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ENVIRONMENTAL EDUCATION AS A VIABLE TOOL IN PREVENTING GROUNDWATER POLLUTION IN NIGERIA

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ABSTRACT. - Environmental Education as a Viable Tool in Preventing Groundwater Pollution in Nigeria. The study focused on the use of environmental education, particularly at elementary level, to prevent groundwater degradation in Nigeria. This is especially germane because of the relative advantage of groundwater over other sources of water because of its near universal availability, dependability and low capital cost; groundwater remains the preferred source of water in most parts of the country. The development and management of the resource remains central to the success of rural and urban development programmes. Issues discussed in the research include importance of groundwater in meeting supply challenges imposed by ineffective and inefficient public water supply in Nigeria, groundwater resources and use in the country, sources of groundwater pollution, the need for environmental education and developments and techniques in environmental education. The research concluded by suggesting the need for environmental education, particularly at elementary level in addressing problems of environmental degradation and groundwater pollution in particular. This is considered appropriate because, once a good environmental attitude is developed in children, it will be very difficult for them to change their behavior negatively toward matters concerning the environment.

Keywords: *groundwater, pollution, aquifer, environment, education.*

Introduction

Groundwater is water which occurs below the surface of the Earth within the saturated zone where the hydrostatic pressure is equal or greater than atmospheric pressure (Wiggan, et. al., 2013). This water which represents 97% of the world's available freshwater resources is extensively abstracted

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throughout the world (Herbert and Doll, 2019). Groundwater has recently become of particular importance as a source of domestic water supply in Nigeria. This is due to both the failure of government at all levels in meeting the water needs of the people and the characteristics possessed by groundwater over other sources of water.

Although one can say that Nigeria as a country is blessed with a sizable water infrastructure including dams, treatment plants, pumping stations and reservoirs, acute water shortages affect both the urban and rural dwellers in the country. According to the Federal Ministry of Water Resources FMWR (2013), Nigeria is among the ten countries in the world that are home to two thirds of the global population without access to the improved water sources and has the highest population (more than 66 million) without improved sources of drinking water in Africa. While Sule *et al*. (2016) observed that water production facilities in the country rarely operate to capacity due to breakdown of equipment or lack of power for pumping, the World Bank (2002) linked the poor performance of water agencies in the country to high operating cost. Okeola (2005, 2009, 2014), Odigie and Fejemirokun (2005), Adah and Abok (2013) and Iroye (2014) have cited some fundamental reasons responsible for the poor level of service delivery by public water supply agencies in Nigeria.

In the light of the above stated problems confronting public water supply in the country, most private individuals and some government agencies have resulted to the use of groundwater in meeting their water demand. This usage is particularly due to the inherent characteristics possessed by groundwater. Ayoade (1988) listed inherent characteristics possessed by groundwater which makes it a preferred option as source of water supply, including:

i. it has low cost of development, maintenance and operational works;
ii. it has high chemical and bacteriological qualities;
iii. it records less fluctuations in water temperature;
iv. it has little or no seepage losses;
v. less area of land is required for its development when compared to surface water sources;
vi. its development records little or no loss of farmland or historical sites;
vii. its development causes no resettlement problems;
viii. it is available at the point of demand; and,
ix. it records no evaporation losses.

Because of the above enumerated advantages of groundwater over other sources of supply, the resource is being extensively abstracted, not only in Nigeria, but throughout the world. The UN (2018) observed thus on ground usage:

> "During the 20th century, there was an enormous boom in well construction for urban water supply, irrigation and industry, facilitated by advances in drilling and pump technology, geological knowledge, and support from state subsidies, especially for irrigation. Groundwater has therefore *de facto* become a key resource supporting human well-being and economic development. It represents a critical resource in terms of risks as well as opportunities for development in a changing world."

However, groundwater use is often unsustainable. While its supplies are diminishing in some regions, its quality is also becoming increasingly deteriorated. It is thus highly germane that these trends are quickly reversed in order to sustain its critical role, especially in the ecosystem of man. This is the trust of this study; with particular focus on groundwater pollution control. The study discussed the use of environmental education, particularly at elementary level in preventing groundwater pollution. This is very important considering the fact that groundwater is often considered a fallback resource in all countries of the world. UN (2018) observed that it is indeed a paradox that such a vast and highly valuable resource, which is likely to become even more important as climate change increasingly affects surface water sources, has been so neglected by government and development community at a time when interest and support for water sector as a whole is at an all-time high.

