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GUIDING PRINCIPLES ASSOCIATED WITH SOCIAL-ECONOMIC ASPECTS FOR CONSTRUCTED WETLAND TECHNOLOGY IN TANZANIA

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ABSTRACT

The guidelines will provide all stakeholders especially planners, designers, constructors, users as well as funding agencies in the Tanzania with an easy guidance in social-economic aspects required to be considered for proper planning, designing, construction and sustainable use of constructed wetlands technology. In Tanzania, the need for guiding principles associated with social economic aspects in the planning, designing, construction and implementation of constructed wetlands technology is apparent increasing due to unsuccessful stories given by some stakeholders for some of the implemented constructed wetlands. It is hoped that when these guidelines are properly followed and adhered to, it will yield to positive results in terms of performance of the technology. The methodologies used were documents review and interview.

Keywords: Constructed Wetland, Social-Economic Aspects, Sustainable Use, Wastewater.

1. 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. Vyamazal (2016) 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. CWs 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.

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 known as Constructed Wetlands (CWs). 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 0.6m, 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.

The overall objective is to provide social economic dimensions 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 includes: To provide social economic requirements in planning phase of constructed wetlands; To provide social economic requirements in design phase of constructed wetlands; to provide social economic requirements in construction phase of constructed wetlands, and to provide social economic requirements in implementation phase of constructed wetlands.

2. 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.

Social Economic Dimensions Guidelines in Planning, Design, Construction and Implementation Phases

Planning Phase

The planning process must incorporate all stakeholders to make informed decisions about water, sanitation and hygiene services, particularly in terms of identifying and providing services to those communities who do not have access. Planning includes data collection and analysis such as the magnitude of the problem, available means of solution and prioritisation, allocation of resources to implement plans.

A participatory approach to community learning and planning should be employed as a strategic decision making. Planning for sanitation services should address the following:

a) Existing sanitation services, including existing infrastructure and current water services providers.
b) Identify and evaluate environmental and social risks and impacts of the project.
c) Involvement of traditional patterns of community leadership and organisation that have proven to be effective i.e. identify successful traditional approaches and adopt them in the project planning where possible.
d) Participatory methods should be the basis for all contacts between partners and community.
e) Awareness and sensitization of sanitation facility to be installed to the population.
f) Economic benefits from ‘productive’ sanitation systems, including the recyclables (soil conditioner, fertiliser, energy sources and reclaimed water), employment creation, increased productivity through improved health and the reduction of environmental and public health costs.
g) Socio-cultural acceptance and appropriateness of the system, convenience, system perceptions, gender issues and impact on human dignity, the contribution to subsistence economies and food security, and legal and institutional aspects.
h) Allow stakeholders to see, understand and influence company on decision making-process by providing clear, accurate, understandable and timely information to stakeholder about the proposed project and potential impacts on them.
i) Develops practises and procedures to avoid or reduce negative impacts.
j) Establish transparency procedures for carrying out the proposed project.
k) Promote and provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them.
l) Ensure that relevant environmental and social information is disclosed and disseminated.

m) Identify and evaluate environmental and social risks and impacts of the project.
n) Promote improved environmental and social performance of clients through the effective use of management systems.
o) Anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected.
p) Ensure that the development process fosters full respect for human rights, dignity, aspirations, culture and natural resource-based livelihoods of the community.
q) Promote sustainable development benefits and opportunities for the community in a culturally appropriate manner.
r) Establish and maintain an ongoing relationship based on informed consultation and participation with the community affected by a project throughout the project's lifecycle.
s) Ensure the Free, Prior and Informed Consent of the affected communities when the circumstances described in this Performance Standard are present, and
t) Respect and preserve the culture, knowledge and practices of the communities.

Design Phase

The design and installation of a sanitation system requires a multidisciplinary approach to bring an understanding of system function. When sanitation systems are designed and built with community participation they can treat the desired effluents including short-term increases in volumes. Therefore the sanitation experts should assist the community to understand the available sanitation technological options and help them to select the technology best suited for their needs.

