Water Resources and Sub-Sahara African Economy: Anthropogenic Climate Change, Wastewater, and Sustainable Development in Nigeria

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ABSTRACT

Most African agriculturists rely on freshwater sources that have recently become scarce. This study focuses on the use as wastewater, especially for agricultural development in Nigeria. In view of the country's dwindling economy; escalating herders-farmers' conflict over resources, water security perspective contributes to our understanding of the roles that water resource management can play . This study argues that with Africa's increasing population in this climate change era vis-a-vis the precarious situation of African economies, attainment of most Sustainable Development Goals (SDGs) by 2030 is unrealistic. The study submits that there is the need for a paradigm shift in waste water perception in sub-Sahara Africa as this would reduce pressure on freshwater and fast-track sustainable development through an increase in agricultural production – the mainstay of most economies in the continent.

Keywords: Agriculture, climate change, food security, water resources, waste water, Nigeria.

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Introduction

The problem of poverty and declining agribusiness in Nigeria has received scholarly attention in similar ways that scholars have theorised farmers-herders crisis in West Africa. Despite the reciprocal relationship between the latter, the two major schools of thought on environment and conflicts agree that structured animosity has been one of the defining features of herders-farmers relations over the years (Braukamper, 2000; Hartmann, 2001; Homer-Dixon,1999; Tonah, 2006).Nevertheless, more lives and properties have been lost since 2013 to the increasingly violent clashes between the two in Nigeria (Amnesty International 2018). As the Nigerian government and some concerned scholars debate this national crisis and others, attention has been on the nexus between the country's declining grazing land, ethnicity, and the proliferation of arms.

Religious and political sentiments that accompany this economic crisis in Nigeria and other African states have been deployed, not only to demonise one group by the others (Benjaminsen & Ba, 2009; Bennett, 1991),but to also place undue emphasis on corruption .Even as the farmers-herders' clashes defile a monocausal explanation in Nigeria, Bassett (1988) discovers in his assessment of agrarian change in West Africa that violent conflicts between livestock managers and farmers remain intense due to competition over access to water despite sufficient grazing land in northern Cote d'Ivoire and central Cameroon Steve Tonah (2006), the increasing demand for watered land to match agricultural needs of Ghanaians was the major trigger of deadly attacks in the Volta Basin. Given the central role of water in production, it seems neither land nor ethnicity is arguably the most important determinant of these conflicts, but water points (close to nutrient-rich land) that is increasingly becoming scarce across Northern Nigeria due to ecological changes. Scholars have

shown that in developed economies and few emerging ones where agricultural activities improve people's livelihood, integrated water resources management *vis-a-vis* wastewater recycling has been a key breakthrough in addressing poverty and agricultural production (Angelakis et al., 1999; Jobson, 1999).

With little interest in exploring the role of water in economic development, much of these debates have ignored the perspective of water resources management. Even when the issue of water is raised, such discussion is often limited to either drinking water or pollution of sources, forgetting that the quantity of water that would produce food exceeds drinking water. This perhaps explains the futility of policies emanating from the Federal Ministry of Agriculture and Rural Development directed to reduce poverty and improve Nigeria's agro-based economy. Given that water resources and productive land are prerequisites for meeting at least eight of the Sustainable Development Goals (SDGs)[1] This paper argues that wastewater does not only need reclassification, but should also be recognised as a renewable water resource that could mitigate the impact of climate change on agriculture, and power economic development in sub-Saharan Africa.

