WATER POLUTION AND SUSTAINABLE DEVELOPMENT IN NIGERIA - A REVIEW

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Abstract

Water pollution has continued to impact adversely on health and sustainable development in developing countries of the World. Patronage of hospitals and other health care facilities in Nigeria is on the increase due to water-borne diseases arising from contamination of water sources. The review, which relied on secondary information, is an attempt to capture water pollution as it affects sustainable development in Nigeria. Public policy has not improved the situation in Nigeria. Interventions against water pollution remain majorly unco-ordinated and poorly monitored. It is recommended that mechanism be put in place to sensitise policy makers on the challenge of water pollution to health and sustainable development in Nigeria.

Introduction

Water is a colourless transparent liquid compound of hydrogen and oxygen. It has neither taste nor smell. It turns to steam when boiled

and to ice when frozen. Water is undoubtedly the most precious natural resource that exists on our planet and it is vital to all forms of life. It comprises over 70% of the earth's surface. Since water is needed by both plants and animals, there is need for it to be supplied at the least contaminated form. This will enable plants and animals to assess water naturally and to minimize the negative effects of water pollution.

Access to and usage of unpolluted water is very important for health, sanitation and sustainable development in every nation. Water pollution occurs when the quality of water in a body of water is adversely affected due to addition of large amount of contaminants to the water body. It has continued to impinge on the health of citizens and sustainable development in Nigeria. Massive pollution of the biosphere must be controlled in order to survive the crisis of environmental degradation and maintain the earth as a place for human habitation.

The awareness of water pollution by wastes is very low in Nigeria. Collecting groundwater through shallow wells, sometimes very close to excreta dump, is a common practice. Also, extensive use of water downstream of effluent discharge points is not uncommon. The pollution of natural and artificial waters by waste matters resulting from human activities constitute one of the most important, difficult and complex problems confronting public health authorities in Nigeria. Pollution-linked illnesses result in loss of productivity, and excess levels of mortality imply substantial welfare loss as well.

Nigeria has tremendous pressure for the improvement of various aspects of living, and sustainable development is always on the highest priority of any government. The large increase in

industries has brought about huge increase in the quantity of discharge and a wide diversity of types of pollutants reaching water bodies. Increased industrial activity has also led to migration of people from the rural to the urban centres. Population explosion has resulted in huge generation and discharge of municipal waste. The combined discharge of industrial and municipal waste in highly populated concentration points has undesirable effects on human and other life forms.

Water pollution has caused loss of sources of livelihood to some individuals. Health hazards emanating from the use of polluted water has equally caused more harm to most people in Nigeria. It has affected governments, locally and internationally. This review relies on secondary information to capture water pollution as it affects sustainable development in Nigeria.

The study will enable the concerned groups know how to tackle these problems in order to have less contaminated aquatic environment. The study will enable the policy makers and implementation agencies, project proponents, environmental authorities and other stakeholders to fully appreciate water pollution and the negative effects it has on sustainable development and give it due weight.

Water quality, health and sustainable development in Nigeria

A number of studies (World Bank, 1993; Brockehoff, 1995; Hoddinott, 1997) have examined water quality, water pollution and the impact of water pollution on health status of household members and sustainable development. Most of the studies hypothesized that

an improvement in water quality has a direct effect on people's health via reduced exposure to water-associated diseases.

Water quality is the physical, chemical and biological characteristics of water (Ajayi and Oshibanjo, 1981). It is most frequently used by reference to set a set of standards against which compliance can be checked. The most common standard used to assess water quality relate to drinking water, safety of human contact and for the healthy ecosystems (Nwafor, 2006).

Water quality is a complex subject because water is a complex medium intrinsically tied to the ecology of the earth. Different parameters for water quality are determined by the intended use. There are guidelines for drinking water quality which are the international reference point for standard setting and drinking water safety set by the World Health Organization (WHO). The guideline was set up in 1993 and revised in 2006. Nigeria also has her standard for drinking water quality.

