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Review Article

An Overview of the Challenges Facing Water Resources Utilization in Nigeria: A Holdup to Environmental Sustainability

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ABSTRACT

Nigeria as a country has about 13,879 km^2 land area, covered by water with over 40 rivers and streams. The water is not uniformly distributed based on geology and rainfall pattern. Groundwater is estimated at 51.93 ×10^9 m^3, out of which sedimentary basins accounts for 67 %. The sustainability of these resources is being threatened by variability of the hydrological regime and availability of fresh water, pollution, erosion and flooding, reservoir sedimentation, saltwater intrusion and increased soil salinity and land use pattern. Findings show that the concentration of heavy metals in all the major rivers across Nigeria are above the WHO recommended values and these were attributed to anthropogenic influence. Issues such as eutrophication resulting from nutrient loadings, salinization from irrigation return flows, open defecation practice, serious cases of over abstraction of ground water leading to up coning in coastal areas, frequent flooding witnessed in recent times, calls for concern. Therefore, the aim of this paper is to study the challenges on utilization of water resources, the impact on our environment and its linkage to sustainability.

1. INTRODUCTION

The Federal Republic of Nigeria, with an area of 923,769 km^2 (made up of 909,890 km^2 of land area and 13,879 km^2 of water area), is situated between 3^o and 14^o East Longitude and 4^o and 14^o North Latitude. About 31.29 % of the land constitutes arable land and permanent crops account for 2.96 %, others constitute

65.75 % as at 2001. Irrigated land is 2,330 sq km, based on 1998 estimates (NBS, 2012). The water resources of Nigeria are enormous and unevenly distributed among the various hydrological areas (Amah, 2015). The Niger Delta and tropical rainforest areas have the highest precipitation of about 3000 mm/yr., and longer duration of rainfall up to eight months (Adejuwon, 2012). Next is the Savannah zone with 1000 mm - 1250 mm/yr. rainfall, the amount of rainfall decreasing north-ward. The Sahel has annual precipitation of less than 750 mm/yr. and may be as low as 500 mm/yr. in the Northeastern region occasionally (Ekpoh, 2015). Rainfall duration can span for 3 - 4 months in these northern zones and shallow wells normally dry up during the dry seasons due to insufficient recharge (Kwoyiga and Stefan, 2018). The south witnesses massive flooding and inundation of coastal aquifers by saline water especially low lying areas and reclaimed wetlands (Amah, 2015; Idu, 2015; Kwoyiga and Stefan, 2018).

From the annual total rainfall of 560 km^3, surface run-off is estimated at 215 km^3/yr., distributed among the major drainage systems (Lohdip and Gongden, 2013) which are Niger- Benue Drainage System, (127 × 109 m^3), Lake Chad drainage system, (0.63 × 109 m^3), South-East (Cross River., Anambra River .etc.), (66 × 109 m^3), South-West (Ogun River., Oshun River. etc.), (22 × 109 m^3) (Figure 1). The Niger-Benue system alone accounts for over 50 % of the total annual run-off. The potential annual groundwater resources are estimated at 51.93 ×10^9 m^3, out of which the sedimentary basins account for 67 % (FMWRRD, 1995). The country has well over 40 rivers and streams (Majasan and Young, 1997). There are also lakes, including the Chad and Kainji. The Nigeria component of Lake Chad has a total area of about 550,000 hectares, while, Kainji lake covers about 127,000 hectares.