Sources of Groundwater Pollution

Water pollution is the addition of some foreign substances to water which degrades its quality and makes it a health hazard or unfit for use. The addition of foreign substances to water either changes its physical or chemical characteristics or interferes with its use for legitimate purposes. Normally, water is never pure in chemical sense; it usually contains impurities of various kinds, which can either be dissolved or suspended. Such impurities include dissolved gases (i.e. H_2S, CO_2, NH_3, N_2), dissolved minerals (i.e. Ca, Mg, Na, salts), suspended matter (clay, silt, sand) and microbes. These impurities which are usually derived from atmosphere, catchment areas and soil are found in low amount, they are natural and thus do not degrade water quality.

Polluted waters are however turbid, unpleasant, smelling and unfit for any domestic activities. Such waters are harmful and are vehicles for a number of diseases such as cholera, dysentery, and typhoid. WHO (2000) reported that water-bore diseases have been estimated to cause more than two million deaths and four billion cases of diarrhea annually. Infectious diarrhea according to Lee *et al*. (2002) is responsible for the greatest burden of this morbidity and

mortality, and children less than five years of age are the most severely affected population. Quality of water thus remains a vital concern for man as it is directly linked with human welfare.

Groundwater contamination occurs when man-made products get into groundwater and cause it to become unsafe and unfit for human use. Sources of man-made products that contaminate groundwater do emanate from domestic, industrial and agricultural activities. Studies such as Almasiri *et al*. (2004), Awofolu (2006), Sacchidananda and Prakash (2006), Yerima *et al*. (2008), Feighery (2010), Soladoye (2011), have revealed groundwater contamination through leachates outflow, infiltration from landfill, infiltration of trace metals from industrial production and underground flow from leaking latrines.

Domestic wastes and methods of their disposal are of primary concern in groundwater pollution in urban areas. Prime factors responsible for groundwater deterioration in these areas include pathogenic organisms, oxygen demand, nutrients and solid from domestic wastes (Gruber *et al*., 2014). Agricultural activities contaminate vulnerable aquifers with a number of pathogens and hazardous substances (Griffiths *et al.*, 2003). This is usually from the usage of fertilizers, pesticides, insecticides and herbicides. Processing and animal waste being produced on farms also go a long way in contaminating groundwater. The scale of ground pollution from agricultural practice is far greater than pollution from other human activities, as manure, agrochemicals, and wastewater are intentionally applied to land, most often in large areas.

Although pollution of groundwater resources in Nigeria has generally not reached a crisis point, the nature of groundwater resource which allows it to move from zones of recharge to zones of discharge and the difficulty associated with its clean-up when degraded suggest that action must be taken now to ensure the future integrity of the resources. Dispersion of groundwater is affected by the heterogeneity of subsurface systems and the difference in hydraulic conductivities between aquifers. And because groundwater dispersion patterns are difficult to predict, the tasks of detecting its pollution and monitoring its quality are extremely difficult and highly expensive. This thus means that once an aquifer is polluted, it may remain polluted for a long time. Even when such pollution is finally detected, and restoration of the groundwater is attempted, clean-up may be difficult to carry out because of the cost and time it will take.

The above discussed factors thus call for efforts to protect groundwater through environmental education, particularly at elementary level. However, because this approach will take a long time to be effective, the task of protecting groundwater can immediately be carried out first by reviewing the various geological conditions in the country towards resolving key practical

groundwater management questions in order to guide optimum groundwater development and to determine groundwater protection zones around boreholes in fractured rocks (Tindimugaya, 2005).

Groundwater Resource and Use in Nigeria

Nigeria, which is located between longitudes 2˚50' and 14˚20' East of the Greenwich Meridian and between latitudes 4˚10' and 13˚48' North of the Equator in the subcontinent of West Africa, South of the Sahara (fig. 1) is geologically made up of two types of rocks; i.e. the basement complex and the sedimentary rocks with each of these two formations making up about 50% of the nation's geology (Omorinbola, 1984).