Environmental pollution can be categorized into three groups. These are air or atmospheric pollution, aquatic or water pollution and land or surface area pollution. The World Health Organization (WHO, 1990) submits that air pollution is "limited to situation in which the outer ambient atmosphere contains materials in concentrations which are harmful to man and his environment".

Water pollution can be defined in many ways. Usually, it means one or more substances have built up in water to such an extent that they cause problems for animals or people. Water pollution occurs when a body of water is adversely affected due to the addition of large amount of materials to the water. When it is unfit for its intended use, water is considered polluted. When chemical, pathogens or contaminants are detected, water could be

said to be polluted. Water pollution is all about quantities, how much of a polluting substance is released and how big a volume of water it is released into. A small quantity of a toxic chemical may have little or no impact if it is spilled into the ocean from a ship. Hence, the same amount of the same chemical can have a bigger impact if it is pumped into a lake or river, where there is less clean water to disperse it.

There are two different ways in which pollution can occur. They are point source and non-point source pollutions. Point source pollution occurs when harmful substances are emitted or discharged directly into a body of water. If pollution comes from a single location, such as discharged pipe attached to a factory, it is point source pollution. Other examples of point source pollution include an oil spill from a tanker or someone pouring oil from car down the drain.

The World Commission on Environment and Development (Brundtland Commission) defined sustainable development as meeting the needs of current generations without compromising the ability of the future generations to meet theirs (UN, 1987). The debates of the Millennium Summit upheld this definition (UNDP, 2001). Hughes and Johnston (2005) recognize that sustainable development is now as much about efficient resources for present generation as for future ones.

Sustainable development is a mainstream recognition of relationship between development and environment. This is interested in meeting the economic, political, cultural social and other health needs of generations of today without compromising the ability of the future generations to meet their own needs (Eneh & Owo, 2008).

Sustainable development stands on three pillars in terms of its definition for the 2002 World Summit on Sustainable Development (WSSD). These are social development, economic development and environmental protection. In 1972, the first World United Nations Conference on Human Environment took place in Stockholm, Sweden, consequent upon the recognition of environmental problems as global issues.

MDG 7 seeks to ensure environmental sustainability; implement national strategies for sustainable development by 2005 so as to reverse the loss of environmental resources by 2015; halve by 2015 the proportion of people without sustainable access to safe drinking water; and achieve by 2020 a significant improvement in the lives of at least 100 million slum dwellers (Eneh, 2009).

Hence, water pollution is not in favour of sustainable environment for the future generation. Water pollution have continued to generate unpleasant implications for health and economic development in Nigeria and the Third World in general, the consequences of which include 4.6 million deaths from diarrhoeal disease and a sizeable number of casualties from ascariasis (Esrey et al., 1991). In the West African sub-region (with significant contribution from Western Nigeria), there are estimated 4 million cases of guinea worm, while about 500 million cases of trachoma leads to blindness of about 8 million people each year (Hoddinott, 1997). However, despite the public and international agencies' policy focus on this problem, the situation in Nigeria seems degenerating and, therefore, demands increased attention.

Patronage of hospitals and other health care facilities in Nigeria is on the increase because of water-borne diseases. The rapidly increasing populations coupled with the deteriorating

environment are some of the factors responsible for this trend (Sangodoyin, 1995). Hospital records have confirmed high incidence of typhoid, cholera, dysentery, infectious hepatitis and guinea worm in urban settlements of Nigeria.

Amongst all the costs of urban environmental degradation, damage to human health is by far the highest. There is a direct link between urban environmental degradation and public health in terms of water-related diseases, such as diarrhoea, dysentery, cholera and typhoid. The rapid growth of urban centres in Nigeria, coupled with the development of unstructured infrastructural and social services have created an environmental situation in many parts of the country, which is becoming inimical to healthy living.