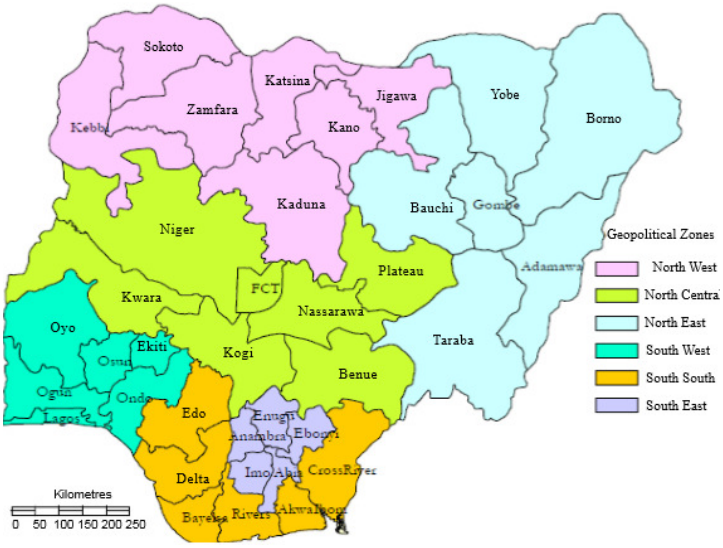

Figure 1: Map of Nigeria showing the 36 states and federal capital territory as well as the 6 geopolitical zones (Ogah *et al.,* 2012)

The quality, quantity and distribution of water has several potential consequences for the human well-being in a way that its connection with the security, conflict and health has become a subject of growing concern globally (Okpara *et al.,* 2014; Cosgrove and Loucks, 2015; Loucks and van Beek, 2017). This is because man has been endowed with reason, with the power to create, so that he can add to what he's been given. But up to now he hasn't been a creator, only a destroyer. Forests keep disappearing, rivers dry up, wildlife become extinct, the climates ruined and the land grows poorer and uglier every day (Roberts, 2013). Currently, environmental related issues in Nigeria include variability of the hydrological regime and availability of freshwater, water pollution, erosion and flooding, sedimentation of reservoirs, rivers and water courses (Fulazzaky, 2014; Talbot *et al.,* 2018).

This research is therefore aimed at studying these challenges on surface and ground water resources utilization in Nigeria and its linkage to environmental sustainability.

2. ENVIRONMENT

The natural environment includes the nature of the living space (sea, or land, soil or water), the chemical constituents and physical properties of the living space, the climate, and the assortment of other organisms present (Malmstrom, 2012). The environment is referred to as the aggregate of external conditions that influence the life of an individual or population, particularly the life of man and other living organisms on the earth's surface (Sherbinin *et al.,* 2007; Parmar *et al.,* 2016). It includes both biotic (living) and abiotic (non-living) factors that affect the organism in the surroundings. Land (lithosphere), water (hydrosphere), and air (atmosphere) make up our environment and these serve as the buckets where wastes are channeled or disposed (Sterner and Elser, 2002).

Man through his technological process converts natural resources to energy and good for use, which bring about changes in his environment some of which may be detrimental (Oyedepo, 2012; Owusu and Asumadu-Sarkodie, 2016). However, the core mandate of the Federal Ministry of Environment, Nigeria is to secure a quality environment conducive for ecosystem health and integrity, promote sustainable use of natural resources, and raise awareness on the environment (Mailafia, 2012). These mandate have been pursued vigorously through National Environmental Standards and Regulations Enforcement Agency (NESREA) established in 2007 by making twenty-four regulations, all geared towards addressing four broad environmental problems being accorded highest priority in Nigeria, these are ensuring sustainable industrial production, preventing and reversing desertification, managing forest, wildlife and natural resources, combating floods and erosion.

3. SUSTAINABILITY

According to the office of sustainability, University of Alberta, sustainability means meeting our own needs without compromising the ability of future generations to meet their needs. It is defined as a process of living within the limits of available physical, natural and social resources in ways that allow the living systems in which humans are embedded to thrive in perpetuity. In addition to natural resources, we also need social and economic resources. Sustainability is a holistic approach that considers ecological, social and economic dimensions (See Figure 2), recognizing that all must be considered together to find lasting prosperity (United Nations General Assembly, 2005). Environmental Sustainability ensure ecological integrity is maintained, all of earth's environmental systems are kept in balance while natural resources within them are consumed by humans at a rate where they are able to replenish themselves (Mensah and Casadevall, 2019). Economic sustainability focuses on that portion of the natural resource base that provides physical inputs, both renewable (e.g. forests) and exhaustible (minerals) into the production process (Goodland, 1995).

