</sup> WIOSAP Project Steering Committee meeting  
25<sup>th</sup> to 27<sup>th</sup> June 2019

# Implementing Institution and Mandate

- ▶ 1. Kenya Marine and Fisheries Research Institute (KMFRI)
- ▶ A State Corporation established in 1979 by the Science and Technology Act, Cap 250 of the Laws of Kenya, which has since been repealed by the Science, Technology and Innovation Act No. 28 of 2013
- ▶ 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",
- ▶ **Vision:** A Centre of Excellence in Innovative Research in Marine and Fisheries
- ▶ **Mission:** Generate and disseminate scientific information for sustainable utilization of marine and fisheries resources, development of strategic enterprises, food security, employment creation, conservation and restoration of the aquatic environment
- ▶ **Role:** Overall leadership of the project.
- ▶ The institute has qualified personnel, equipped laboratories and office space 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.

# Background and justification

- ▶ Coastal & Marine systems provide goods and services- National growth and community livelihood
- ▶ Ecosystem integrity, biodiversity, community livelihood and revenue generation
- ▶ Natural and anthropogenic impacts on coastal and marine environment- domestic, industrial and agricultural discharge
- ▶ UNEP-GEF WIOLAB Project identified municipal and industrial waste as main sources of land-based pollution sources in Kenya
- ▶ Need to mitigate the impacts by among other ways use of 'green infrastructure' such as constructed wetlands to manage sewage and wastewater
- ▶ The infrastructures are man made engineered systems that use natural functions vegetation, soil, and organisms
- ▶ Operationalization of such infrastructure will benefit marine ecosystem, public health and enhance revenue generation

# Background and justification (Contd)

- ▶ ***Why this Project?***
- ▶ Project site Shimo la Tewa Prison
- ▶ Prison adjacent to Mtwapa Creek-Indian ocean inlet with small marinas and fringing coastal forest and is important for bird watching, fishing and recreation.
- ▶ To the southern part of Mtwapa creek is Mombasa Marine Park and Reserve
- ▶ Prior to 2008, Mtwapa creek used to receive raw sewage effluents from Shimo la Tewa prison facility
- ▶ Under UNEP-WIOLAB project, Wastewater treatment facility for Shimo la Tewa prison was initiated and commissioned in 2010
- ▶ The facility included a sewer line for collecting wastewater and effluents, septic tank for primary treatment and a wetland for secondary treatment
- ▶ Effluent from this water was expected to be of good quality for reuse in flushing toilets, greening the prison compound and for fish farming
- ▶ **Project phased challenges hence objectives not realized**