Studies have shown that zoonotic diseases (diseases of animals transmitted to humans) are yet to be eliminated or fully controlled in above 80 percent of the public abattoirs in Nigeria (Olugasa et al., 2000). Thus, they pose serious environmental health risk. Some of the infectious diseases are tuberculosis, colibacillosis, samonellosis, brucellosis and helminthoses. These are common examples of zoonoses prevalent in slaughters cattle population in Nigeria. Kajogbola (1998) revealed the prominence of malaria, dysentery, chicken pox, measles and pneumonia as the greatest causes of morbidity within the Ibadan region in Nigeria. The study also revealed that the leading killer diseases in the region are solid waste management related and are precipitated by ignorance, poverty and low standard of living.

The concern for increases in the level pollutants in surface and underground water is justified, since a large proportion of rural, and recently urban, dwellers in Nigeria obtain domestic water, and sometimes drinking water from ponds, streams and shallow wells

(Sangodoyin, 1990). The use of dump as a mode of waste disposal, is seen as a means of reclaiming natural gullies and excavations in Nigeria. More so, leachates from such waste dumps may contain organic and inorganic toxic pollutants which may flow laterally or percolate through permeable soil strata and pollute surface or ground water (Benka-Coker and Bafor, 1999). These leachates may contain high concentration of sulphates and other chemicals harmful to both aquatic plants and animals.

In their study of the pollution potential of the Teboga waste tip in Benin City, Nigeria on the physical and chemical characteristics of the adjacent Ikpoba River, Benka-Coker and Bafor (1999) suggested that the leachates have the potential to pollute both surface and underground waters, as could be inferred from the generally acidic nature of the waters of the Ikpoba river, when compared to the values for previous years.

However, Sangodoyin (1989) examined the quality levels of both river water and adjacent dug wells along the Ogunpa stream in Ibadan, Nigeria and infers that the quality of the water, as determined by several quality parameters, fall far below established standards (FEPA, 1991).

Interests shown in the contamination of groundwater by pollutants are not much. This may not be unconnected with the slow movement of groundwater, as well as the slow degradation of many pollutants, the latter sometimes remain for years (Cohen et al., 1984).

Types of water pollution

The most obvious type of water pollution affects surface water (oceans, lakes, rivers and streams). For example, a spill from an oil

tanker creates an oil slick that affects a vast area of ocean. Water stored underground in aquifers is known as groundwater. Aquifers feed rivers and supply much of drinking water. They too can be polluted, for instance, when weed killers used in the gardens drain into the ground. Groundwater pollution is much less obvious than surface water pollution, but is no less of a problem. Both surface and groundwater are the two types of water resources that are affected by pollution.

A non-point source delivers pollution indirectly through environmental changes. A great deal of water pollution happens from many different scattered sources which are non-point sources. This could happen if chemicals from farms are carried into the stream by rain in the form of run-off, which in turn affects aquatic life. The pollution from non-point sources accounts for a major source of the contaminants in streams and lakes. Most of the times, pollution that enters the environment in one place has an effect hundreds or even thousands of miles away. This is known as trans-boundary pollution (DANIDA, 2000).

Pollution control is all about having a cleaner environment. Sometimes, this involves costly measures and controversial political decisions. As a result, developing countries, poor communities and financially constrained enterprises have often argued that the environment is an expensive luxury that diverts resources from more productive uses. This perspective is giving way to a new paradigm stating that neglecting the environment can impose high economic and even financial and health challenges on the people. Excessive water pollution levels damage not only economic assets but human health as well.

Causes of water pollution

The causes of water pollution are endless. Water pollution has many different causes and most of the water pollution does not begin in the water itself. Take the oceans for instance, about 80% of the ocean pollution enters the seas from the lands.