While, environmental sustainability adds consideration of the physical inputs into production, emphasizing environmental life support systems without which neither production nor humanity could exist (Basiago, 1998). These life support systems include atmosphere, water and soil - all of this need to be healthy, meaning that their environment service capacity must be maintained (Goodland, 1995). Environmental sustainability demands that the society designs activities to meet human needs, while indefinitely preserving the life support system of the planet, such degradation on a global scale would imply extinction of humanity; hence the emphasis on MDG7 - ensure environmental sustainability (Martín-Hurtado *et al.,* 2002; Lim *et al.,* 2018; Mensah and Ricart Casadevall, 2019).

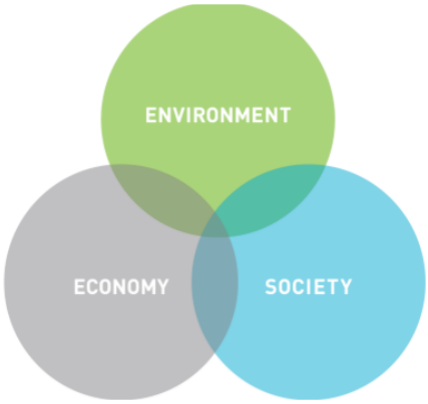

Figure 2: Pillars of sustainability (Adapted from the United Nations General Assembly, 2005)

4. ENVIRONMENTAL SUSTAINABILITY VIS-À-VIS WATER RESOURCES

Nwankwoala (2011) approached sustainability based on the physical laws that govern the behaviour of earth systems and was defined a sustainability encompasses the beneficial use of groundwater to support present and future generations, while simultaneously ensuring that unacceptable consequences do not result from such use (Cosgrove *et al.,* 2015). This view of sustainability entails four premises; (i) the surface and groundwater constitute a single resource; (ii) groundwater is a finite resource and a component of a larger natural resources system. Actions on one or more system components generally affect the long-term balance of the whole system; (iii) groundwater replenishment is strongly influenced by climate variability, as well as natural and enhanced recharge processes. Consequently, groundwater resources development must adapt to the system's varying capacity for renewal, (iv) communities need to share and manage groundwater resources so that the natural resources system retains its integrity for the future. We are living beyond our means, as a people, we have developed a life-style that is draining the earth of its priceless and irreplaceable resources without regard for the future of our children and people all around the world (Adeagbo, 2013).

5. THREATS TO SUSTAINABILITY OF WATER RESOURCES

The principal threats to water resources for humans include water pollution (the contamination of surface water and groundwater reservoirs with chemicals and microorganisms; water scarcity (the change of run-off regimes and the change – mostly lowering – of the groundwater table); overexploitation (mining); and most importantly, global climate change with consequences such as redistribution of precipitation, rising sea levels, change in the CO_2 absorption of the oceans and increase in extreme precipitation events (Stolberg *et al.,* 2003; Hamilton, 2005).Water resources development that is not sustainable is ill-planned. In many parts of the world, fresh water resources are scarce and to a large extent finite. Although, surface water may be considered a renewable resource, it only constitutes 1.5 % of all terrestrial fresh water resources; the vast majority is groundwater (98.5 %) part of which - at a human scale - is virtually un-renewable (Savenije, 2000).