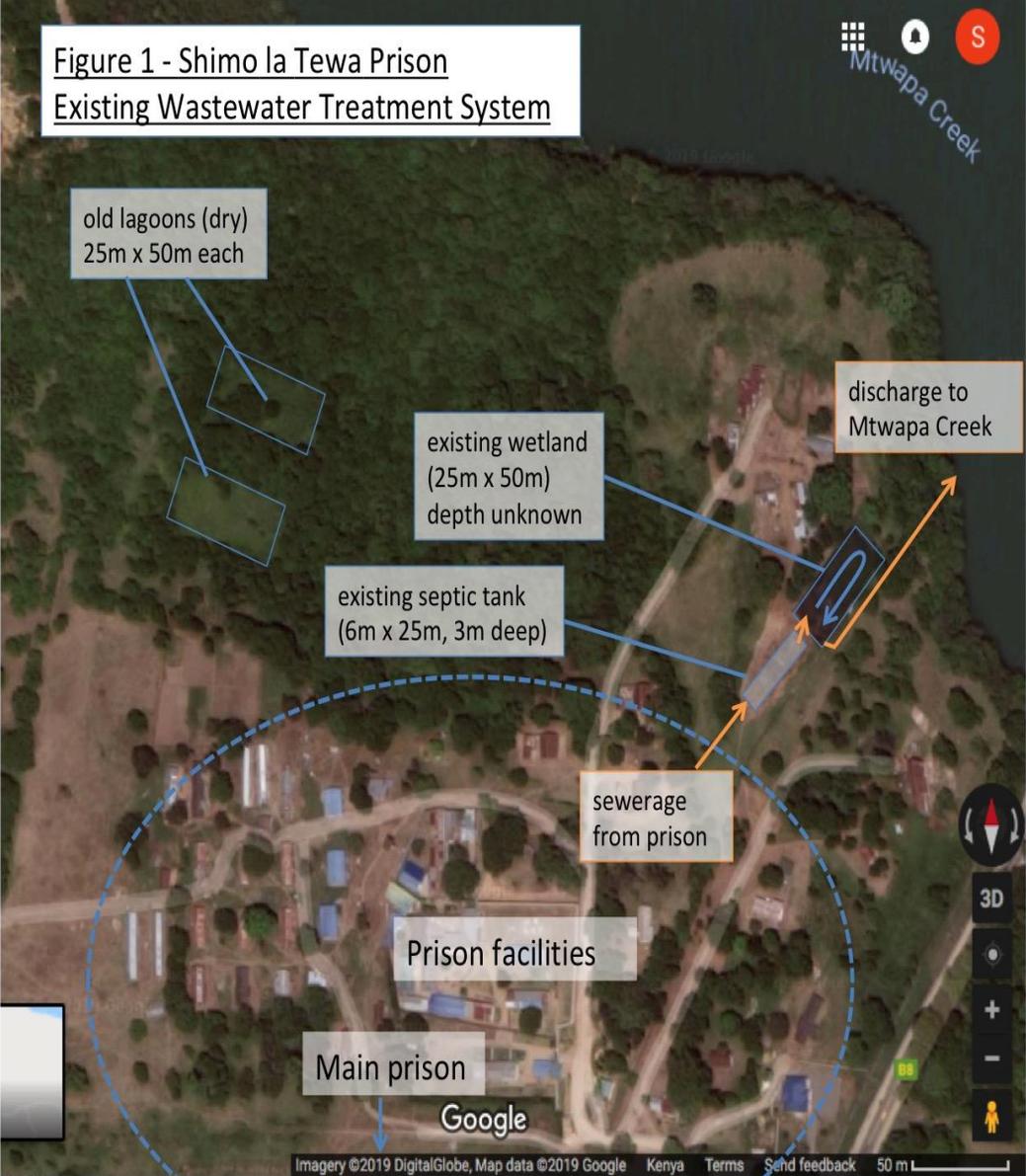
# Project site







# Existing



# Challenges

- ▶ Inadequate human, technical and financial capacity to run the facility resulting in non realization of the project objectives.
- ▶ Inadequate design, wrong choices of vegetation, overloading of the facility carrying capacity due to increase in the number of users
- ▶ Inadequate training of the prison personnel which compromised the sustainability aspect of the project.

# Current status

- ▶ Prison population has increased to over 5000 (Maximum security prison, women prison, probation office, Shanzu court, women and senior staff quarters)
- ▶ Producing an estimated 400M<sup>3</sup>/day of wastewater discharged into Mtwapa Creek partially treated hence impacting on the marine environment





## Effluent from Shimo la Tewa prison and 'fishing' in the creek



# What is proposed

- ▶ Project proponents appreciate the investment by UNEP-WIOLAB and by rehabilitating this facility will contribute to the WIOLAB goal envisaged in 2007.
- ▶ The current facility is producing some positive results though not optimal
- ▶ Intend to take advantage of lessons learnt to rehabilitate and operationalise the waste treatment facility so as to meet the intended objectives and maximum benefit to the marine environment, prison community and neighbouring and other stakeholders.
- ▶ Implementation of this project through WIOSAP support will greatly contribute to realisation of WIOLAB goal
- ▶ Contribute to conserving the creek marine resources
- ▶ Address WIOSAP priority area of reducing impacts from land-based sources and activities and sustainably manage critical coastal and marine ecosystems and

# Main Activities

- ▶ **Objective 1**
- ▶ Evaluate the design and performance of the existing wastewater treatment facility in Shimo la Tewa by collecting baseline water quality parameters **in effluent of existing plant and Mtwapa Creek.**
- ▶ Conduct topographic survey and redesign the wastewater treatment system
- ▶ Temporarily divert sewage/wastewater away from septic tank to pre-wetland septic tank
- ▶ Desludge septic tank
- ▶ Remove gravel from the existing horizontal flow (HF)
- ▶ Renovate/convert septic tank into anaerobic baffled reactor (ABR)
- ▶ Renovate/convert HF bed to vertical flow (VF) bed with associated chambers/pumps

# Main Activities

## Under objective 1 (contd)

- ▶ Construct two HF bed and associated chambers/pumps.
- ▶ Commission system once all works are complete
- ▶ Conduct training on operation and maintenance of the system and establish associated check lists
- ▶ Assess the performance of improved constructed wetland facility and suitability for reuse by measuring relevant parameters both during dry and rainy seasons.
- ▶ 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).

