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Policy, Institutional and Legal Guidelines for Sustainable Use of Constructed Wetlands in Tanzania

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***Abstract*—** *The guidelines will provide all stakeholders especially planners, designers and constructors as well as funding agencies in the Tanzania with an easy guidance in policy, institutional and legal aspects required to be considered for proper planning, designing, construction and sustainable use of constructed wetlands technology. These guidelines will contribute towards improving sanitation delivery services in areas without access to conventional sanitation systems and hence will improve the environmental protection against pollution. In Tanzania, the need for guidance in policy, institutional and legal aspects during planning, designing, construction and implementation of constructed wetlands technology is paramount important due to poor institutional arrangement pertaining to issues of sanitation and due to unsuccessful stories given for some of the implemented constructed wetlands in some parts of the country. It is hoped that when these guidelines are properly followed and adhered to, it will yield a positive results in terms of proper planning, designing construction and implementation of the technology. The methodologies used were documents review and interview.*

***Keywords*—Constructed wetland, Guidelines, Sustainable use, Policy, wastewater treatment.**

I. INTRODUCTION

Constructed wetlands (CWs) are planned systems designed and constructed to employ wetland vegetation to assist in treating wastewater in a more controlled environment than occurring in natural wetlands. Hammer (1989) defines CW as a designed, manmade complex of saturated substrate, emergent and submerged vegetation, animal life, and water that simulate natural wetlands for human uses and benefits. CW are "eco-friendly" alternatives for secondary and tertiary treatment of municipal and industrial wastewater. The pollutants removed by CW's include organic materials, suspended solids, nutrients, pathogens, heavy metals and other toxic or hazardous pollutants. Different types of CWs can effectively treat secondary or tertiary treated wastewaters. However, they should not be used to treat raw sewage and, in industrial situations, the wastes may need to be pre-treated so that the biological elements of the CW system can function effectively with the effluent. CW's are practical alternatives to conventional treatment of domestic sewage, industrial and agricultural wastes, storm water runoff, and acid mine drainage.

There is not even a single city or town in Tanzania with adequate sewage treatment facilities (Mohammed, 2002). Under normal circumstances, urban centres would be served by wastewater treatment plants and regulated septic disposal facilities, while peri urban areas would experience un-regulated waste dumping and burial. In Tanzania however, a very small portion of the urban centres is served with adequate wastewater treatment facilities. Coverage by sewerage services in major cities such as Dar es Salaam, Arusha and Mwanza is less than 15%, with an exception of Moshi at 40% (Mihayo and Njiru, 2005). About 60-70% of the urban population (Mato, 2002), in Tanzania, lives in unplanned peri-urban areas, relying mostly on pit latrines and septic tank soak away systems for sanitation. Major problems with pit latrines and septic tanks in Tanzania are leakages caused by poor construction, flooding of low lying areas, and lack of maintenance. Soak away pits fill up due to poor infiltration when built in clay soil areas. Possibility of conventional systems polluting drinking water sources is high due to close proximity to shallow water wells and surface water sources. Additionally, there is generally lack of adequate wastewater treatment due to lack of funds to install centralized wastewater treatment systems and lack of commitment among policy makers to seriously deal with the problem.

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To tackle these problems, good solutions for improving sanitation systems in Tanzania have to be identified. A sustainable low cost solution for hygienic sanitation identified is engineered wetland systems, also known as Constructed Wetlands (CW). The use of constructed wetlands for domestic wastewater treatment in Tanzania has gained much popularity over the last fifteen years since the early pioneering works by Mwegoha et al. (2001), Mwegoha et al. (2002), Kimwaga et al. (2002a, 2002b), Njau et al. (2002), Senzia et al. (2002a, 2002b), Haule et al. (2002), Kaseva et al. (2002), Kimwaga et al. (2004) and Senzia et al. (2003).

The long operational experience and research results have shown greater treatment efficiency, greater nutrient reclamation as compared to other natural biological treatment systems. These systems are low energy-consuming and use natural processes, in contrast to the complex conventional treatment systems that are high energy and high-maintenance demanding. Other advantages include: simplicity, low construction, operation, and maintenance costs, use renewable energy, use locally available materials and robustness. Although they have been found to be commonly used for treating domestic wastewaters, they can also be used for treating industrial wastewater, including water that contains agro-industrial wastes.