5.1. Pollution

This includes industrial pollutants from industries sources, such as organic matter, metals, minerals, sediments, bacteria and toxic chemicals. Emission of organic water pollutants in Nigeria was estimated to 72,082 kg per day, and this rose to 82,477 kg per day in 2000 representing 14.4 % increase over the period (World Bank, 2003; Orubu, 2006; Inyinbor Adejumoke *et al.,* 2018). This made the country the third heaviest water polluter in Africa in 1980 and fourth in 2000. Nigeria was reported to account for more than 87 million litres of spent oil waste annually and adequate attention has not been given to its disposal (Anoliefo and

Vwioko, 1994; Nwite *et al.,* 2014; Rotimi and Ekperusi, 2014; Zitte *et al.,* 2016). A number of surface and ground water quality research measuring the concentration of heavy metals had been conducted in different locations in Nigeria with findings presented in Table 1.

Table 1: Synthesis of some research works on surface and ground water pollution in Nigeria

Location	Research topic	Results and conclusions	References
Aba, Abia State	Quality assessment of Aba river using heavy metal pollution index	Concentrations of some metals higher than the WHO recommended safe reference values	Amadi, 2012
Ado-Ekiti, Ekiti State	Determination of heavy metal concentration in fish samples, sediment and water from Odo-Ayo River	Mean metal concentration of all the metals were slightly higher than the maximum permissible value for a safe drinking water postulated by the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007) except Cd.	Edward *et al.,* 2013
Bompai-Jakata Drainage Basin, Kano	Assessment of heavy metal concentrations in the surface water of Bompai - Jakata, Basin	The bio-concentration factor of heavy metals in gills, kidney and liver of the fish are high beyond the tolerable level	Imam, 2012
Ibadan, Oyo state	Heavy metal characteristics of groundwater in Ibadan South Western, Nigeria	Concentration above the FEPA,WHO,AWWA, CCME, standard limit for effluents discharge into surface water	Laniyan *et al.,* 2013
Kaduna, Kaduna State	Assessment of heavy metals level of River Kaduna at Kaduna Metropolis	Ca, Fe and K were above the WHO standard	Abui *et al.,* 2017
Lagos Lagoon, Lagos State	Studies on the occurrence and distribution of heavy metals in sediments in Lagos Lagoon and their effects on benthic microbial population	Concentrations of the metals were observed to be higher than WHO acceptable limits	Uaboi-Egbenni *et al.,* 2010
Makurdi, Benue State	Contamination of surface waters of River Benue with trace elements at Makurdi	The values for heavy metals for all zones are of public health significance and pose a threat to the survival of both humans and aquatic life	Akaahan *et al.,* 2015
Ogbomoso, Oyo State	The impact of abattoir activities and management in residential neighborhoods: A case study of Ogbomoso	Mean values of the heavy metals (Pb, Ni, Cr, Cd and Al) in the waters of River Benue were above the drinking water quality standard set by WHO	Bello and Oyedemi, 2009
Okrika, River State	Trace metals contents of Bonny River and creeks around Okrika	Pollution of wells and air causing reduced quality of health of residents leading to cases of elevation of excessive coughing, typhoid fever, diarrhea, and malaria and muscle pains among these residents.	Marcus, 2011

Location	Research topic	Results and conclusions	References
Owan, Edo State	Heavy metal concentrations in surface water and bioaccumulation in fish (*clarias gariepinus*) of River Owan	The levels of Pb and Cd in water exceeded EPA maxima for marine/brackish water	Enuneku *et al.,* 2013
Baga, Borno State	Assessment of pollutants in water and sediment samples in lake Chad, Baga, North Eastern Nigeria	Fe and Zn had higher concentrations in fish than WHO and FEPA guidelines for fish consumption.	Joseph *et al.,* 2012
Warri, Delta State	Heavy metal levels in water and sediment of Warri River	The concentrations of Fe, Mn, Cu, Cd, Pb, Ni and Co in the water samples were higher than the WHO guideline limits	Ogagu *et al.,* 2015
Yauri, Kebbi State	Seasonal potential toxic metals contents of Yauri river bottom sediments	Concentration of Pb, Cd, and Cu in water exceeded regulatory limits of safe drinking	Yahaya *et al.,* 2012
Zaria, Kaduna State	Heavy metals contents in soils and some crops irrigated along the Bindare stream Zaria	Enrichment factor showed that the river is contaminated with Cd, Cu, Pb and Zn	Funtua *et al.,* 2014

