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Environmental Pollution Control Using Wetlands in Poverty Alleviation for Sustainable Development in Tanzania

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ABSTRACT

Environmental pollution control using Wetlands for poverty alleviation research was conducted in Nachingwea District at latitude 10° 30' S and Longitude 38° 20' E. The general objective examined the use of wetlands for environmental pollution control and poverty alleviation for Sustainable Development. Specifically (i) To identify types of wetlands environment at Nachingwea in Tanzania. (ii) To examine the contributions of wetlands in environmental pollution control and poverty alleviation. The research hypotheses: Null (Ho) and the alternative (Ha) hypotheses at a significant level of 0.05. Ho: Wetlands in Rural and Urban localities contribute significantly in environmental pollution control and poverty alleviation. for Sustainable Development. Ha: Wetlands in Rural and Urban localities do not contribute significantly in environmental pollution control and poverty alleviation. Quantitative and qualitative methods were employed. Data collection involved observation, questionnaire, interview and documentary review. Random sampling was used to identify people from each village for the administration of questionnaires and the interview. Data analysis utilised Excel (2007) to construct percentage Tables and online ICT facilities. Results revealed Nachingwea District wetlands for poverty alleviation were in rural localities while for environmental pollution controls were in urban. The results indicated wetlands contribute significantly in environmental pollution control and poverty alleviation. These are through agricultural and mining activities which create employment by food and cash-crops production and livestock for increasing income to alleviate poverty. Aesthetics for tourism, hoabouring migratory birds, fishing and other activities create jobs. It is recommended that the utilization and management of wetlands for production purposes should be considered by the community, policy makers and researchers. This is a strategy in the environmental conservation as a significant area of environmental pollution control and poverty alleviation for Sustainable Development.

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Introduction

Worldwide, over a billion people lack safe and adequate food as well as safe drinking water, and nearly half the worlds population has no acceptable means of sanitation as narrated by World Health Organization, 2019. Due to industrialization which has led to rapid urbanization, there is problem of water and sanitation problems in many countries especially the third world countries. In many cities of the third world, the untreated water is used for drinking, bathing, and washing. This situation is typical of many rivers even open defecation is widespread even in urban areas of third world cities. More than 1 billion people on the planet are exposed to potentially health-damaging levels of pollution. Unfortunately, in cities around the world, residents have come to accept smog and polluted air as “normal.” Air pollution in urban areas is caused primarily by emissions from automobiles and secondarily by emissions from electric power plants and heavy industries. Urban smog not only limits visibility; it can lead to health problems as uncomfortable as eye irritation and as deadly as lung cancer. Such problems are especially severe in developing countries. The World Health Organization

(WHO, 2016) estimates that up to 700,000 premature deaths per year could be prevented if pollutants were brought down to safer levels. For instance in Indian cities are polluted by smokes from vehicles and industries. Dust due to vehicles also contributing up to 33% of air pollution. In cities like Bangalore, around 50% of children suffer from asthma.

The majority of Africa's population estimated to be around 1.5 billion continues to live in rural areas where lives of smallholder subsistence agriculture and a lack of access to basic needs, such as food and water, have put many people in poverty (Binns *et al.*, 2011). Despite some progress towards achieving the Sustainable Development Goals (SDGs), statistics suggest that food insecurity and under-nourishment continues to rise, which remain a major challenge due to population growth (UNEP, 2006; UNICEF, 2006; FAO, 2006 & 2011; UNDP, 2012b).

It is estimated that 239 million people are undernourished in Sub-Saharan Africa (FAO, 2011) and around 340 million people the majority live in rural areas continue to lack access to safe drinking water (UNICEF, 2006). Climate change compromises food security and

agricultural livelihoods due to changes in growing seasons, increased rainfall variability and water shortages (Muller, 2009, Rebelo *et al.*, 2010).

In Tanzania, the wetlands are being encroached for grazing, agriculture, mining, collection of firewood, charcoal, draining wetland water for irrigation and hence filling up the wetlands with sedimentation. The consequences are the drying up and the disappearance of the natural ecological systems of the wetlands (McCartney and van Koppen, 2004).

In Nachingwea the main activities that take place in wetland is Agriculture, mining, making fish ponds, grazing of livestock, collection of fire woods, charcoal making and use the areas for disposing of waste. Both cash and food crops which are found in Nachingwea wetlands are Cashew nuts, maize, wheat, fruits, vegetables and sugar cane farms. Minerals found in Nachingwea wetlands include gold, ruby (red & green ganets). The livestock include cattle, goats, sheep, ducks, chicken and wild whiteleghorn and flamingoes. Other activities include fishing and tourism. This study, therefore, examined the use of Nachingwea wetlands in the environmental pollution control and poverty alleviation for Sustainable Development.