Some of the causes include:

i. ***Industrial discharge of chemical wastes and by-products***

Dumping and discharging of industrial wastes containing heavy metals, harmful chemicals, by-products, organic toxins and oils into any source of water is one of the visible causes of water pollution. Chemical wastes in water bodies include dissolved metals and their salts, acids and bases, organic and inorganic compounds, solvents, solutions and others. Some industrial effluents contain dyes and colourants, fluorine, heavy metals, waste water and other chemicals that may be toxic to human and aquatic lives. These pollutants are discharged either directly or indirectly to the water sources. Attimes, they are leached through the deposited sites into ground water system.

Crankcase oils discharged by mechanical workshops, industries, power stations and commercial houses estimated at about 20 million gallons per year are discharged carelessly into drains and surface waters, thereby contaminating surface and underground waters.

ii. ***Nutrients***

Sewage and fertilizer contain nutrients, such as nitrates and phosphates. Sewage can be a fertilizer, if suitably treated and used in moderate quantities, by returning important nutrients

to the environment which plants and animals need for growth. The trouble is that sewage is often released in greater quantity than the natural environment can cope with (Adelegan, 2004). Some of the nutrients drain into the water bodies. The fertilizers used in the farms add nutrients to the soil which drains into rivers and seas adding to the fertility effect of the sewage (Benka-Coker, and Ojior, 1995). All these give rise to increase in the growth of algae that overwhelms huge areas of oceans, lakes or rivers. This is referred to as harmful alga boom (or red tide because it can turn the water red) (Gruber and Galloway, 2008). This harmful effect removes oxygen from the water and kills other forms of life leading to what is known as dead zone.

iii.   *Solid Waste*
Most people, who are not conscious of the environment, dump solid waste, especially household waste, into rivers, streams and flood without a thought about where they eventually end up. These wastes are subsequently transported from one place to the other downstream, contaminating larger water bodies. The solid waste could include textiles, plastics, wood, rubber, paper, debris, metal scraps, clothes, and many other household wastes.

iv.   *Oil Spill*
Globally, over 70% of oil pollution at sea comes from routine shipping and from the oil people pour down the drains on land. About 12% of the oil comes from tanker accident (World Bank, 1994). This is destructive because it delivers large quantity of oil at once into a localized area of the water. In Nigeria, oil spills occur due to a number of reasons,

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including corrosion of pipelines and tankers (about 50%), sabotage (28%), oil production operations (21%), with 1% of the spills being accounted for by inadequate or non-functional production equipment (Oghogho and Adejeko, 2007). The largest contributor to the oil spill total corrosion of pipes and tankers is the rupturing or leaking of production infrastructures that are described as "very old" and lack regular maintenance.

The pipelines with life span of about 15 years are old and susceptible to corrosion (World Bank, 1998). Many of the pipelines are as old as twenty five years. Sabotage through what we know as "bunkering" in which the saboteurs attempt to tap the pipeline, in the process of extraction, most of the times damage the pipeline. This has become a major issue in Niger Delta region of Nigeria, and contributes further to the environmental degradation.

v.   *Increase in Temperature*
Rise in water temperature can result in the death of many aquatic organisms and disrupt many aquatic habitats. This is caused by heated water discharged by factories and power plants. By raising the temperature, it reduces the amount of oxygen dissolved in the water. Global warming, which is a process whereby the average global temperature increases due to the greenhouse effect, equally causes a rise in the earth's water temperature.

vi.   *Other causes of water pollution* include the waste from construction firms, such as cement, lubricants, plastics, and metals.

Effects of water pollution

The effects of water pollution are far-reaching and affect not only the environment, but human beings and animals as well. Some effects show up immediately, while others take some months or years to manifest. It affects the food chain. When toxins are in water, they migrate from the water to animals through drinking and to man through meat and fish consumed. Acid rain contains sulphate particles, which can harm fish or plant life in lakes and rivers. Pollutants in water alter the overall chemistry of the water, causing changes in acidity, temperature and conductivity. These changes have adverse effect on the marine life and are not favourable for sustainable development in Nigeria.