5.2. Sanitation and Hygiene

Ensuring availability and sustainable management of water and sanitation for all is the SDG 6. According to their report in 2015, an average of 69.5 % of the population had access to safe drinking water in the Southern zones compared to 46.0 % of the population in the Northern zones with the situation at its worst in the North-east that is 37.9 %. On Sanitation, over 124 million (> 70 %) people lack access to improved sanitation. The breakdown shows that over 44 million Nigerians (25 %) practice open defecation; 4million people (24 %) sheared Toilet facilities between two or more households; 38 million (22 %) practice no hygiene separation of human excreta from human contact (WHO/UNICEF Joint Monitoring Programme, 2015).

5.3. Over-abstraction

Recent over-abstraction of groundwater from parts of the coastal sedimentary aquifers has led to problems with saline intrusion. This has been noted particularly around Lagos, Ondo, Edo, Delta and Rivers States (Jimoh *et al.,* 2018). Over-abstraction of groundwater for irrigation in the arid northern areas also has the potential to cause salinization of shallow ground waters (Li *et al.,* 2018).

5.4. Water Scarcity

Reports show that water withdrawal in Nigeria during the 1990s was 28 m^3per person per year (World Bank, 2003). In its target at ensuring availability and sustainable management of water and sanitation for all, SDG in 2010 wished to: halve by 2015, the proportion of the population without sustainable access to safe drinking water and sanitation. In Nigeria, access to water, sanitation and hygiene has been a very big challenge. Citizens in both the urban and rural areas struggle daily with this problem particularly women who spend a large proportion of their time in search of potable water for drinking and other household requirements (Dinka, 2018). The concomitant effect of acute water shortage is the outbreak of waterborne diseases which threatens the lives of citizens particularly children who are susceptible to waterborne diseases such as cholera, diarrhoea, guinea worm, typhoid fever, hookworm infection (Ojile, 2020). Indeed, in many communities in Nigeria, inadequate safe water supply and sanitation facilities have increased infant mortality rates.

The history of drought in the Lake Chad basin is defined by its changing rainfall patterns. From the middle of the 1960s, rainfall started to drop intermittently until the droughts of 1972 - 1975 which coincided with the shrinking of the basin to 10,700 km^2 from its initial level of 25,000 km^2 in 1963. Another drought of 1982 - 1985 resulted in a drop in basin area to 1,410 km^2, and now it covers an area of less than 1000 km^2, the lowest basin surface level recorded over the past 100 years (GIWA, 2004). During this time period half of the loss is attributed to a continued decrease in precipitation; the remaining half is due to a large increase in irrigated agriculture. Figure 3 shows the extent of shrinkage of Lake Chad since 1963.

Figure 3: Schematic map of Lake Chad's average status in 2010 (Lemoalle, 2015)

6. SOIL EROSION AND SLUDGE PRODUCTION

Disposal of excessive sludge into the receiving environments is a clear indication of not adhering to Integrated Water Resources Management (IWRM) implementation, forest land conversion and agricultural land occupation (Collivignarelli *et al.,* 2019). Major sources of sludge are from soil erosion and sedimentation that comes from agricultural land occupation and this shows that soil conservation principles are not quite well understood and implemented by farmers (Wolka, 2014). Solid waste disposals and night soils as well as chemical and activated sludge produced from water and wastewater treatment plant (WWWTP) evidently contribute to an increase in quantity for sludge released into the environments (Hospido *et al.,* 2004). Sludge from soil erosion might eventually encourage an enormous accumulation of sediment in lakes and reservoirs hence the impact of decreased storage capacity may reduce water potential gradients in the stem. Another potential source of sludge is associated with latrines or toilets referred as night-soil, having collected during the night in the past (Kawa *et al.,* 2019). The problems with fecal sludge management is that the collected night-soil in most cities in many developing countries are discharged untreated into the receiving environments due to excessive distance of disposal sites, traffic congestion and lack of suitable night-soil treatment options (Fulazzaky, 2014). Sludge overdose may affect the discharge regime of rivers, which in turn reduces the inland water availability and worsens the quality of waters for use (Fulazzaky, 2014).

