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Application of Water Recovery Option for Agricultural Use in Developing Countries: Case Study of a Nigerian Community

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Abstract

Africa's current approximate population of 1 billion people is estimated to increase to 1.8 billion in 2050. This compliments the fastest growing population rate which stands at 2.4 %. Moreover, 40% of Africa's land is semi-arid while another 27% is desert leaving a common conclusion that water is a crucial resource with tremendous implication on African development. The rapid urbanization and growing population in African cities has resulted in new water management challenges. About 85% of water in Africa is used on agriculture. Only 10% and 5% are used in households and industries respectively. The objective of this study is to appraise the different methods available for water collection, treatment and reuse for agricultural purposes in parts of Nigeria. The study involves the assessment of water sources used by farmers for the promotion of agriculture. The study deployed the use of interviews, onsite investigation and group discussions in various areas in a typical semi-urban city in southwest Nigeria. The procedure combines descriptive data on the amount of water used per day on farms, sources of the water used, and purpose of the water used. Results of this study showed that a comparatively large volume of water being used for agricultural sustenance is withdrawn from natural aquifer storages. This poses a challenge and threatens global effort of achieving the United Nation's water-related Millennium Development Goals (MDG 7c) in developing countries aimed at making potable water available for millions of people. It was concluded that a sustainable, de-centralized wastewater treatment plant can be deployed for irrigation purposes in order to reduce pressure from agriculture on groundwater resources and, at the same time, encourage artificial recharge of wells. Also, adequate and efficient water management procedures which would help to overcome emerging water challenges were proposed.

Keywords: Agriculture, Nigeria, reuse, treatment, wastewater

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Introduction

The world switched from Millenium Development Goals (MDG) to Sustainable Development Goals (SDG) in 2015 after the former expired (UNDESA, 2015). In both goals, ending hunger and achieving food security was given prominence. Threats to ending hunger in Africa includes scarcity of arable lands (40 % is semi-arid while 27 % is desert); and sustainable water supply (Omole and Ndambuki, 2014). However, it is impossible to achieve food security for present and future generations without sustainable agricultural practices. One such unsustainable agricultural practice is the exploitation of aquifers at unsustainable rates for agricultural purposes. About 85% of withdrawn freshwater in Africa is used for agriculture; much of this water is extracted from groundwater (Omole, 2013). This over-reliance on groundwater has led to drawdown in water level up to several metres per year and imposes the risk of subsidence on agricultural landscapes (Lalzad, 2007). Unregulated use of groundwater resources results in the depletion of valued reserves which may require decades or centuries to recharge (Omole, 2013). With a growth rate of 2.4 %, Africa has continued to experience an exponential increase in demand for water meant for use in food and energy production (Omole and Ndambuki, 2014). In order to promote sustainability, prompt intervention is required. The possibility of reducing the withdrawal of freshwater can be found in the re-use of wastewater since approximately 80 % of used water is converted into wastewater with much of it presently being discharged untreated into the environment (Omole and Isiorho, 2011). Uddin et.al. (2014) revealed that 30 - 50 % of household water can be re-used after appropriate treatment. Treatment technique, however, will depend on intended use. Therefore, this research is aimed at appraising the different methods available for water collection, treatment and reuse for agricultural purposes in sub-Saharan Africa using cases from Nigeria.

Methodology

Farms located within the south-west and the south east zone of Nigeria were studied. These farms include Covenant University (CU) farm (located in Ota and Igbesa, Ogun State), Ajah Livestock Farm (Located in Lagos State), Enugu North Livestock farm (located in Enugu State, Ogundeji Farm (located in Akure) and Ojemaie Livestock Farm (located in Port Harcourt). The farms were randomly selected and information on their water use and wastewater reuse practices for livestock (Broilers and Layers, Pork), arable crops, vegetables, plantation crops, water melons, cassava and oil palms were requested. Information gathering was done using structured questionnaires, physical observations, personal interviews, and literature review.