From a policy and academic perspective, the second section provides the conceptual and theoretical framework of the study. Though the conventional philosophy is getting rid of wastewater for sanitation and hygiene purposes, the object here is to argue for a redefinition of 'wastewater' as renewable water by using water security framework. In this context, the paper emphasize the competing uses of fresh water and argue that Nigerians, like many

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. [1] Sustainable Development Goals (SDGs) are not only water-dependent for success, but in particular, rely heavily on Integrated Water Resources Management strategy in order to achieve SDG 1, 2, 5, 6, 7, 8, 10, and 15.

other Africans, rely heavily on subsistence agriculture that is highly prone to climate change. The third section describes Nigeria's water and wastewater (mis)management. The focus is on the country's increasing population, climate change impact on rain-fed agriculture, the rejection of water recycling for 'water mining' and the use of unsafe waste water in some places to mitigate water scarcity. This fourth and final part throws up Integrated Water Resource Management (IWRM) as the widely accepted approach that is yet to receive adequate attention in many African states, including Nigeria. The paper contributes to existing literature on sustainable economic development by concluding that understanding the importance of 'wastewater' as a resource holds the promise of resolving both crop-water and livestock-water scarcity in Nigeria and in other sub-Saharan African countries.

Water Security and Sustainable Development Nexus

The idea of 'sustainability,' in its historical context, is as old as man. But the philosophy was first codified in the early eighteenth century by Carl von Carlowitz - the Chief Mines Inspectorate of Saxony -who advocated for the conservation of forest in 1713. In the nineteenth century, the theory was randomly mobilised against the exploitation of nature that accompanied the industrial revolution in Europe. Following the adverse environmental impact of scientific and technological advancement during and after the two World Wars, sustainability was again revived to counter the unguided exploitation of natural resources that had for decades been couched in the language of 'development', 'improvement', 'progress', and 'growth' (Jean-Baptiste &Fressoz, 2016; McNeill & Engelke, 2016). As this and other global concerns (including the unguided quest for economic development by post-colonial states, population explosion, rapid urbanization and pollution, climate change, and the energy crisis

of 1973) culminated in the emergence of radical environmental groups with thought-provoking reports from the 1960s[2],it was the World Commission on Environment and Development (WCED) that officially merged sustainability with development in the1987 United Nations Commissioned report titled *Our Common Future*.

Despite the vagueness imposed on the idea and definition of 'sustainable development' by the four dimensions of conflict that emerged from their merger[3], the commission managed to describe sustainable development as' development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987, p. 43). In their responses to its evolution and widespread mobilization, particularly as condition for technical assistance and international aid, some critics from the global south and post-development scholars view the idea and its practice not only as a full-stomach Western post-materialist/post-industrialist approach to development but also as one of the neo-colonial ideologies aimed at preventing former colonies from catching up with the West (Escober, 1995; Hewitt, 1995; Huha & Martinez-Alier, 2000; Ibhawoh, 2011).

In the light of the above, when the 1987 Brundtland report indicated that drought-triggered crises have started putting about

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.[2] These include but not limited to the Stockholm UN Environment Conference of 1972, the publication of the 'Limits to Growth' the same year by the Club of Rome, Rachel Carson's *Silent Spring* of 1962, and the establishment of World Commission on Environment and Development (WCED) in 1987. See: Ulrich Grober. (2012). *Sustainability: A Cultural History*. Translated by Ray Cunningham, Cambridge: Green Books.

.[3] The theoretical concerns about the idea of sustainable development, sustainability, and the longer-term human-environment nexus became obvious during the commission's work and after. These include the economic versus environmental divide that restrict developing states from increasing economic growth without engaging in environmentally harmful activities; reconciling the interest of the present and future generation; the North-South economic imbalance considering the legacies of colonialism; and balancing scientific accuracy with political acceptability. See: Iris Borowy. (2013). *Defining Sustainable Development for Our Common Future: A History of the World Commission on Environment and Development (Brundtland Commission)*. New York: Routledge.

36 million people at risk in Africa for instance, some Africanist scholars labelled the report and some other warnings of drought and desertification as 'crisis narrative' – a set of received orthodoxy about Africa's complex environment. These critics call to question the use and reliance on data and statistics from western development agencies (Fairhead& Leach, 1996; Leach &Meams, 1996; Milligan & Binns, 2007; Thomas & Middleton, 1994). They based their argument on the ground that conclusions about African environment by development agencies are not only devoid of long-term observation and systematic censuses, but that such claims are usually insensitive to 'normal' climatic fluctuations that occur in the continent.