Another potential advantage of using sub-surface flow constructed wetlands is that they do not allow mosquitoes to breed. Also, the systems can be designed in clay soils by which septic tank systems cannot fit, they can be designed in areas with high water table because the maximum depth below the ground surface is 0.6 m, they can fit for decentralized wastewater treatment as it can be designed in small, medium and large scales.

Developing these guidelines followed the introduction of economic development frameworks such as sustainable Development Goals (SDGs), MKAKATI WA KUKUZA UCHUMI NA KUPUNGUZA UMASIKINI TANZANIA - Strategy for raising economy and reducing poverty in Tanzania (MKUKUTA), with the guidelines providing a platform for proper planning, designing, construction and sustainable use of constructed wetlands technology hence improving sanitation delivery services in areas without access to conventional sanitation systems and consequently contribute towards improving the environmental protection.

Overall Objectives

The overall objective is to provide Policy, Institutional and Legal guidelines in order to increase access, affordability, and sustainability of constructed wetland technology in urban, peri-urban and rural area of Tanzania.

The specific objectives are:

(a) To provide policy, institutional and legal requirements in planning phase of constructed wetlands,

(b) To provide policy, institutional and legal requirements in design phase of constructed wetlands,

(c) To provide policy, institutional and legal requirements in construction phase of constructed wetlands, and

(d) To provide policy, institutional and legal requirements in implementation phase of constructed wetlands.

II. METHODOLOGY

The methodologies used were documents review and interview. Relevant research reports on constructed wetland technologies in Tanzania were reviewed. Different researchers who researched on constructed wetland technologies in Tanzania were interviewed.

III. POLICY, INSTITUTIONAL AND LEGAL GUIDELINES IN PLANNING, DESIGN, CONSTRUCTION AND IMPLEMENTATION PHASES

Planning Phase

During the planning phase for the construction wetland project, the following are required.

Land Title Deed

A Developer must hold either a title deed issued by the Ministry responsible for land matters or any other documentation evidencing ownership for the land upon which the CW shall be located.

Environmental and Social Clearances

An Environmental and Social Impact Assessment (ESIA) is a process pursuant to which a development proposal (including its alternatives) and its effects on physical environment and human life, including the mitigation and management of effects is evaluated. An ESIA is carried out in order to ensure that the likely effects of new developments are taken fully into account before the development is allowed to go ahead.

The EIA process covers the period commencing at the initial concept of the proposal and run through implementation to completion and, where appropriate, decommissioning. An EIA is conducted under the provisions of the Environmental Management Act, Cap. 119, which is managed by the National Environmental Management Council. As provided in the Environmental Management Act, Cap. 119 and depending on size and potential for impact, some projects may not require a full EIA.

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Wastewater Analysis

The developer should analyze the wastewater design parameters in authorized institutions such as Ardhi University, University of Dar es Salaam e.t.c.

Design Phase

The design of a CW should be carried by qualified and registered engineers by engineer's registration board (ERB) and should be designed by following manuals, standards and code of practice. The design should meet the recommended effluents discharge standards

Construction Phase

At this stage a building permit is required. The construction of any major installation must be authorized by relevant authorities responsible for town and country planning. The authorities that issue building permits include district, municipal and city councils (local government authorities). The authority issues a permit to the developer or proprietor after checking the designs and engineering drawings if they correspond with best engineering practices and also, after checking the design and construction site if comply with master plan. Then the proprietor should find the registered construction company by Engineers Registration Board (ERB) for the construction and should find the qualified and registered consultants for regular check of the construction process.

Implementation Phase (Operation and Maintenance)

CW effluent quality should be monitored by the proprietor for checking if they comply with allowable effluent discharge standards (Tanzania Standards or WHO standards). Institutional such as primary, secondary schools should arrange environmental unit/club for Operation & Maintenance of CW. The operation and maintenance manual for constructed wetlands in Tanzania should be used with this guideline.

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