World-wide by the year 2000, there were more than one thousand wetlands receiving and cleaning a variety of municipal, industrial and urban runoff polluted water in the process of environmental pollution control (Kadlec and Wallace, 2009). There are two broad types of wetlands namely natural and constructed wetlands.

Natural wetlands

Natural wetlands include marshes, swamps, bogs and the likes which are found in flat vegetated areas, depressions in the landscape, between dry land and water along the edges of streams, rivers, lakes and coastlines in every climatic condition world-wide. Natural wetlands are usually found at the interface between the terrestrial and aquatic ecosystems (IWA, 2003). They have been used world-wide as dumping or disposal sites for environmental pollution control. In Zambia natural wetlands receive polluted water from the sugar cane fields of the commercial farms (Musiwa, *et al.*, 2002).

In Tanzania, the Dar es Salaam Msimbazi natural wetlands are dominated, by *Typha latifolia* and *Phragmites mauritianus* have been receiving polluted water from a number of factories for some time (Mashauri *et al.*, 2000). Lake Victoria at Kagondo lake shore which are dominated by *Cyperus papyrus* and *Vossia cuspidata* receiving polluted water from a number of industries in Mwanza Municipality.

In Nachingwea District, Marambo, Mnero-ngongo, Mnero-Miembeni, Matekwe, Nambambo, Naipingo and Mitumbati Wards the natural wetlands receive polluted water from Nachingwea Council. They also receive the runoff polluted water from the surroundings such as the farms, commercial areas, hospitals, dispensaries, industrial areas and the domestic premises. The natural wetlands in Nachingwea which receive the polluted water include Marambo, Ruponda, Kiegei and Ilo-Ilo-Lionja.

Constructed Wetlands

Constructed wetlands are man-made constructed and designed to employ environmental processes found in natural wetland environments. The constructed wetland systems like mangroves, utilize wetland plants, soils and associated micro-organisms to remove contaminants from polluted water: (<http://doi.org/10.1081/E.EEM-120051985>) and Mahenge (2015).

The environmental pollution control using constructed wetlands technology provides an opportunity to create environmental cleanliness, create wildlife habitat, greenbelts and the passive recreation areas (Adams, 2009). These are associated with the ponds and other environmental facilities such as green playgrounds and landscaping. The utilization of constructed in water pollution control provides alternatives which are controlled by the legal framework and environmental conservation requirements or regulations. Several conferences dedicated to the use of natural wetlands and wetlands constructed in water quality and environmental pollution control have been held dating back to the year 1976 as cited by Kadlec and Knight (1996). This research, therefore, focused on the use of wetlands for environmental pollution control and poverty alleviation for Sustainable Development in Nachingwea District, Lindi Region, Tanzania. The policy makers of the Ministry of the environment, natural resources and the tourism may spearhead the policy for the conservation and restoration of the wetlands for sustainable development. This research therefore, focused on the use of wetlands for environmental pollution control and poverty alleviation for Sustainable Development in Nachingwea District, Lindi Region, Tanzania.

The importance of wetlands in environmental pollution control

The importance of the constructed wetlands for cleaning polluted water in developing countries includes cost effectiveness with regards to construction, operation, maintenance and reliability (Mbwette *et al.*, 2001). They provide toxicant retention sites and groundwater recharge. Wetlands offer mutual benefits in buffering storm polluted waters and flood risks to humans. Wetlands buffer water bodies, urban and countryside run off to stop water and environmental pollution. The wetlands protect the society from suffering ill-health associated with inappropriate polluted water treatment, management and disposal practices. Constructed wetlands provide recreation, aesthetic appreciation, ecological/environmental education and research centres.

Many types of wetlands play an important role in sequestering and storing carbon to control global warming and climate change. Wetlands are a critical area in the process of adapting to climate change, population growth and mitigating its impacts on the environment (Matby and Acreman, 2011). They are also particularly vulnerable to climate change impacts, while human disturbances of the same wetland systems can cause huge carbon emissions (Matby and Barker, 2009).

In Nachingwea, many people move from highlands to the lowlands around the wetlands for some economic activities. In doing so, allows the highlands to rejuvenate with trees, therefore creates forest areas for sequestering and storing carbon emissions to control environmental pollution, thus, global warming and climate change is controlled.