Yet, a former professor of geography lamented the devastating impact of climate change on drought-affected Nigerians whom he claimed 'out-numbered those of Senegal, Mauritania, Mali and Niger combined' in the wake of the Sahelian and African drought that had started in the 1970s through to the 80s (Mortimore, 1989). Amidst drought and herders-farmers' crises across many sub-Saharan Africa countries recently, the United Nations Office for the Coordination of Humanitarian Affairs reported that climate changes have seriously compromised the normal rainfall patterns in sub-Sahara Africa, reducing water availability for agriculture and animal husbandry. In this setting, delays and insufficient rainfall in many parts of Africa, have affected food and human security. This phenomenon has aggravated water stress in Nigeria, where the vegetation is Sahel and vulnerable to drought and desertification. In particular, from January 2016 to October 2018 alone, over 3641 people were killed in herders-farmers conflict over water and grazing land across Nigeria (International Crises Group, 2018), with hundreds of these deaths occurring in Benue, Adamawa, Plateau, Zamfara, Taraba, Kaduna, and tens in Enugu, Delta, Kogi, Ekiti, and Oyo state.

Employing a modest approach to global transformation before 2030, the United Nations' Sustainable Development Goals (SDGs) acknowledged the key role of water resources in *Realizing the Future We Want* through SDG 6 which seeks 'availability and sustainable management of water and sanitation for all.' In the pursuant of water availability both at global and local levels, water security emerged as a guiding principle and framework. Widely defined as the capacity of a population to safeguard sustainable access to water supply for sustaining lives and socio-economic activities, water security is closely linked with human security *vis-a-vis* food, energy and ecosystem security.

Water security as a strategy through which environmental protection and the adverse effect of water stress is tackled; the UN-Water identifies its key elements as water access for productive activities, environmental protection, and prevention of water-related disasters. In this context, water resources are harnessed in such a manner that minimizes wastage of freshwater and reuse of wastewater. That is, when water is not safe for domestic use, it is reclaimed for agricultural production or artificial groundwater recharge.

In fact, the United Nations World Water Development report of 2015 which succinctly reiterate that SDG 6 flows through the three pillars of sustainable development – economic, social and environmental. (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015), puts wastewater recovery at the heart of achieving eight other SDGs. This include the need to end poverty (SDG 1), achieve zero hunger (SDG 2), attain gender equality by ending disproportionate burden of water collection placed on women and girls in developing countries (SGD 5), end water scarcity (SDG 6), exploit the food–water–energy interlinkages for development (SDG 7),

achieve sustainable economic growth (SDG 8), end inequality and marginalization (SDG 10), and protecting the environment (SDG 15). The 2018 UN-Water report likewise affirms the need for wastewater recycling in sustaining economic growth in agriculture, industry and energy generation, and in maintaining healthy ecosystems' (United Nations Water, 2018, p. 10).

Water security issues have been instrumental in the design of national policy frameworks. It is the acceptance of water security idea in the policy-making circle that birthed the Integrated Water Resources Management (IWRM) framework which continues to drive participatory and cross-sectoral collaboration globally. As subsequent sections of this paper will show, this framework has been misunderstood and poorly domesticated in many African states by associating it with construction of large infrastructure and establishment of River Basin Development Authorities while emergent 'green' water preservation methods, storm water capturing ideas, 'virtual' water saving strategies and artificial recharge of aquifers are mostly ignored.