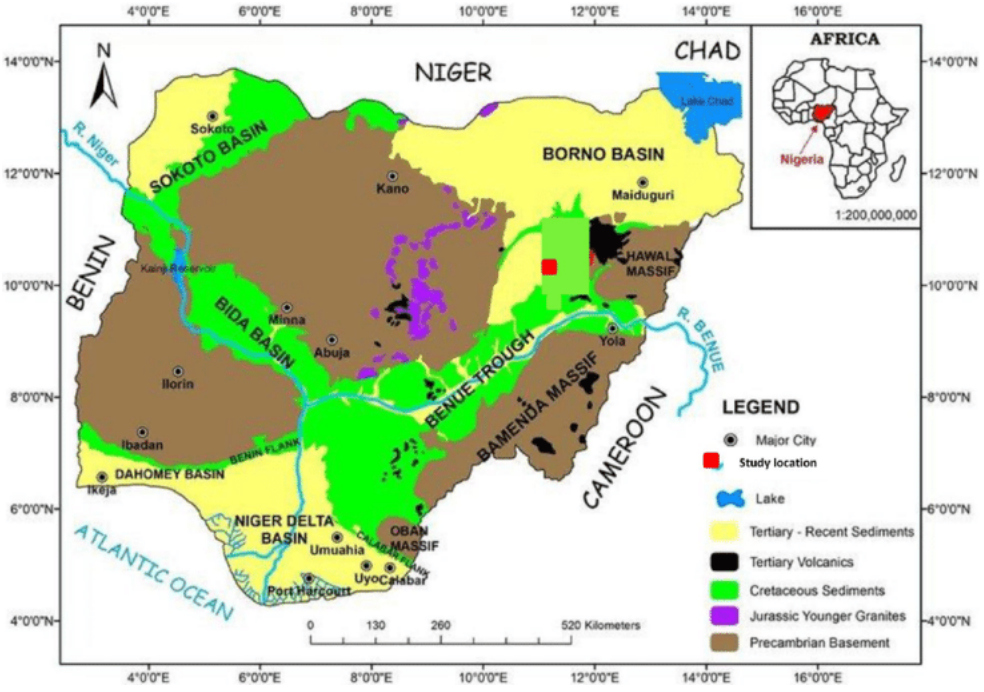

Fig. 1. Geological Map of Nigeria.
Source: Lar et al. (2018)

Although the country's groundwater resource is abundant and generally of good quality, the occurrence of groundwater in the basement complex regions of the country only accounts for 33% of the total amount of groundwater in the

country (Okeola and Salami, 2014). This is because groundwater occurrence in regions underlain by basement complex is determined by the porosity developed in geological formation as a result of various structural geological processes. Crystalline Basement Rocks do not make good aquifers because of their zero level of porosity and permeability (Azeez, 1972). According to JICA (2014), the total renewable groundwater resource potential of Nigeria derived from estimated annual groundwater recharge is around 1555.8 billion cubic meters per year. This recharge value is however variable across the country, controlled largely by climate (Tijani *et al*., 2016).

Groundwater is widely used in the country for domestic, agricultural and industrial purposes, with cities of Calabar and Port Harcourt totally dependent on its supply for their various activities. Tijani *et al*. (2016) identified a total of 77, 602 ground water access points in Nigeria, made up of boreholes with motorized pump (19,758), boreholes with hand pump (44,736) and shallow hand dug wells (13,108). While the quality of groundwater in Nigeria has been reported to be generally good (Okeola and Salami, 2014), there are reports of highly mineralized groundwater in Awe Formation Sedimentary aquifer in Benue Basin, sea water intrusion in Southern Coastal aquifers, local contamination by industrial chemicals in Lagos and metal contamination from mining activities in different parts of the country.

The Need for Environmental Education in Nigeria

The human ability to manipulate the environment is destroying the planet Earth and causing significant threat to human existence. Attempts to reduce the rate of this degradation process call for development of techniques that can be used in increasing the knowledge of the population, to provide a positive attitude and behavior towards the environment; this is what is referred to as environmental education. Environmental education aims at promoting among citizens the awareness and understanding of the environment, their relationship to it, and the concern and responsible action necessary to ensure man survival and to improve the quality of life (Okpala, 1977). According to Norris (2016), environmental education helps to enlighten individuals and give them greater insight into their own nature and the consequences of their actions. It helps people in finding novel ways of fostering positive attitudes and attributes to overcome environmentally destructive behaviours, thereby leading to the individual desire and willingness to take action for the environment (Thathong, 2012).