The effect of uncontrolled disposal system renders surface water and underground water system unsafe for human, agricultural and recreational use, destroys biotic life, poisons the natural ecosystems, poses a threat to human life and is, therefore, against the principles of sustainable development. Since the drive for increased control of the environment gathers momentum, the financial expenditures for pollution control also increases (Bulama, 2005). This becomes necessary to prevent deterioration in the quality of life arising from rapid economic development.

Nigeria, like other developing countries suffer from a number of primary environmental problems mainly attributable to under-development and attendant poor living conditions. Also, numerous industries are fast springing up in different parts of the country. Consequently, failure to begin waging an early war against environmental degradation today is likely to affect output adversely and increase costs in the future. However, if the adverse effects of river pollution and spread of water-borne diseases are to be

mitigated in Nigeria, it would appear that current planning laws and waste disposal practices should be reassessed (Sangodoyin, 1989).

Diseases can spread through polluted water. Infectious diseases such as typhoid and cholera can be contracted from drinking contaminated water (microbial water pollution). The human heart and kidney can be adversely affected if polluted water is consumed regularly. Other health problems associated with polluted water are poor blood circulation, skin lesions, vomiting, and damage to nervous and skeletal system and so on. In fact, effects of water pollution are said to be the leading cause of death for humans across the globe.

Marine food sources are eliminated or contaminated by the water pollutants. If oil spill occurs, the oil can wash up on nearby beaches devastating the ecosystem and affecting tourism severely. The oil clings to the gills of fish and prevents oxygen extraction from the water by the fishes, leading to oxygen starvation and consequent death.

Oil spill, especially in the Niger Delta region of Nigeria, dispossesses fishermen of their sources of livelihood, thereby encouraging militancy and unrest. Many of the pollutants are carcinogenic. Some of these can affect generations to come by changing the body's chromosomal makeup.

Heavy metals washed into the water causes serious injury to the aquatic lives. This means that entire animal communities can be badly affected by this type of pollutants. It however, disrupts the community structure of an aquatic environment. Microbial pollutants from sewage often results in infectious diseases that infect aquatic life and terrestrial life through drinking water

(Akpata, and Ekundayo, 1978). This often increases the number of mortalities seen within an environment.

Organic matter and nutrients causes an increase in aerobic algae and depletes oxygen from water column. This is called eutrophication and causes the suffocation of fish and other aquatic organisms. Suspended particles can often reduce the amount of sunlight penetrating the water, thereby disrupting the growth of photosynthetic plants and micro-organisms. This has subsequent effects on the rest of the aquatic community that depend on these organisms to survive. This also adversely affects biodiversity.

Sulphate particles from acid rain changes the pH of water, making it more acidic. This damages the health of marine life in the rivers and lakes it contaminates, and often increases the number of mortalities within an environment.

According to Eneh (2011a), nitrate in water is particularly dangerous to babies and children. In proportion to their body weights, babies and children consume much more water than adults. The digestive system of an under-6-month infant secretes lower amounts of gastric acid, leading to low acid concentration or higher pH level and attendant proliferation of acid-inhibited bacteria, which transform nitrate to nitrite. Thus, when water with excessive nitrate concentration is used for preparing baby food or as baby drinking water, the baby's immature digestive system, with its lower concentration of gastric acid and the attendant higher concentration of bacteria, facilitates the reduction of the nitrate to nitrite. The nitrite ions (NO_2^-) react with haemoglobin and oxy-haemoglobin to form methaemoglobin, which cannot carry oxygen, and thereby, making oxygen transfer difficult.

$$\text{Haemoglobin} + NO_2^- = \text{Methaemoglobin}$$
$$\text{Oxy-Haemoglobin} + NO_2^- = \text{Methaemoglobin}$$
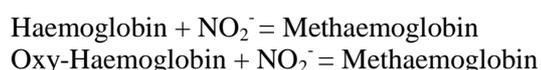
This leads to asphyxia (difficulty in breathing), which may result to death. This blood disorder is called methaemoglobinemia (blue baby syndrome). It occurs mostly in babies, pregnant women and people with weak immune system.