Wastewater Resource in the Nigerian Context

Rain-fed agriculture has been the mainstay of most African communities since the pre-colonial time. McCann (1999) and Maddox (2016) among others have shown the scale and effects of anthropogenic environmental change in this sector, which began several millennia ago. They also demonstrated Africans' tenacity in working to control these environmental changes. But in a blunt summary, Gilbert and Reynolds (2012) bust the age-long myth about the fertility of African soils. While refraining from grand generalization about the scale and diversity of African landscape, they tilt toward Nwa (2003) to argue that most African soils are poor (ancient and highly leached) as a result of geological inactivity, cyclical rainfall due to ITCZ (Intertropical

Convergence Zone), and other geological factors that have reduced her GDP growth by four percent.

As part of the people's ingenuity deployed towards managing their agro-based economy before the colonial period, it was not uncommon in many places across pre-colonial Africa to find people using human excreta and untreated wastewater unsafely on farmlands - the contemporary ecosan system of safely 'closing the loop.' In Nigeria where the total cultivatable land is 39,200,000 hectare, shaduf, canals, tanks, and other sub-irrigation methods were used to appropriate both waste and freshwater resources for agricultural activities. Although wastewater and polluted water were considered filthy in pre-colonial Africa as in other regions, the understanding of its safe management and use within the context of water security was rarely considered despite its widespread unsafe use.[4]

The spread of miasma theory of disease causation to Africa in the nineteenth century discouraged the pre-colonial unsafe wastewater use. This is because pervasive open drains, indiscriminate fecal disposal and stagnant water bodies in urban and rural communities were condemned for causing diseases - a claim that later conceded to germ theory in the late nineteenth and early twentieth century. After the partition and colonization of African states from the 1890s, colonial administrators, especially in sub-Saharan Africa made little provision (often reactionary) for sewage and drainage systems. Instead, the colonisers focused on

[4]Since the definition of what constitutes wastewater varies from one culture to another, only blackwater (flush water, fecal waste, urine, and floodwater) and greywater (all other wastewater generated outside toilet) are examined in the context of this paper. It should also be noted that until the end of Europe's 'sanitary Dark Age' in the nineteenth century, several unhygienic methods of collection, management and reuse of wastewater evolved across the world in response to economic needs, especially the use of sewage farms in Africa, Europe, and America for increased agricultural productivity.

extracting as many agricultural products as possible from the continent. Even though agricultural activities in southern Nigeria benefitted little from colonial irrigation policies, northern Nigeria served as a research laboratory for colonial experimental farms.

From the coloniser's mismanaged Kware irrigation project in Sokoto, to the Badeggi scheme, Toroko scheme, Wuya-Edozhigi irrigation project in Kaduna, and several other medium and small-scale dams for crops, livestock, and human watering across northern Nigeria, the British colonial administration exploited Nigeria's water resources through what Allan (2003) calls 'virtual water,' – a process by which water is exported to Europe through export-oriented agricultural production. Throughout this period and after, blackwater and grey water were not only treated as worthless, but as harmful waste and often disposed of into compounds and streets as most buildings neither have plumbing connections nor sewers network (Echenberg, 2002; Epprecht, 2016). Whilst it is estimated that eighty percent of wastewater flow back to the environment untreated, sanitation and public health in colonial Nigeria, as in many other African colonies, was left in shambles.

Since the end of colonial rule in Africa, Western countries have moved on to embrace wastewater recycling as a reliable solution to water scarcity. The appropriation of what used to be considered 'waste' cannot be divorced from a growing recognition of its composition as a resource (for meeting economic development goals) and as a menace (posing threat of public health and environment). However, most former colonies in Africa and Asia have lacked behind in effectively appropriating this component of water cycle despite the pressure on their freshwater sources. In most parts of Africa, water resources management has not received adequate attention from national governments,

especially wastewater treatment. Until 1993 when the Water Resources Decree was promulgated by the Nigerian federal military government, no law governed water resources in the country. Successive governments perceive investment in water and wastewater reuse as financially burdensome (Alade, 2017), an investment without immediate returns - perhaps due to the abundance of streams and rivers which are often channelled into domestic, agricultural and industrial uses. Despite this lack of foresight which hides diverse realities and put more pressure on groundwater, 70 percent of freshwater goes into producing export/cash products, and traditional waterborne sewerage continues to dominate sanitation.