In its report to the congress on the need for environmental education, the National Environmental Education Advisory Council (2000) stated:

> "Our nation's future relies on well-educated to be wise stewards of the very environment that sustains us, our families and communities, and future generations. It is environmental education that can best help us as individuals to make the complex, conceptual connections between economic prosperity, benefit to the society, environmental health, and our own well-being. Ultimately, the collective wisdom of our citizens, gained through education, will be the most compelling and most successful strategy for environmental management."

The inadequate attention paid to environmental education in Nigeria, and indeed in most developing countries, is the reason why people cut trees indiscriminately, set bush on fire and ply road using vehicles that do not fully combust. According to Ogbeibu (2007), every person needs to be educated as no one can be expected to appreciate the value of sound environmental ethics or the tragedies of environmental abuse unless such a person is first equipped with the relevant working background knowledge of the entire concept of the man-environment relationship.

The Nigerian environment is full of numerous environmental challenges. Though some of these challenges can be linked to natural forces, many of the challenges are human induced (Jimoh and Ajibade, 1995; Iroye 2010). While Miller and Spolman (2011) identified population growth, wasteful and unsustainable use of resources, poverty and insufficient knowledge of the working of the environment as the major causes of environmental problems, Ofomata and Phil-Eze (2007), Jimoh and Ajibade (1995), Ajibade (1998) and Iroye (2010) linked the incidents of environmental degradation in Nigeria to poor application of the principles of environmental management.

Among the human activities degrading the Nigeria environment, one includes agricultural activities, especially the arable type, livestock rearing, lumbering, industrial production, poor liquid and solid waste generation and management, and the urbanization process. These activities have resulted in problems of soil erosion, sedimentation, deforestation and pollution of water, land and air in different parts of Nigeria.

A number of steps have however been taken over the years by the Nigerian government towards managing the environment. Some of such efforts according to Adelegan (2006) had even existed as bye-laws since the inception of the British rule in the country. The laws, regulations and policies on environmental issues in Nigeria include:

i. The Criminal Code Act of 1916 which prohibited water and air pollution;
ii. The Forest Ordinance of 1937 which led to the establishment of various forest reserves in the country;
iii. The Criminal Code of 1958 which ban burial in houses to control water pollution;
iv. The Public Health Act of 1958 which aims to control the spread of diseases through slaughtering of sick animals;
v. The introduction of environmental content in the Biology Syllabus by the West African Examination Council in the 1950s;
vi. The introduction of hygiene and nature study to be taught as environmental subjects in the 1960s;
vii. The 1974 promulgation of the Petroleum Refining Regulation Act to curb oil pollution, especially in the Niger Delta wetland;
viii. The establishment of the Nigerian Conservation Fund (NCF) in 1982;
ix. The promulgation of the Federal Environmental Protection Agency Act (FEPA Act) of 1988;
x. The promulgation of the Harmful Waste (Special Criminal Provision Act) Act in 1988;
xi. The Adoption of the National Conservation Education Strategy in 1989 as sponsored by UNESCO;
xii. The promulgation of the Environmental Impact Assessment Act (EIA Act) in 1992;
xiii. The Repeal and Replacement of FEPA Act in 2007 by the National Environmental Standard Regulation Agency (NESREA) Act.

In Nigeria today, NESREA has the responsibility for protecting the environment, conserving the biodiversity and ensuring sustainable development of Nigeria's natural resources. The Agency also coordinates and liaises with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines. The NESREA Act allows each state and local government in the country to set up its own agency for the protection and improvement of the environment. Each state agency is also empowered to make laws to protect the environment within its jurisdiction.

With specific reference to water resources in Nigeria, the laws, regulations and policies guiding both surface and groundwater resources are governed by the National Environmental Regulation of 2011 made under section 34 of National Environmental Standards and Regulation Enforcement Agencies Act of 2007. The act defines water pollution offences and prescribes

penalties for such offences. The regulations aim to protect water resources for various purposes, including clean water supply, agriculture and aquatic life. In the regulation, a permit is required:

i. for storage treatment and transportation of harmful toxic waste;
ii. where effluents with constituents beyond permissible limits are discharged into public drains, rivers, lakes, sea, or as an underground injection;
iii. when oil in any form is discharged into public drains, rivers, lakes sea, or as an underground injection;
iv. for an industry or a facility with a new point source of pollution or a new process line with a new point source. Such an industry or facility must apply to the agency for a discharge permit.