7. SOIL EROSION

Erosion is defined as the weathering, and/or detachment, transportation and deposition of soil particles over the landscape (Lal, 1990). Factors which influence the rate of erosion include climate variables such as rainfall amount, rainfall intensity and duration, raindrop size, wind speed and wind direction and topographical features such as slope angle, slope length and slope shape and vegetation characteristics such as crop canopy (Ziadat and Taimeh, 2013). So also the role of ground cover and plant roots; the influence of

inherent soil properties such as texture, structure, organic matter, clay content and exchangeable cations; and lastly, the impacts by humans (Schoonover and Crim, 2015). Nigeria faces severe problem of soil erosion – both sheet and gully erosion due to both natural and human causes. Over 6000 km^2 of land are affected by erosion and about 3400 km^2 are highly exposed. Erosion has a devastating effect on many peoples' lives and destroys essential infrastructure for economic development and poverty alleviation (Igwe, 2012). Gully erosion contributes to environmental problems and damage estimated at over $100 million annually (mostly in South-Eastern Nigeria) (Anyadiegwu *et al.,* 2011).

8. FLOODING

This is seen as the inundation of an area not normally covered with water, through a temporary rise in level of stream, river, lake or sea which is a body of water which moves over and above an area of land which is not normally submerged is a common environmental problem in Nigeria (Agbonkhese *et al.,* 2014). It has been estimated that in Nigeria, a one meter sea level rise could flood about 18,000 km^2 of land, and damage economic assets worth billions of US dollars, and force the relocation of up to 3.7 million people – putting the moderate cost of protecting a fraction of the coastline against inundation at US $3,162 billion (Kavalsky *et al.,* 2010). In 2012 alone, Nigeria experienced an unprecedented flood that affected about twenty seven states of the Federation, causing the deaths of over four hundred (400) persons and displaced about two million people from their homes. The total amount of losses was estimated to be approximately ₦2.29 trillion (NEMA, 2013). The health implication of flooding in the country is that it exposed many people to diseases such as cholera, malaria, skin infections and other water-borne diseases.

9. HYDROLOGIC PROCESSES AND LAND USE (URBANIZATION)

In natural systems, the physical processes of the hydrologic cycle (primarily precipitation, evaporation, evapotranspiration, condensation, infiltration, and runoff) serve to purify water, replenish land with freshwater, and transport minerals. However, in urban systems, altered land uses cause changes to the natural hydrologic cycle (MSDGC, 2012) as seen in Figure 4. For example, as an area of land is converted from open space (e.g., woodland) to residential, the amount of runoff for that area of land will increase as the amount of impervious surface increases. Rain, which would have once seeped into the soils beneath the forest floor and been absorbed by tree roots, instead flows off impervious surfaces (roofs, driveways, streets, parking lots, etc.) into the nearest stream, pond, or lowland area. As rainwater runs off these surfaces, it will also carry off any existing pollutants. Thus, not only has the rate of runoff increased for that area, but the amount of pollution that enters nearby water bodies may also increase. Therefore, altered infiltration, surface runoff, and stream flow in urban environments can increase the amount of nonpoint source pollution to water bodies and can increase the peak flow, volume, and frequency of flooding events (MSDGC, 2012).