As rural-urban migration in developing countries increased from 18 to 42 percent in the immediate post-colonial period to 2003, Nigeria's population also jumped from 129.2 million in 2002 to 186.9 million in 2016. To this increasing population, unsafe use of wastewater poses a credible threat to their health and environment. The UN-Waterdata which shows that about 4 to 20 million hectares of land are irrigated with untreated wastewater in developing countries, with sub-Sahara African cities having only 2 percent of functioning wastewater treatment plants and only 30 percent performing satisfactorily (Mara, 2004; Veenhuizen, 2006). In fact, wastewater data for Nigeria and some African countries are not reported in UN AQUASTAT, thus leaving us to guess the scale of unsafe wastewater reuse in the country. It is less surprising therefore that despite the diverse articulated policies and enormous financial resources expended on the Millennium Development Goals (MDGs), Nigeria did not meet many of goals in 2015, particularly water supply and sanitation targets.

Policies and initiatives for rejuvenating agriculture since 1976 (such as Operation Feed the Nation, Green Revolution of 1980

and Back to Land Program of 1980) have had little impact on agricultural development. Nigeria, like many other African states, is yet to come to term with novel Water Demand Management (WDM) strategies employed in fast-growing global economies where wastewater reuse in agriculture and industries is embraced. Despite the fact that a neglect of development initiative like WDM could be said to have cost Nigeria much loss during the draughts of 1973, 1975, 1993, 1994 and 1995; disproportionate removal of surface and groundwater for agriculture, coupled with the anthropogenic challenges aggravated by global warming (famine, droughts, flood, shifting rainfall and river-flow patterns) have also affected food production and economic development of the country.

Nigeria has the potential to irrigate about 3.1 million hectares of farmland provided the country joins wastewater recycling (given her huge population using water daily) with her surface and freshwater resources. Wastewater from residential and industriesgoes down the drains untreated, leaving only 150,000 hectares of farmland irrigated with depleting freshwater. Apart from a few industrial areas, rich housing estates, and Government Reserved Areasin Lagos, Abuja, Ibadan, Port Harcourt, and Zaria, there are no functional sewer connections in the country. 80 percent of wastewater is neither collected nor treated. In southern Nigeria, Lagos State (former federal capital, the largest city in Nigeria and arguably the fastest growing in Africa) has no major wastewater treatment facilities. The state operates 4 small plants in Iponri, Oke-Afa, Alausa and Abesan which connect 5 percent of over 21 million population. Even the 1.5 million cubic meters of wastewater collected per day for treatment by these plants is dumped back into water bodies without consideration or plan for collection/treatment cost recovery.

Aside from Port Harcourt which serves 1 percent of its population there are no other wastewater treatment facilities in the southern part of the country. In the north, Kaduna operates one functional industrial wastewater treatment plant, Bauchi State Water Agency serves only 4 out of 20 towns under its jurisdiction and Kano - the third largest city in Nigeria has one non-functional plant. With the exception of Abuja in the Federal Capital Territory, what exist in other states are non-functional treatment plants (Adewumi & Oguntuase, 2016; Macheve et al., 2015). As the country lacks a general strategy for sanitation, sewage and waste water from homes and industries go into streets, water bodies, and sometimes into septic tanks where the sludge settles and the waste water drains into the soil, sometimes contaminating nearby shallow wells and edible plants.