On the other hand, there are challenges accompanied by using constructed wetlands for wastewater treatment for pollution control such as high investment costs, limitations in less spacious cities and town centres. Other challenges include infilling which may cause floods and draining due to competition for water sources, conversion to agriculture and urban purposes as in the case of the Lake Victoria in East Africa (Kamukala, 2007). Because of lack of regulatory framework, this can lead to health perception fears of people in handling new technologies in wastewater access, cleaning

and re-use in the wetlands. Wetlands enhance changes in local land use and land cover. For instance for poor agricultural practices; Species removals and/or invasive introductions; Eutrophication and pollution control; Hydraulic infrastructure development; Water abstraction for irrigation; and Climate change threats (Irene, *et al.*, 2014).

The wise use of wetlands, extraction, utilization and conservation strategies for polluted water is essential in order to sustain their existence, productivity and environmental pollution control (Ramsar, 1971-2011). Therefore, the wise use of the wetlands in order to control pollution threats can be beneficial in the provision of food, fresh water, fuel, fishing, mining, genetic resources and tourism activities. Furthermore, wetlands play role in regulating climate change, water recharge, and the natural hazards mitigation. Additionally, the wetlands can be used in cultural issues such as spiritual and aesthetic as well as supporting the ecosystem primary production and nutrient cycling (Ramsar, 2009; Irene Aurelia Tarimo and Harieth Hellar-Kihampa, 2015).

The importance of wetlands in poverty alleviation

Wetlands form the ecological habitat for endangered species and migratory birds, provide fishing sites, water supply and addressing poverty eradication by supporting aquaculture (Wetlands International, 2005; Mwakalila, 2007, Verhoeven and Setter, 2010). Thus, providing irrigation and so contribute to food security to alleviate poverty as in Figure 1.



Figure 1. Nachingwea Wetlands for water supply and irrigation

In Nachingwea, Lindi Region, Tanzania, the main activities that take place in the wetlands for poverty alleviation are Agriculture, mining, making fish ponds for fishing, grazing of livestock, collection of fire woods, charcoal making and use the areas for disposing of waste. Both cash and food crops which are found in Nachingwea wetlands are Cashew nuts, maize, wheat, fruits, vegetables and sugar cane farms. Minerals found in Nachingwea wetlands include gold, ruby (red & green ganets and tormaline). The livestock include cattle, goats, sheep, ducks, chicken and wild whiteleghorn and flamingoes. Other activities include fishing and tourism activities.

Therefore, people use wetlands for multiple sustainable benefits, of the economic, social and environmental nature for human development and livelihood security facing Africa in the 21st Century (Howard *et al.*, 2009); FAO, 2011; UNDP, 2012a). There should be a control of stopping the wetlands from being degraded or lost. Degradation and loss of wetlands make climate change worse and leave people more vulnerable to climate change impacts such as floods, droughts, famine and poverty. All these may threaten food security and thus impacts on the sustainable development.

The policy makers of the Ministry of the environment, natural resources and the tourism may spearhead the policy for the conservation and restoration of the wetlands for sustainable development. Not only that, but wetlands which are constructed can also be used for the treatment of different types of wastewaters, such as domestic, commercial, run-off and different types of industrial wastewaters for re-use in Agriculture and aquaculture in aquatic environments (Irene *et al.*, 2014 and Arias, 2017).

In Nachingwea the wetlands are important in two main ways as follows:

• Pollution Control

By many people occupy the wetlands localities, the uplands areas have remained afforested which facilitates the removal of green house gases such as Carbon and Methane emissions. Thus, control greenhouse effects, global warming and climate change. The constructed wetlands have facilitated the wastewaters treatment which emanate from domestic, commercial, run-off and different types of industrial wastewaters for re-use in Agriculture and aquaculture.

• Poverty Alleviation

Wetlands are used to alleviate poverty from cash crops and food agricultural activities, livestock keeping and mining works taking place in Nachingwea district and the nearby districts of Ruangwa, Liwale and Lindi Rural.

However, there are some challenges facing Nachingwea Wetlands areas such as floods which leads to eruptions of some diseases such as Malaria, diarrhea, dysentery, bilharziasis, elephantiasis and typhoid. Other challenges include environmental and water sources and quality degradation, deficit of water due to agricultural irrigation and land conflicts.

MATERIALS AND METHODS

Study Area

Nachingwea is a District in Lindi Region of Tanzania. The District is bordered to the north by Ruangwa District, to the east by Lindi Rural District, to the south-east by Mtwara Region, and to the south-west by Ruvuma Region. Nachingwea District is located at the latitude 10° 30' S and Longitude 38° 20' E degrees and minutes respectively as in Figure 2.