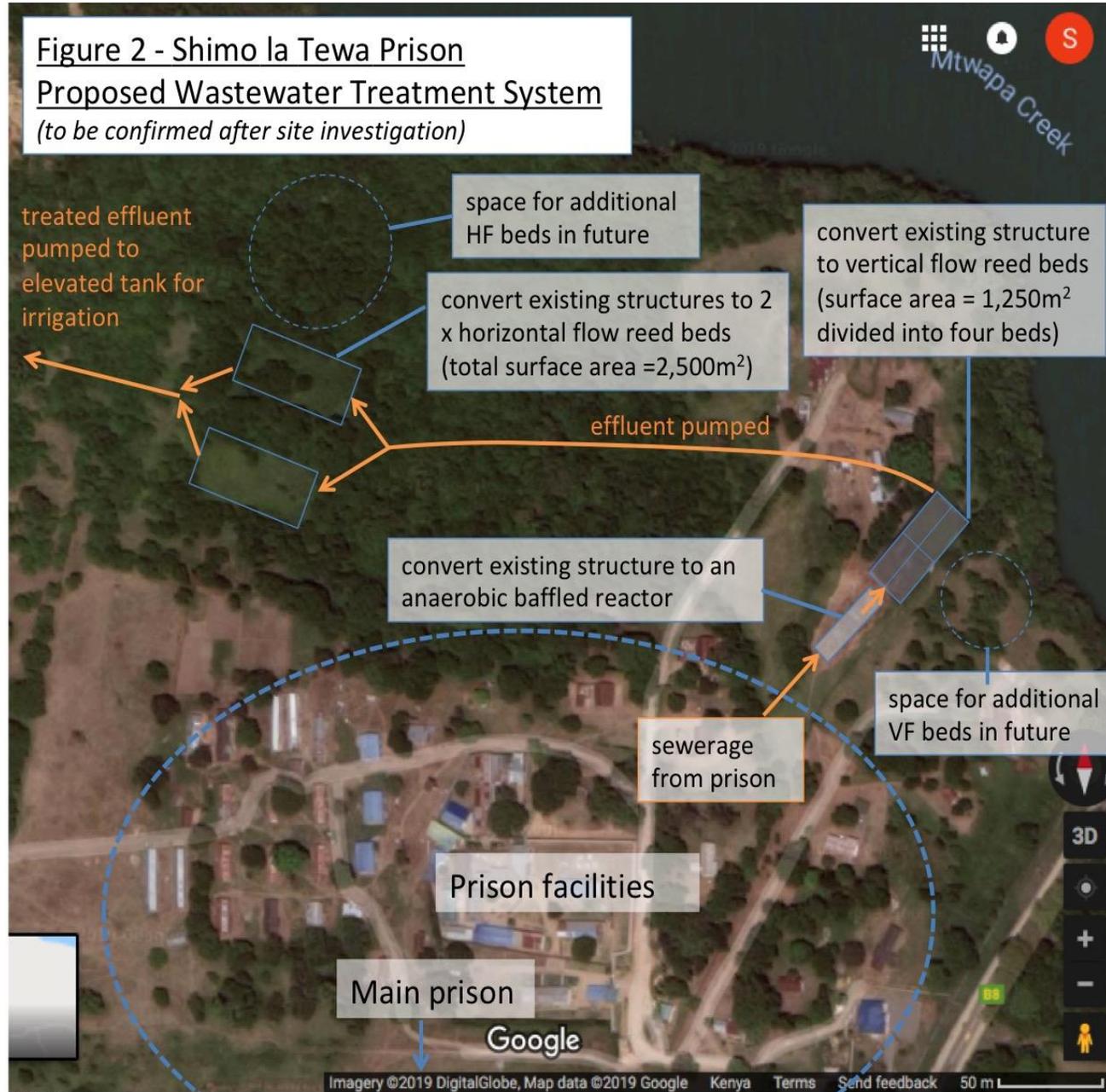
## ▶ Under objective 2

- ▶ Rehabilitate sewer system feeding into the anaerobic baffled reactor (ABR)
- ▶ Improve bathrooms at the prisons
- ▶ Improve solid waste management by provision of bins