The Nigerian Federal Ministry of Water Resources launched a 15-year Partnership for Expanded Water Supply, Sanitation and Hygiene (PEWASH) program in late 2016 which aims to improve sanitation and hygiene in Nigeria from 2016 till 2030.Through this program, the federal government seeks to 'go beyond the minimum service levels for domestic water consumption, and enable the provision of services to meet other demands' (Federal Government of Nigeria, 2016, p. 28). Yet, there was neither a mention of wastewater in the 84-page policy document nor any plan for wastewater management within the program. This keeps keen observers wondering how the country seeks to achieve the SDGs by 2030 after failing to meet MDGs in 2015. In the absence of a proactive policy that would address water resources management as a key to food security and economic development, water scarcity remains one of the biggest challenges to peace and the development of agriculture - the mainstay of most Nigerian communities.

It has been predicted that water scarcity will continue to increase in the agriculture sector in Nigeria, and across Eastern and South Africa (All Africa Global Media, 2017); not only because of the increasing population but also due to climate change. While linking the farmers-herders' crisis in Nigeria to lack of food and water *vis-a-vis* low irrigation practice in November 2018, the Nigerian Minister of Agriculture, Audu Ogbeh argued that 'poor water use is the leading cause of illnesses such as cholera, typhoid, malaria' (Vanguard News Nigeria, 2018). This does not only suggests that some farmers use untreated wastewater in agriculture, but that wastewater irrigated produce are beginning to increase health problems across the country. Given that unsafe wastewater uses largely go unreported in many developing countries, reliable data on the scale of its use agriculture Nigeria is difficult to get. Empirical evidence suggests that rural and peri-urban farmers in Nigeria irrigate vegetable farms with untreated wastewater. A study conducted by Okafo, Umoh, and Galadima (2003) in Kaduna and Zaria communities reveals that salad crops transported from this region to eastern and western Nigeria are irrigated with sewage-polluted Kawo drain, Sabon Gari drain, and River Galma. While some of these Nigerian farmers claim ignorance of the hazard posed to soil and humans, similar patterns have been observed in Dakar and Burkina Faso where 52 percent of farmers in Pikine and another 40 percent in Ouagadougou make use of untreated wastewater for irrigating vegetables.

The increasing population of Nigeria which is close to 200 million requires food security for its survival. As a corollary, more than mere scarcity of freshwater, the enormous advantage of wastewater (such as agro-business opportunities and less use of chemical fertilizers) have proliferated its unsafe use in many rural and peri-urban communities of the country. This further poses a threat to public health in Nigeria and other sub-Sahara African

countries. Apparently, the interdependence between availability *vis-a-vis* the management of water and development in Nigeria is exemplified by the link between water and poverty. In July 2015, *Daily Trust*, a local Newspaper reported that farmers in Plateau and Abuja were happy when the rain started in April and May in the northern part of the country. However, staple crops wilted in many farming states due to a long dry spell that followed immediately. Nigerian farmers in Plateau and other states resorted to planting vegetables and green beans in their farms which they can easily irrigate with untreated wastewater (SA'idu et al., 2015). This trend holds implications for human and food security. The News Agency of Nigeria with the same period attributes the high cost of food items from the beginning of the year to insufficient rainfall, while Novus Agro Nigeria Ltd, an agro-allied company in the country attributes the scarcity of maize, a staple food in many parts of Nigeria, to the lack of rain.

Institutional Reform and Reclassification of Wastewater in Nigeria

Human welfare and economic development in Nigeria have solely depended on freshwater over the years. In particular, the term 'toilet'-to-tap has over the years pitted many Nigerians against drinking recycled water, but agricultural and industrial activities need an adequate water supply for proper growth and productivities. Currently, this seems to be at a crossroad because of government's inaction and climate change which often manifest in the form of drought, famine, and flood. With water withdrawals in most African countries predicted to increase by 50 percent before 2025 coupled with the country's population explosion, recycling and reusing wastewater by farmers or herders is arguably a way out of Nigeria's current economic challenges.