10. RESERVOIR SEDIMENTATION

Sedimentation causes loss of approximately 0.5 to 2.0 % of the world reservoir volume annually (Issa *et al.,* 2015), while global average total sediment yield is put at 190 $t/km^2/yr$. (Mahmood, 1987). An estimated 30 - 40 % of irrigated land worldwide relies on dams which generate 19 % of world electricity (World Commission on Dams, 2000). In a study, Onwuegbunam *et al.* (2013) showed that the reservoir storage capacity of Afaka dam constructed in 1987 had decreased, due to sediment build-up, from its initial design capacity 16400 m^3 to 10665 m^3, implying a storage loss of about 35 %. The result established that the rate of change (decrease) in the reservoir storage capacity of Afaka dam is 221 m^3yr^{-1}. Also, massive siltation had been reported at Bagoma and Gimbawa dams as well as Matari earth dam in Kaduna State (DIS, 2013).

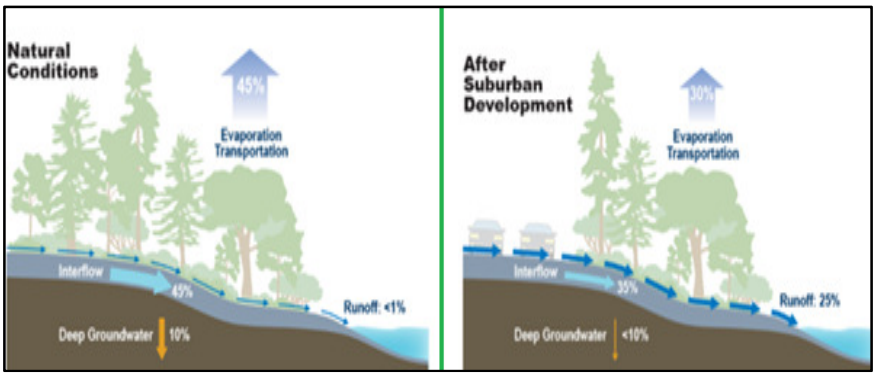

Figure 4: Effects of urbanization on the hydrologic cycle (Source: Adapted from MSD Integrated Sustainable Watershed Management Manual, 2012)

11. DEGRADATION OF ECOSYSTEM

Aquatic and riparian ecosystems may be subject to a number of threats. The most important ones include habitat loss due to river training and reclamation of floodplains and wetlands for urban and industrial development, poor water quality due to discharges of pesticides, fertilizers and wastewater effluents, and the infestation of aquatic nuisance species (Loucks and van Beek, 2017). Exotic aquatic nuisance species can be major threats to the chemical, physical, and biological water quality of a river's aquatic resources and a major interference with other uses (Bashir *et al.,* 2020). The destruction and/or loss of the biological integrity of aquatic habitats caused by introduced exotic species is considered by many ecologists to be among the most important problems facing natural aquatic and terrestrial ecosystems (Havel *et al.,* 2015). Biological integrity of natural ecosystems is controlled by habitat quality, water flows or discharges, water quality, and biological interactions including those involving exotic species (Atique *et al.,* 2019). Once exotic species are established, they are usually difficult to manage and nearly impossible to eliminate and this creates a costly burden for current and future generations. The invasion in North America of nonindigenous aquatic nuisance species such as the sea lamprey, zebra mussel, purple loosestrife, European green crab, and various aquatic plant species, for example, has had pronounced economic and ecological consequences for all who use or otherwise benefit from aquatic ecosystems (Strayer, 2010). Environmental and ecological effectiveness as well as economic efficiency should be a guiding principle in evaluating alternative solutions to problems caused by aquatic nuisance organisms. Funds spent in prevention and early detection and eradication of aquatic nuisance species may reduce the need to spend considerably more funds on management and control once such aquatic nuisance species are well established (Reaser *et al.,* 2020)

12. RECONSIDERATION OF THE CONCEPT OF INTEGRATED WATER RESOURCES MANAGEMENT

The concept of integrated water resources management (IWRM) has been developing over the past several decades. IWRM is the response to the growing pressure on our water resources systems caused by growing populations and socioeconomic developments. Water shortages and deteriorating water quality have forced many countries in the world to reconsider their development policies with respect to the management of their water resources (Loucks and van Beek, 2017). As a result water resources management (WRM) has been undergoing a change worldwide, moving from a mainly supply-oriented, engineering-biased approach toward a demand-oriented, multi-sectoral approach, often labeled integrated water resources management.