The violator of any of these laws is liable to pay a fine, compensation or damages to those affected, and restore or remediate the polluted environment. In addition, non-compliance with the provisions of the guidelines attracts imprisonment for a term up to two years for first offence.

There is also the Federal Water Quality Standard Regulation which is overseen by the National Environmental Standards and Regulations Enforcement Agency (NESREA). In this Act, the discharge of harmful quantities of any hazardous substance into territorial waters or at adjoining shorelines is prohibited except where such discharge is permitted by law. Violators of this law can incur a fine of ₦1 million for a corporate body with additional fines of ₦5,000 for every day the offence subsists or a prison sentence of up to five years. Other regulatory Acts on water pollution in Nigeria include:

i. The Nigerian Industrial Standards for Potable Water and Natural Mineral Water Act;
ii. The State Water Supply Edict/Laws;
iii. The Local Government Water and Sanitation Byelaws;
iv. The National Water Supply and Sanitation Policy;
v. The Federal Ministry of Water Resources Act;
vi. The National Water Resources Institute Act;
vii. The River Basin Development Authorities Act;
viii. The Navigable Waterways (Declaration) Act;
ix. The National Guidelines and Standards for Water Quality Act.

It is however disappointing to know that most of the environmental laws in Nigeria are not respected (Ijaiya and Joseph 2014) and they are also poorly implemented by government agencies (Otu, 2000; Ogidiolu and Balogun, 2000). The alarming rate of environmental degradation in the country is

probably borne out of the fact that the majority of the citizens do not really value nature. Most people do not understand the inter-dependence of nature, the interaction between the various species on the planet. A better understanding of the man-environment relationship when combined with behavioural change in matters concerning the environment will greatly improve the Nigeria environment.

Development and Techniques in Environmental Education

Environmental education is now considered a necessity globally due to the high rate of environmental degradation taking place in different parts of the world. Governments at various levels throughout the world have realized that continued growth on the planet Earth needs to be met with sustainable practices; hence the development and implementation of strategies towards educating the general public on matters concerning environmental issues.

The importance of environmental education was first brought to light in Stockholm at the United Nation's Conferences on Human Environment in 1972. At the conferences, participants highlighted the importance of education for both the public and specialists as a means of solving and preventing global environmental problems.

One of the recommendations proposed at the conferences was to establish an international programme on environmental education, hence the setting up of the International Environmental Education Programme (IEEP) in January 1975. In October 1975, an International Education Workshop was held at Belgrade where trends and issues in environmental education were observed. This workshop led to the establishment of the Belgrade Charter which has provided a frame of reference for global environmental education. The goal of environmental education as defined by the Belgrade Charter is:

> "… to develop a population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively towards finding solutions to current problems and the prevention of new ones".

To attain the above-stated goals, the workshop identified six objectives which were thereafter reduced to five in the Tbilisi Declaration in 1977. The objectives are:

i. Awareness: To help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
ii. Knowledge: To help social groups and individuals gain a variety of experience in, and acquire a basic understanding of the environment and its associated problems.
iii. Attitudes: To help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
iv. Skills: To help social groups and individuals acquire the skills for identifying and solving environmental problems,
v. Participation: To provide social groups and individuals with an opportunity to be actively involved at all levels in working towards the resolution of environmental problems.

The aforementioned objectives indicate that the ultimate goal of environmental education is to provide individuals with the opportunity to explore environmental issues, engage in problem solving and take action to improve the environment. This goal in UNEP and IEEP documents is to be achieved through formal, informal and non-formal education.

The propagation of environmental education which started in Nigeria as far back as the 1950s with the introduction of environmental contents into the curriculum at all levels of educational sectors has however had little or no impact in the country. A cursory look at the Nigerian environment shows high level of degradation in all areas of the environment. The introduction of environmental education into the nation's educational curriculum is yet to materialize into anything concrete (Anijah-Obi *et al*., 2013). Although Adedoyin (1988) linked the ineffectiveness of environmental education in the country to the integrated approach being adopted in its teaching, Norris (2016) noticed that the strategy conforms to the interdisciplinary approach emphasized by the Belgrade Charter.