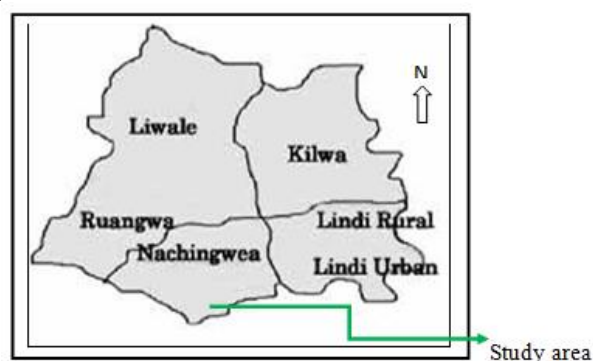


Figure 2. Nachingwea District study area

Methods and Design of the study

This study employed survey in both quantitative and qualitative methods. Quantitative was used to identify the types of wetlands as the primary data. Qualitative was employed descriptively on the importance of wetlands in poverty alleviation for sustainable development.

Population of the study

According to the 2012 Tanzania National Census, Lindi Region had the population of 864,652. Nachingwea had a population of 178,464 (National Bureau of Statistics Tanzania

webpage).<http://www.citypopulation.de/php/tanzania-admin.php?adm1id=08>

Sampling techniques

A random technique as well as purposive sampling was used to identify people from each village for the administration of questionnaires and interviewing purposes as the research tools.

Sample size

A total of 45 people were identified purposively and interviewed. Three (3) villages in five (5) wards were identified in the wetlands areas whereby 15 people from each ward were interviewed. The interview was based on the questionnaires and the information obtained was recorded for statistical processing in data analysis.

Data analysis methods

The study used Excel (2007) to construct Tables for the percentages and the graphs to present the field data. Descriptive statistical analysis was carried out in this study. The online ICT calculations were also utilized in this study.

In Nachingwea District there are a number of Natural wetlands (Total 35) and Constructed Wetlands (Total 16). The Constructed wetlands were built by the Tanzania government and some by settlers during the colonial era in

East Africa, especially during the Groundnut scheme period. This is a period when constructed wetlands were built for the purpose of domestic use that is water for human beings and livestock (Dixon and Wood, 2003). Examples of wetlands, which were constructed during the colonial period in Tanzania were namely *Mkumba, Farm three, Farm Four, Farm one, Farm eighteen and Matekwe*. After independence, the government wetlands of Matekwe has been used as a pilot study area. The number of natural and Constructed wetlands in some selected wards are as shown in Table 1. Figure 3 depict the number of Wetlands for environmental pollution control and for poverty alleviation.

Table 1. Number of Wetlands per Ward (Source: Field study, 2019)

WARDS	Number of Natural Wetlands	Number of Constructed Wetlands
NAMBAMBO	4	3
MATEKWE	11	7
RUPONDA	7	1
MARAMBO	7	3
MITUMBATI	6	2
TOTAL	35	16

The online ICT calculations are as follows:

Raw Score total (X):

51

Population Means (μ) at two-tailed test:

3.2&2.4

Standard Deviation (σ):

0.19

Standard Deviation Calculation Natural

N: 5

M: 7

SS: 26

$$s^2 = SS/(N - 1) = 26/(5-1) = 6.5$$

$$s = \sqrt{s^2} = \sqrt{6.5} = 2.55$$

Standard Deviation Calculation constructed

N: 5

M: 3.2

SS: 20.8

$$s^2 = SS/(N - 1) = 20.8/(5-1) = 5.2$$

$$s = \sqrt{s^2} = \sqrt{5.2} = 2.28$$

Sum of the two means Standard Deviation Calculation

N: 2

M: 2.42

SS: 0.04

$$s^2 = SS/(N - 1) = 0.04/(2-1) = 0.04$$

$$s = \sqrt{s^2} = \sqrt{0.04} = 0.19$$

Variance = 0.03645.

Thus, Standard Deviation = 0.19092.

NOTE: The P-Value is < .00001. The result is significant at $p < .05$.

Thus, the Alternative **Ha**: hypothesis is rejected as well as the Null hypothesis that **Ho**: Wetlands in Rural and Urban localities contribute significantly in environmental pollution control and poverty alleviation for Sustainable Development.

Instead, the results revealed that in Nachingwea District **wetlands for poverty alleviation were highly observed in rural localities** while for **environmental pollution controls were observed in urban localities**.