The concept of IWRM moves away from top-down "water master planning" that usually focuses on water availability and development, and toward "comprehensive water policy planning" that addresses the interaction between different subsectors (Figure 5), seeks to establish priorities, considers institutional

requirements, and deals with the building of management capacity. Integrated water resources management is a process which promotes the coordinated development and management of water, land, and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP, 2000).

Figure 5: Interactions among the natural, administrative, and socioeconomic water resource subsectors and their environment (Adapted from MSDGC Manual, 2012)

13. EMBRACING DIVERSE WATER SECURITY ISSUES AND THE LINK TO SUSTAINABLE DEVELOPMENT GOALS (SDGS)

While IWRM focuses on the *process* to improve water management (the how), the term "water security" focuses on the *output* (the what). The World Economic Forum has identified Water Security as one of the biggest global economic development issues. Water Security is defined by as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability (Aboelnga *et al.,* 2019).

In 2015 the UN adopted the Sustainable Development Goals 2015 – 2030 that specify specific targets for various goals such as the provision of water for drinking and sanitation, water productivity in agriculture, industry and energy, environment, and reduction of floods and droughts. It is expected that many countries will expect their water managers to use the SDGs as objectives in water resources planning. This means that our planning and management proposals need to be able to quantify the impacts of possible plans and policies in terms of the SDG targets.

14. SUGGESTED CORRECTIVE MEASURES

In view of the importance of water resource to the continued survival of the present generation and the incoming ones, the following corrective approaches are suggested: Adoption of the principle of watershed management to include:

i. Utilizing the land according to its capability
ii. Putting adequate vegetal cover on the soil during the rainy season c) Conserving as much rain water as possible at the place where it falls.
iii. Draining out excess water with a safe-velocity and diverting it to storage ponds and store it for future use.

iv. Avoiding gully formation and putting checks at suitable intervals to control soil erosion and recharge ground water.
v. Maximising productivity per unit area, per unit time and per unit of water g) Safe utilization of marginal land through alternate land use systems.
vi. Ensuring sustainability of the eco-systems benefiting the man-animal-plant-land-water complex in the watershed.
vii. Improving infrastructural facilities with regard to storage, transportation and marketing
viii. The River basins and research institutes must evolve routine mitigation measures appropriate for the environment.
ix. Education of the benefitting populace is also expected to help in reducing anthropogenic pressures to our water bodies and to the environment in general thereby consolidating sustainability.

Since urbanization is an indication of development, masses should be enlightened to be using interlocking tiles as against concrete surfacing of their compound to assist infiltration and reduce runoff, and water board should be given rebate to those who comply-this is being practice in Japan, there should be a strict application of all environmental laws that are in the constitution.

15. CONCLUSION

The best way to mitigate threats to our water resources is to step up Integrated Water Resources management where all sectors must synergize to realize the stated objectives. Water quality degradation had been found most severe in States reported in Table 1, where most of the country's industries are situated with successive effects on public health and socio-economic development. There is need for protection of water bodies in Nigeria as millions of the populace rely on it for daily water supply. The Federal Ministry of Environment and the Integrated Water Resources Management Commission must strengthen the present environmental/water laws such that the polluters of water bodies could be prosecuted. Industrial and agricultural sectors should also be obligated to treat their wastes before being discharged into the water bodies. This paper has reviewed the various threats to water resources and environment in Nigeria that impedes sustainability. The variation in water quality experienced in Nigeria reproduces dissimilarities in the kind of pollutant inherent in that particular environment. Knowing the condition of rivers and streams and other environmental degradation is critical to effective mitigation of dangers to water our precious resources.

16. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

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