The failure of environmental education in achieving effective result in Nigeria may not be unconnected with the exclusion of moral philosophy in the curriculum of instruction. It is the need of the hour to carry out environmental education with the essential element of moral philosophy. This is because the conventional educational methods are no longer adequate for the real needs of tomorrow (Govindaswamy, 2006). Although some of the efforts used in curbing environmental problems can be said to be effective in tackling some environmental challenges, new problems are daily emanating because the root cause of the problem is yet to be addressed. Thathong (2012) observed that most strategies used in addressing environmental challenges only focus on the

'end of the pipe' control and treatment rather than prevention; according to him, this is the reason why desired results have not been achieved. According to Norris (2016), the sources of environmental challenges lie in the knowledge, attitude and behavior of the people towards nature. Therefore, to tackle the problem, special attention of the authorities concerned should be directed at increasing the knowledge of the people on issues related to the environment. This action will no doubt create positive attitude and behavior towards those matters that concern the environment.

Attitude refers to a set of emotions, beliefs and behavior towards a particular thing, it is a settled way of thinking or feeling about something. Attitudes are often the result of experience or upbringing, and they can have powerful influence over behavior. Once an attitude is developed on a particular issue, changing behavior towards that matter becomes extremely difficult. Behavior change according to Thompson and Hoffman (2003) is difficult to achieve in the world today, because the acceptance of the gap between values and behavior has reached epidemic proportions.

The fact that attitude once developed is difficult to change, especially in adults, makes this research work to suggest to the authorities concerned, the need to focus more attention on environmental education with essential elements of moral philosophy at elementary levels. This in fact is the need of the hour, not only in Nigeria, but throughout the developing countries. This approach is expected to produce better result in the area of environmental education. According to Landrigan *et al.* (2002), children ingest greater quantities of toxins because they breathe twice as much air, consume three to four times as much food, and drink two to seven times as much water relative to their body weight than an adult; and because they are particularly more vulnerable to problems induced by unwholesome environment. Once children are equipped with the right training in the area of environmental education, they are likely to grow up acquiring more knowledge and skills on how to tackle environmental challenges in their different areas of specialization.

The teaching of environmental education at elementary level as being canvassed in this write up will not only promote the children's awareness of their environmental conditions, but will also aid in their age long active participation in solving local problems. According to Radeiski (2009), providing environmental education to children very early in life will equip them with basic skills which are prerequisite for future political influence in the environmental decision process. Teaching of environmental education at elementary level should however not be limited to just natural science; ethical and social aspects of environmental education should also be focused.

Conclusion

Raising awareness of the people through environmental education, particularly at elementary level on issues concerning groundwater pollution is of great importance. This is borne out of the fact that groundwater which is fast becoming a key resource that is supporting human well-being and economic development in different parts of the world is fast depreciating in quality. Attention is thus needed in different parts of the world to put a stop to this degradation process of groundwater. This is important because once an aquifer is polluted, it may remain polluted indefinitely even if the source of pollution is removed. Attempts to prevent this problem from happening thus call for environmental education of the people, especially at the elementary level. This is germane because once a good environmental attitude is cultivated in children, changing behavior negatively towards matters concerning the environment will become extremely difficult.

REFERENCES

1. Ada, P.D. and Abok, G. (2013), *Challenges of Urban Water Management in Nigeria: The Way Forward*, Journal of Environmental Science and Research Management, 3, 111-121.
2. Adedoyin, F.A. (1988), *Teacher Preparation in Population Education*, Nigerian Journal of Curriculum Studies, Special Edition, 3, 11-16.
3. Ajibade, L.T. (1998), *Deforestation and its Control in Kwara State. Priority for Action*, Urban and Regional Affairs, 2 (1) 14-17.
4. Anijah-Obi, F., Eneji, O.O., Ubom, B.A.E., Dunnamah, A.Y. and William, J.J. (2013), *Introducing Environmental Sanitation Education in the Primary Curriculum*, International Research Journals, 4 (3), 227-230.
5. Awofolu, O. (2006), *Elemental Contamination in Groundwater: A Study of Trace Metals from Residential Area in the Vicinity of an Industrial Area in Lagos, Nigeria*, The Enviromentalist, 26 (4), 265-293.
6. Ayoade, J.O. (1988), *Tropical Hydrology and Water Resources*, Agbo Areo Publishers, Ibadan.
7. Azeez, I.O. (1972), *Rural Water Supply in the Basement Complex of Western States, Nigeria*, IASH Bulletin, 17 (1), 97-110.
8. Federal Ministry of Water Resources FMWR (2013), *Innovative Funding of the Water Sector*. *Presidential Summit Address on Water*, Forward Journal of Environmental Science and Resource Management, 5 (1), 111-121.