Discussions

Wetlands for environmental pollution control

The study on Wetlands for environmental pollution control was observed in wetlands found near urban area where the population is high (Nambambo Ward 1 in Table1). These areas have some contribution on formation of good organic soils due to waste materials and thus are also used for agriculture. In rural areas, the wetlands are not much for pollution control (Table 1), but rather for poverty alleviation. Nambambo is urban and other wards Matekwe, Marambo, Ruponda and Mitumbati are in rural areas which have wetlands used in agriculture for poverty alleviation.

Wetlands for poverty alleviation

The wetlands for poverty alleviation were highly observed in rural areas (Figure 3). These wetlands seem to be more fertile due to animal waste produced in rural areas and thus when used for agriculture they enhance performance of the grown food and cash crops. Also the vegetation cover contributes to addition of the organic matter when they undergo decomposition.

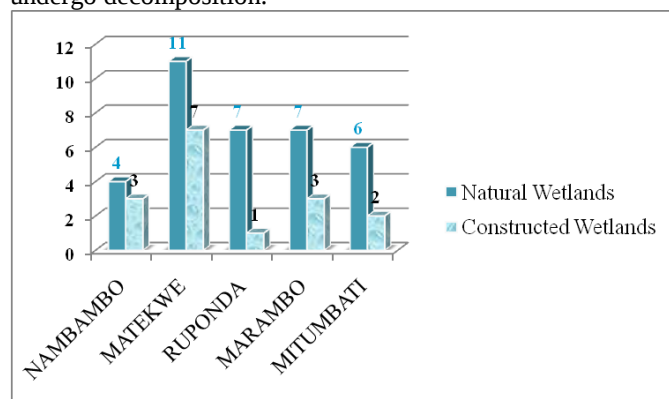


Figure 3. Wetlands for environmental pollution control and for poverty alleviation

Studies in other areas of Tanzania, have found that wetlands contribute significantly to the livelihoods of households living near them. In the Kilombero valley in Tanzania, the contribution of wetland for cultivation to get cash income was 66% of the approximately US\$ 518 cash income per household per year. The poor households getting 80% of this income from wetland cultivation, while the intermediate and better-off households obtained 70% and 48% of their total cash income respectively from wetland cultivation (McCartney and van Koppen, 2004; Chapter 2).

Similar findings come from other studies which have shown a wide range in household income generated from wetlands, especially through cropping. In the Ga-Mampa wetland in South Africa the average annual value of wetland cultivation per household was estimated at US\$93 (Adekola *et al.*, 2008); in Nakivubo urban wetland in Kampala, Uganda it was US\$300 per household (Emerton, 2005); in the Barotse floodplain in Zambia, \$109 per household (Seyam, *et al.*, 2001 and FAO, 2004). In the Lower Shire, Malawi US\$363 per household (Turpie *et al.*, 1999); and in the Chipala Ibenga wetland, Zambia from US\$19 to US\$107 per household (Masiyandima *et al.*, and FAO, 2004). Household dependence

on wetlands and hence demands on wetland resources are highly site specific.

Wetlands play ever more important roles in livelihood diversification in facing the challenges emerging from population growth and climate change. In northern Nigeria, for example, seasonally flooded low lying areas known as fadamas support the livelihoods of hundreds of thousands of smallholder farmers (Dan-Azumi, 2010). Similarly, throughout central and southern Africa, seasonally inundated dambos are common Wetlands landforms that provide a reservoir of soil moisture during the dry season and hence represent valuable agricultural resources for food security (Innocencio *et al.*, 2003).

Conclusion

The Wetlands contribute significantly in environmental pollution control and poverty alleviation through agricultural activities as well as Aesthetics and Tourism. Agricultural activities involve crops and livestock production. Due to the use of Wetlands in agriculture, the production and income increases and thus alleviate poverty for Sustainable development in helping to meet the Sustainable Development Goals (SDGs) by the year 2030.

Recommendations

➤ The people in Nachingwea District and others elsewhere should consider utilization of wetlands for pollution control, production purposes and poverty alleviation. The people should manage properly the wetlands in order to promote sustainable agriculture which will increase income and make an important contribution to livelihoods for poverty alleviation.

➤ The Policy makers of the Ministry of the Environment, Natural resources, Education and Tourism should plan and set policies that reflect positive view on the benefits of the wetlands. Also wetland policies, land policies and management regimes need to better reflect the realities of wetlands for agricultural purposes and other accrued benefits.

➤ Researchers should consider the requirements to better understand and determine the best practices that will enhance performance and management of wetlands in Tanzania for pollution control, aquaculture and agriculture to alleviate poverty for sustainable development.

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