Pollution loads by domestic and industrial effluents in Nigeria

Several researchers (Aka, et al., 2009; Atubi, 2009; Ugwu, 2010; Eneh, 2011 b, c) report that water pollution remains a major problem in the Nigerian environment. Both urbanization and industrialization have contributed to the scale of pollution. Presently, there are no incentives for the adoption of pollution abatement measures and very few disincentives, if any, for polluting the environment. Wastes are disposed of indiscriminately, especially for small and medium scale industries, but excluding major establishments like the refinery industry, which is encouraged to adopt adequate waste disposal and good refining practices under the Petroleum Refining Regulation Act of 1974.

The discharge of wastewater into surface water and the resultant changes in its ecology have been reported by several researchers (Law, 1980; Okoronkwo & Odeyemi, 1985; Odokuma and Okpokwasili, 1993), who also express concern over human health and the possible accumulation of human enteric pathogenic microorganisms by aquatic organisms. Incidences of water-borne diseases in rural areas of developing countries leading to millions of deaths have been reported (UNU, 1983). Some of these deaths have

been traced to the use of waters grossly polluted by untreated waste (UNEP, 1991).   Researches show that coliforms and *E. coli* in particular increased in streams and lagoons where faecal matters were released (Apkata and Ekundayo, 1978; Egborge and Benka-Coker, 1986).   The discharge of wastewater from bathroom, laundry, slaughterhouses, among others, have been used to explain the deterioration of most tropical rivers as they pass through inhabited places (Oluwande *et al*, 1983).   This condition, pollution load and effluent effects on water sources in Nigeria have impacted negatively on the health of the people.

Table 1.1 shows the morbidity patterns.

Table 1.1: *General morbidity pattern in Nigeria*

S.No.	Morbidity rank	Percentage
1.	Infectious and parasitic diseases	38.2
2.	Respiratory disease	12.7
3.	Diseases of nervous systems and organs	9.9
4.	Ill-defined conditions	9.2
5.	Skin diseases	8.4
6.	Digestive system	4.7
7.	Accidents	3.1
8.	Muscle and skeletal diseases	2.9
9.	Genito-urinary diseases	2.9
10.	Blood diseases – anaemia	2.5
11.	Nutritional and metabolic diseases	1.8
12.	Others	3.7
	Total	100

Source: Federal Ministry of Health (FMH, 1986)

Infectious and parasitic diseases constitute 38.2% of water-related diseases.   Respiratory disease accounts for 12.7%.   Diseases of nervous systems and organs are responsible for 9.9%.   Ill-defined

conditions account for 9.2%. Skin diseases were 8.4%. Diggestive system diseases were 4.7%. Accidents accounted for 3.1%. Muscle and skeletal diseases were 2.9%. Genito-urinary diseases acounted for 2.9%. Blood diseases (anaemia) were 2.5%. Nutritional and metabolic diseases were responsible for 1.8%. Others constitute 3.7%. These point to the fact that the MDG disease reduction target by 2015 is still a far cry with water pollution.

Environmental Regulation in Nigeria and the Challenges of Sustainable Development

Sustainable development poses important question as to how economic growth is conceived and managed through incentives and regulation.   The examination of environmental regulation and sustainable development principles in Nigeria shows that the nation needs to integrate the principles of sustainable development into the country policies and programmes in order to reverse the loss of environmental resources. In spite of the fact that the country has embraced the concepts of sustainable development, Nigeria is far from pursing the goals and objectives (Adelegan, 2004).