Beginning from the 1990s, many governments of developing countries such as India, Brazil, Argentina and Chile have left African states behind by reason of over-reliance on imported food commodities. They redefine their respective economy by separating 'food-water' water from 'non-food water' through wastewater collection, treatment and re-use. Whereas 'food-water' is meant for ensuring food security (agriculture), 'non-food water' is for human security and social progress (domestic and industries). This intervention had reduced poverty in two ways. On the other hand, it enables smallholders and marginal agricultural producers to gain access to the productive power of wastewater and use it for food security and income generation.

On the other hand, it has increased food security, employment, and income. To make one example, *NHance Development Partners* estimates that farmers who use treated wastewater in Mexico and Pakistan harvest more crops per year than non-users. The money they would have used to purchase fertilizer for their soil was also saved because of the nutrients in treated wastewater (Purvis, 2017).

Given the inherent benefit of wastewater to agricultural production, Nigeria's policy-makers urgently need to reclassify 'wastewater' as an asset. Re-using wastewater for irrigation or fodder production in Nigeria would not only help agrarian communities build resilience against climate change but would also guarantee food and human security while reducing freshwater competition with other sectors. This will go a long way in alleviating poverty through an increase in agro-businesses, supply regular nutrient to the soil, improve sanitation and hygiene in the country.

In most developing countries where wastewater reclamation for

agriculture has evolved over the years, Open Wastewater Planning (OWP) method - developed by Swed Enviro Consulting Group and WRS (Water Revival System) in Sweden - was often adopted in choosing a sustainable technology for most agrarian communities. This is not unconnected to its 6-stage participatory and cost-effective processes which allow individuals or groups to choose from different land-based (or pond-based) wastewater treatment technologies (See Plate 1). The OWP stages include identification of suitable site for wastewater treatment technology, participatory approach (guided by independent expert) to choosing a suitable treatment technology; terms of requirement (for easy financing and sustainability) through a collaborative approach; expert-supervised community dialogue on different land-based treatment options ranging from Anaerobic to Facultative or Aerobic/Maturation Ponds; selection of sustainable technology; and further investigation of environmental impacts of the selected technology based on population, housing and drainage system, land use, public health, and geology/soils (Ridderstolpe, 2004).

Water and environment specialists have argued that some land-based system constitutes a breeding ground for malaria vectors, especially during raining seasons in sub-Sahara Africa. However, it is the position of this paper that vector surveillance strategies should be factored into the wastewater treatment system plans in collaboration with local health and environmental sanitation officials.

While the land-based technology - whether aerated lagoons, oxidation ditches, or trickling filters - only requires low-skills for operating and maintaining, 'its value comes to expression in combination with other measures, such as safer irrigation practices and post-harvest food safety measures' (Cofe et al.,

2010). In other words, since public health must be given equal consideration as sustainable economic development, volume I, III and IV of 2006 World Health Organization's wastewater reuse guideline outlined several multiple-barrier approaches for reducing contamination during restricted and unrestricted wastewater use in agriculture . Among others, pathogen-reduction strategies should be taught to all farmers in local dialect by experts (See Plate 2).

National policy on sewage and wastewater management plus interest free-loan should be given through Farmers/herders Associations along with contacts of discounted engineers as a way of encouraging this initiative across Nigeria. Moreover, continuous participatory radio and television programs should be sponsored by State Ministries of Information and National Orientation Agencies on the value of wastewater and its safe re-use for agricultural development. Although, this may not totally eradicate water scarcity or wastewater mismanagement in Nigeria; the initiative would, however, serve as government's first major intervention and practical commitment to productive water resources recovery in the country. Significantly, the initiative will serve as a foundation for centralised wastewater planning across the 36 states of the federation.

[5]On the one hand, unrestricted wastewater irrigation does not limit public access to irrigated fields because of the relative cleanliness of recycled water, and on the other, restricted irrigation requires limiting access of people during and after the use of reclaimed water because of its lesser quality. See: World Health Organization. (2006). *WHO Guidelines for the Safe Use of Wastewater, Excreta, and Greywater: Policy and Regulatory Aspects, Volume I*. Geneva: WHO Press; World Health Organization. (2006). *WHO Guidelines for the Safe Use of Wastewater, Excreta, and Greywater: Wastewater and Excreta Use in Aquaculture, Volume III*. Geneva: WHO Press; World Health Organization. (2006). *WHO Guidelines for the Safe Use of Wastewater, Excreta, and Greywater: Excreta and Greywater Use in Agriculture, Volume IV*. Geneva: WHO Press.