9. Govindaswamy, V. (2006), *Importance of Environmental Education for Sustainable Development*, accessed at http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enes/newsletter on 6th September, 2019.
10. Griffith, J.F., Weisburg, S.B. and McGee, C.D. (2003), *Evaluation of Microbial Source Tracking Methods Using Mixed Fecal Sources in Aqueous Test Samples*, Journal of Water Health, 1, 141-151.
11. Herbert, C. and Doll, P. (2019), *Global Assessment of Current and Future Groundwater Stress with a Focus on Transboundary Aquifers*, Water Resources Research, 55, 4760-4784, accessed at https://doi.org/10.1029/2018WR023321 on 21st January, 2021.
12. Ijaiya, H. and Joseph, O.T. (2013), *Rethinking Environmental Law Enforcement in Nigeria*, Beijing Law Review, 5, 306-321.
13. Iroye, K.A. (2014), *Challenges of Water Resources Development and Management in Nigeria*, Ilorin Journal of Management Sciences, 1 (1), 197-207.
14. Iroye, K.A. (2010), *Deforestation and Sustainable Watershed Management*, Environmental Issues, 3 (1), 71-81.
15. JICA (2014), *The Project for Review and Update of Nigeria National Water Resources Masterplan*, Vol. 2, Japan International Cooperation Agency Publication.
16. Jimoh, H.I. and Ajibade, L.T. (1995), *Environmental Education on Soil Erosion Problems in Nigeria: An Overview*, Ilorin Journal of Education, 16, 39-45.
17. Landrigan, P.J., Schechter, C.B., Lipton, J.M., Fahs, M.C. and Schwartz, J. (2002), *Environmental Pollutant and Disease in American Children: Estimates of Morbidity, Mortality and Cost for Lead Poisoning. Asthma, Cancer and Developmental Disabilities*, Center for Children's Health and Environment Report, available at www.childrenenvironment.org.
18. Lar, U.A., Bata, T.P., Dibal, H.U., Daspan, R.I., Isah, L.C., Fube, A.A. and Bsasi, D.A. (2018), *Field Petrographic and Geochemical Study of Basement, Clastic and Carbonate Petroleum Reservoirs in the northern Benue Trough, Nigeria, Petrol. Technol. Dev.* J., 8 (2), 36-52.
19. Lee, S.H., Levy, D.A., Beach, M.J. and Calderon, R.L. (2002), *Surveillance for Waterborne Disease Outbreak in United States 1999-2000*, MMWR Report, 22, 1-17.
20. Miller, T.G. and Spoolman, S.E (2011), *Living in the Environment: Concepts, Connection and Solutions*, 16th Edition, Brooks / Cole, Belmont, CA.
21. National Environmental Education Advisory Council (2000), *Report to Congress on Status of Environmental Education in USA*.
22. Odigie, D. and Fajemirokun, B. (2005), *Water Justice in Nigeria: Crisis or Challenge*, Proceedings of the International Workshop on Water, Poverty and Social Crisis, Agadir, Morocco.
23. Ofomata, G.E.K. and Phil-Eze, P.O. (2007), *Introduction*, in Ofomata, G.E.K. and Phil-Eze, P.O. (eds), *Geographical Perspectives on Environmental Problems and Management in Nigeria*, Jamoe Publishers, Enugu.
24. Ogbeibu, T. (2007), *Environmental Education*, accessed at www.academia.edu/1190268/constraint on 7th Feb. 2019.