# Main Activities

- ▶ **Objective 3**
- ▶ Survey, design and install water reuse infrastructure including reticulating final product water to the farms and fish ponds.
- ▶ Operationalize irrigation of the prison farms.
- ▶ 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

# Proposed



# Sustainability

- ▶ The redesigning of the project is aimed at ensuring efficiency and effectiveness through low cost maintainace and utilisation of available resources, i.e. design will be user friendly
- ▶ Kenya Prison Services (KPS)has enhanced its capacity by recruiting professionals including water engineers, civil engineers and technical staff of different cadres (electricians, plumbers, masons). These will be key in operations and maintenance.
- ▶ KPS commits to have a budget to support the project after handover
- ▶ Research and development-KPS has established a R & D department that commits to work in partnership with KMFRI
- ▶ Multi-agency approach to implementation of the project
- ▶ Stakeholders involvement will boost support for the project
- ▶ Continuous training
- ▶ Succession management
- ▶ Continued monitoring and evaluation after EoP.

## Project beneficiaries

- ▶ 1. Marine environment
- ▶ 2. Over 5000 Shimo la Tewa residents will benefit from improved sanitation, increased food security.-include over 1000 women and 500 children within the facility
- ▶ 3. About 60,000 inhabitants of Mtwapa and 1500 tourists will benefit from clean beaches and clean environment.
- ▶ 4. Over 5000 fishermen will benefit from increased fish population and income due to improved
- ▶ 5. Mombasa marine park and reserve will benefit from improved water quality
- ▶ 6 At least 10 universities and research institutions in Kenya will have the opportunity for learning and conducting research
- ▶ 7. Dissemination: The pilot project will be used as a model for innovative technology hence encourage use of constructed wetlands for wastewater treatment in the country and region.

# Project objectives

## Overall objective

- ▶ 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.

# Partnerships in the project

- ▶ 1. 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.
- ▶ **Role:** 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).
  
- ▶ 2. GreenWater:
- ▶ 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.

# Partnerships in the project

- ▶ **Role:** GreenWater will carry out the topographic survey, offer specialist design, construction supervision and training for the rehabilitation and augmentation of the constructed wetland system.
- ▶ 3. NEMA
- ▶ **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.
- ▶ **Role:** NEMA will play an over-sight role in the project especially ensuring compliance to the relevant laws and guidelines.



## Linkage to ongoing initiatives

- ▶ 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.

# Expected project results and indicators

- ▶ A. 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 30 bathrooms rehabilitated; (ii) At least 20 sanitary bins installed in the facility

- ▶ 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.





# BUDGET

	Category	Quantity	Unit Cost (US\$)	Total Cost (US\$)	WIOSAP Support	Co-financing
<b>1</b>	<b>Personnel</b>			<b>108,714</b>	<b>17,250</b>	<b>91,464</b>
	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
<b>2</b>	<b>Equipment</b>			<b>5600</b>	<b>5600</b>	
	i. Sludge pump	2	1800	3600	3600	
	ii. Submersible pump	1	1200	1200	1200	
	ii. Desktop computer	1	800	800	800	
<b>3</b>	<b>Operating costs</b>			<b>43,000</b>	<b>34000</b>	<b>9000</b>
	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	

	Category	Quantity	Unit Cost (US\$)	Total Cost (US\$)	WIOSAP Support	Co-financing
<b>4</b>	<b>Contract Services</b>			<b>208,600.00</b>	<b>208,600.00</b>	
	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	
<b>5</b>	<b>Travel</b>			<b>34,400.00</b>	<b>34,400.00</b>	
	i. Internal travel (local transport and DSA)	24	600	14400	14400	
	ii. External travel (tickets and DSA)-4 persons 2 trips	8	2500	20000	20000	
	<b>Total</b>			<b>400,314.00</b>	<b>299,850.00</b>	<b>100,464</b>

*THANK YOU*

The background features abstract, overlapping geometric shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily located on the right side of the frame, creating a modern, layered effect against the white background.