Conclusion

In the context of this study, the objective of wastewater recycling is to sustainably manage water resources and sanitation in ways that would protect the environment and public health. Judging by Gross Domestic Product and Purchasing Power Parity, sub-SaharanAfrican countries rank high among the poorest nations in the world. In addition to the region's poor financial accountability and lack of foresight, maladministration and misuse of available resources are major features of these low-and-middle-income countries. Nigeria and some other African states have demonstrated little commitment to water security over the years. Although, efforts in some states have been geared toward the establishment of River Basin Authorities and the construction of visible water infrastructures for water distribution; yet, limited success has been recorded in reducing water scarcity. As most communities in these African states have reached the limits of their water supplies, and many more subjected to the horrors of anthropogenic climate change; human security that is essential for economic development becomes compromised.

Water security as a development framework for meeting economic needs through wastewater recycling puts integrated resources management and conservation at the heart of sustainable development. As Grober (2012) demonstrates, Carlowitz's idea of sustainable forestry was imposed by scarcity of timber which threatened people's sources of income. By considering environmental equilibrium, water security, and sustainable economic development, this study interprets water security and sustainability as: if it is not portable, it may still serve other production purposes, especially in agribusinesses.

With the delay and insufficient rainfall across Nigeria, environmental degradation in the south-south region and

increasing aridity or desertification in the north, Nigeria and many other African states which depend on rain-fed agriculture become vulnerable to food scarcity due to water scarcity. Clearly, protecting people's means of livelihood and the Nigerian environment deserves a holistic approach and should be considered in the country's overall strategy for sustainable development. Given the centrality of water in stimulating agricultural production and its attendant benefits (food security, employment opportunities, poverty alleviation and raw materials for industries), this paper submits that a comprehensive understanding of water security by Nigeria decision-makers would allow the adoption of an integrated water resources management approach to providing appropriate legal and institutional framework required to productively use water infrastructures.

Where conventional treatment is not feasible, rudimentary land-based treatment is a possibility. Small ponds dug on farmland strategically (either individually or in groups) and exposed to appropriate treatment elements would provide good treatment for agricultural uses. In particular, exposure to wastewater to natural processes like ultraviolet radiation of sunlight while the solid waste settles will lead to dying away of contaminants. Empirical evidence has shown that the longer wastewater settles in the treatment ponds, the cleaner the water as well as the lower health risk to man and environment. Although these water treatment ponds cannot manage salinity, an addition of fresh water to the recovered water would go a long way in reducing the salinity of recovered wastewater as well as improve its quality for irrigation. Asano and Sakaji (1990) discovered that about 99.99 percent of contaminants like bacteria and viruses were eliminated in land-based wastewater treatment system under regular field conditions

after two weeks of settlement. This thus confirms the viability of land-based wastewater treatment technology in rural and peri-urban communities in Nigeria.

Adopting low-level waste water recovery and treatment is particularly desirable in Nigeria, not only from the cost perspective only, but also in acknowledgment of the financial and technicalities attached to complex treatment technology. Therefore, a low-grade of effluent rather than advanced treatment system would suit rural and peri-urban farmers/herders in Nigerian communities. Finally, reclassifying and harnessing the productive power of wastewater in Nigeria would not only allow for better water access to farmers and herders whose conflict is gradually tearing the country apart, but will also help in protecting consumers, crops, soil and the environment from risk of contamination and pollution that often accompany the discharge of untreated wastewater. This would also help achieve parts of the SDGs on or before 2030.

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