25. Ogidiolu, A. and Balogun, F.T. (2000), *Techniques of Environmental Monitoring and Management*, in Jimoh, H.I. and Ifabiyi, I.P. (eds), *Contemporary Issues in Environmental Studies*, Haytee Press and Publishing Co. Ltd.
26. Okeola, O.G. (2005), *Public-Private Partnership Initiative: A Model to Accomplish United Nation's MDGs*, Proceedings of National Engineering Conference, Kano, Nigeria.
27. Okeola, O.G. (2009), *Development and Application of Multicriteria Decision Support Models for Sustainable Operation of an Urban Water Supply System*, Unpublished Ph.D. Thesis, Department of Civil Engineering, University of Ilorin, Nigeria.
28. Okeola, O.G. and Salami, A.W. (2014), *Groundwater Resources in the Nigeria's Quest for United Nation's Millenium Development Goals and Beyond*, Journal of Sustainable Development in Africa, 16 (4), 57-71.
29. Okpala, M. (1997), *Environmental Education*, accessed at www.linkedin.com/pub/mariokpala/11/770b on 7th February 2019.
30. Omorinbola, E.O. (1984), *Groundwater Resources in the Tropical African Regolith*, Proceedings of the Harare Symposium on Challenges in Africa, Hydrology and Water Resources, IAHS Publication, 144, 15-23.
31. Otu, N.E. (2010), *An Evaluation of the National Environmental Standards and Regulations Enforcement Agency Act*, paper presented at the Abia State College of Postgraduate Studies, Faculty of Law, Nigeria.
32. Radeiski, J. (2009), *Implementation of Environmental Education in Elementary Schools: A Comparative Study between Sweden and Germany*, Unpublished M.Sc Dissertation, Blekinge Tekniska Hogskola, Karlskrona, Sweden.
33. Soladoye, O. (2012), *Assessment of Groundwater Quality Among Land-use Mix in Lagos State, Nigeria*, Unpublished Ph.D. Thesis, Dept. of Geog. And Env. Mgt., University of Ilorin, Nigeria.
34. Sule, B.F., Agunbiade, M., Adeogun, A.G. and Ihagh, G. (2016), *Small Town Water Supply: Situational Assessment of Shao, Kwara State, Nigeria*, Journal of Mechanical and Civil Engineering, 13 (4), 48-53.
35. Thathong, K. (2012), *A Spiritual Dimension and Environmental Education: Buddhism and Environmental Crisis*, Procedia - Social and Behavioral Sciences, 46, 5063-5068.
36. Thompson, B. and Hoffman, J. (2003), *Measuring the Success of Environmental Education Programmes*, Canadian Parks and Wilderness Society Report, http://macaw.pbworks.com/f/measuring_ee_outcomes.pdf.
37. Tijani, M.N., Crane, E., Upton, K., and O'Dochartaigh, B. (2016), *Groundwater Atlas: Hydrogeology of Nigeria*, British Geological Survey, accessed at http://earthwise.bags.ac.uk/index.php/hydrology on 22nd August, 2016.
38. Tindimugaya, C. (2005), *Groundwater Development and Protection and the Rural/ Urban Interface*, Seminar on Groundwater and Poverty Reduction in Africa, Hydrogeological Group, The Geological Society, Burlington House, Piccadilly, London.
39. UN (2018), *The Perfect Storm: Pathway to Managing India's Water Sector Sustainably*, Publication of UN Council of Energy, Environment and Water.

40. USEPA (2003), *Managing Arsenic Risks to the Environment: Characterization of Waste, Chemistry, Treatment and Disposal*, Proceedings of Workshop by National Risk Management Research Laboratory, Report No EPA/B25/R-03/010.
41. WHO (2000), *Water Supply and Sanitation Council. Global Water Supply and Sanitation Assessment Report*, New York, UNICEF.
42. Wiggan, C.A., Richards, D.J. and Powrie, W. (2013), *Numerical Modelling of Groundwater Flow around Contiguous Pile Retaining Walls*, Proceedings of the 18th Int. Conference on Soil Mechanics and Geotechnical Engineering, Paris, 2127-2130.
43. World Bank (2002), *Water Resources Sector Strategy: Strategic Directions for World Bank Engagement*, Draft accessed at http://inweb18.worldbank.org/ESSD/essdsxt.nsf/18DocByunid/ on 22nd July, 2004.