The following should be considered in designing phase:

a) Historical approaches/background information should be considered to improve the designing
b) Arrangements for monitoring and evaluating services, especially to enable consumers to give feedback on quality issues and service providers to act on the feedback
c) It is essential that the construction of a treatment system such as constructed wetlands does not itself become a source of pollution or lead to the loss of significant intrinsic value at the site. Minor odors may be associated with the wetland, and their potential impact needs to be assessed and addressed.
d) Human potential impact on the institution/enterprise, users, and neighboring communities and properties needs should be assessed and addressed.
e) Particular attention must be given to areas of natural and cultural heritage and where such locations are being considered for a CW, discussions should firstly take place with the appropriate state agencies from local to central government.

f) Location of dwellings or other places of assembly such as nearby schools, churches, hospitals, etc. which are not marked on the available maps, should be established and their distance from the CW site determined.
g) Overhead wires, poles and any other utilities should be marked on drawings. The prevailing wind direction across the proposed CW site should be identified, and the sensitivity of any receptors downwind identified. Impact from any localized heavy rainfall events should be particularly noted.
h) Local or native plants should be used. The use of non-native species may be considered in circumstances where the species does not have the potential to invade natural ecosystems.
i) Information should be provided with an understanding of a CW system's function and how it can contribute to sustainable wastewater management.
j) The rationale for the area required needs to be explained and agreed in order to ensure full compliance with the design needs.

Construction Phase

Effective use of the site's soils, topography and plants (where available) during construction is essential to minimizing costs and obtaining best use for the CW.

The following should be considered in construction phase:

a) The construction activities should promote use of local skilled and unskilled labour. Such contributions help develop a sense of community ownership of the project, enhance local responsibility for long-term operation, maintenance and sustainability, and reduce overall project costs.
b) Adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment;
c) Promote fair treatment, non-discrimination and equal opportunity of workers.
d) Establish, maintain and improve the worker-management relationship.
e) Promote compliance with national employment and labour laws.
f) Protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties and workers in the client's supply chain.
g) Promote safe and healthy working conditions and the health of worker and avoid the use of forced labour;
h) Avoid or minimize pollution from project activities.
i) Promote more sustainable use of resources (including energy and water).
j) Reduce project-related Greenhouse Gas (GHG) emissions.
k) Appropriate fences should be erected to the required standards to control, where needed, the access of people and livestock and where (or when) required under any planning conditions. The shallow depth of the CW and the surround of any deeper water such as the monitoring pond, provide a degree of built-in safety.
l) Local organizations involved in urban planning, enforcement, and monitoring of health and social impacts are ensured adequate training, personnel, technical assistance and

support funds to plan, manage all potential social and health risks, and carry out prevention and control measures and enforcement.

Implementation Phase (Operation and Maintenance)

A fundamental requirement of the CW concept and its design is that it be as self- managing and as self-maintaining as possible. The initial management requirements must be achieved within the physical, chemical and biological dynamics of wetland ecosystem function. If left unmanaged the accumulation of sediments and decaying organic matter combined with changing vegetation structure will eventually cause channeling-type flow to develop thus reducing retention time and plant contact. To minimize such channeling, surface flow must be maintained through the incremental raising of the water level in the various wetland segments. Community involvement in the project does not end with planning, designing and construction but must continue through the implementation and sustainability phases. Sanitation experts should encourage the community to remain engaged in decision-making and in the various implementation activities.

The following should be considered in implementation phase:

a) Maintenance should remove any trees that may grow to large stature on the embankments. Trees of small size or larger trees at appropriate locations may be tolerated and even encouraged, as long as the stability of the banks and their integrity are not compromised.
b) Fences should be maintained with particular attention to preventing livestock from gaining access to the overall CW site (though there are situations where, through design, livestock can be managed on the site, e.g. where embankments are sufficiently wide and shallow and resistant to erosion). Any fences restricting personnel access should be maintained to the level required.
c) Sediments, detritus and biomass will accumulate in all segments of a CW. This will be greatest in the first segment where there is also the greatest phosphorus accumulation.
d) Identify the most commonly cultivated agricultural crops that would be potential to cultivate in relation to the type of the effluent from CW.
e) Anticipate and avoid adverse impacts on the health and safety of affected communities during the implementation phase from both routine and non-routine circumstances;
f) Ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected communities.
g) Protect and conserve biodiversity as well maintain the benefits from ecosystem services.
h) Ensure that complaint from affected communities and external communications from other stakeholders are responded to and managed appropriately.
i) Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

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