Results and Discussions

Water Usage

Findings showed that CU farm (Ota) pumped 20,000 litres of water per day with 75% of the water being used for irrigation and 25% being used for other purposes. The CU farm at Igbesa utilized 1000 litres per day for agricultural purpose while the farms located at Enugu North, Ajah, and PH consumed 2000 litres, 1000 litres and 500 litres per day respectively. The Farm located at Akure showed total reliance on rainfall due to the type of crop being cultivated on the farm. The study further showed the livestock farms had unimpeded access to water with drip/localized system of application in other to sustain the water supply on the farm while the water application frequency for crop producing farms ranged from double to tripple the amount used for livestock farming. The study also revealed that

irrigation was carried out on the farms by use of sprinkler systems between 1 to 3 hours per day on all arable crop farms visited.

Sources of Water Used

The sources of water used for agriculture activities within the study area is shown in Figure 1. More than two-thirds of the water needs on the farms were obtained from groundwater while rainfall and surface water such as streams, rivers and ponds provided one third. Groundwater appears to be used more than other sources owing to the fact that it is found close to the point-of-use. Despite this supposed availability, groundwater is easily depleted when exploited without controls. This may impact adversely on long term food security, livelihood and economic growth.

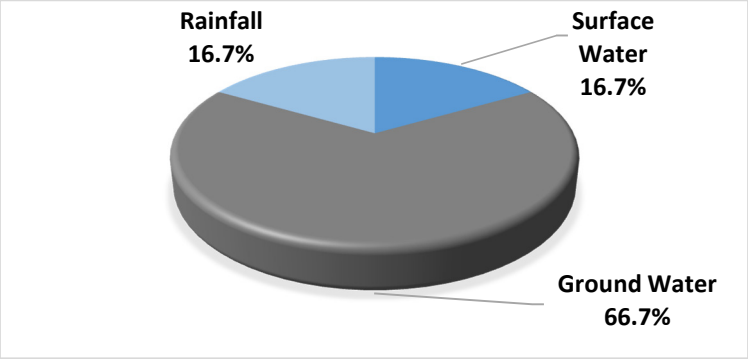

Figure 1: Sources of Water in the study area

Water Treatment and Re-use:

None of the farms studied practiced wastewater re-use. Rather, all the wastewater was discharged into the environment. At CU community (which also owns the largest farm among the studied farms), about 874, 081 litres of wastewater was generated per day from its 10, 000 residents as at 2013 (Isiorho et al., 2014). The authors consider this a vast resource that can be harnessed to augment water demand on its farm which is situated less than two kilometers away from the wastewater treatment plant. Currently, the daily discharge of wastewater is released into a nearby stream. Some local farmers took advantage of this discharge by irrigating their vegetable farms, using the wastewater from CU (Figures 3-4). Analysis of water samples from a previous study shows that wastewater from this source requires further treatment before it can be considered fit for discharge into the ecosystem (Isiorho et al., 2014). This is due to increased wastewater load arising from population increase.

Figure 2: wastewater discharge from CU

Figure 3: vegetable/fruit farm manually irrigated from CU wastewater

Thus using this wastewater for farming purposes in its current state is unhygienic and detrimental to public health, considering some of the vegetables being cultivated from the wastewater is meant to be consumed without cooking (Fig. 3).

Conclusion and Outlook

This research showed that over withdrawal of freshwater (especially groundwater) sources can be stemmed by re-use of wastewater. If properly done, this could assist in controlling the water scarcity problem in sub-Sahara Africa, contribute to food security and protect the environment from effects of discharged polluted water. Wastewater from the African context can be treated for re-use with the aid of economical treatment units such as waste stabilization ponds (WSPs), adsorption, and phytoremediation (Omole et al., 2014; Utsev and Agunwamba, 2012). However, the use of these technologies require adequate advocacy and standards enforcement. Future work on this research is to be directed on experiments aimed at optimizing the parameters affecting the reuse of wastewater. Such parameter include hydraulic designs, topography, economic considerations, social acceptability of farm products from reused wastewater, and legal aspects affecting reuse of wastewater.

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