The evidences and impediments are as follows:

- There is the absence of appropriate national guidelines and standards on environmental pollution and natural resources conservation, although some progress was made in this direction by FEPA. This implies that pollution problems and the damage to the environment cannot be adequately monitored and enforced especially in the industrial sector.
- There is the general absence of effective resource pricing instruments for resource conservation and nature protection.

The major implication is that resources are still being wantonly exploited by individuals, groups, communities and corporate bodies without any concern for environmental damage.

- Techniques and appropriate instruments for environmental costing, especially one that takes into consideration, damage to the value of natural ecosystems is yet to be fully developed in Nigeria. It will be difficult to speak of attaining both a balance and compatibility between resource conservation and economic growth.

- Absence of economic incentives and disincentives for natural resources conservation and environmental management abound.

- Absence of a system of national resources accounting and auditing, especially one that takes reversible and irreversible damage to the environment into account.

Recommendations

There is equally the need to create an environmental monitoring network with an environmental data bank. There is need to improve on the current conservative policy option with regard to public education.   The abject level of environmental deterioration noticeable in Nigeria gives a strong impression that the current level of knowledge of the public regarding public health matters is very low.

There is also the need for supported active research into waste minimization strategies, waste avoidance technologies, cleaner production processes and zero emission concepts in Nigeria.

Wastes that are pushed into waters could be turned to wealth with some research on recycling.

Water pollution is not easy to solve. It is necessary that all hands must be on deck to fight it. This means that both government and citizen's co-operation are needed to reduce water pollution to the barest minimum. Since water contamination comes from many different sources and has many numerous effects, every aspect of water pollution needs to be addressed.

Strategies for tackling the problems include:

Education

Public awareness of this problem is the first step to solving this problem. Massive public education can make a positive difference. Farmers should be enlightened to understand that the use of pesticides and other chemicals around or near streams, rivers, lakes and even small springs can have an effect on the ecology of the water ways. The consumers should be educated on the causes and types of water contamination, the symptoms of water-borne diseases and home methods of preventing and controlling drinking water hazards. Some toxic chemicals can be avoided by taking some precautions.

Laws and regulations

The major problem with water pollution is its trans-boundary nature. Many rivers cross countries, while seas span whole continent. Pollutants discharged by factories in one country with poor environmental standards can cause problems in neighbouring nations, even when they have tougher laws and higher standards. Environmental laws can make it tougher for people to pollute, but to

really be effective. They have to operate across national and international borders. Hence, there are international laws governing the oceans, such as 1982 UN Convention on the Law of the Sea (signed by over 120 nations), the 1972 London Dumping Convention and other laws. Most countries also have their own water pollution laws. Problems lie strictly on implementation, not in the making of laws, especially in Nigeria.

Polluter pays principle
Some environmental experts agree that the best option to solving the water pollution is by what is known as polluter pays principle. This means that whosoever causes pollution should have to pay to clean it up in one way or the other. It could mean that tankers owners should have to take on insurance that covers the cost of oil spill clean ups. Also, it could mean that the factories that use rivers must have their water inlet pipes downstream of their effluent outflow pipes, such that if they cause pollution, they will be the first to suffer it. The polluter pays principle is designed to deter people from polluting by making it less expensive for them to behave in an environmentally responsible way.

Denitrification
This is an ecological approach that can be employed to prevent the leaching of nitrates in soil. Fertilizers contain nitrogen and bacteria in the soil convert it to nitrates making it easier for plants to absorb. During low oxygen levels, another form of bacteria then turns the nitrites into gases, such as nitrogen, nitrogen dioxide and nitrous oxide. The conversion of these nitrates into gas is referred to as

denitrification.   This stops any ground water from being contaminated with nutrients, which lead to algal boom.

With these recommendations, our government and more environmentally responsible corporate industries can lower the water pollution that also affects food supplies, since they have the resources to prevent or remove these contaminants. It is worth noting that water pollution cannot be entirely stopped as long as there are industries, but can be reduced to a minimum level with less threat to aquatic lives and human health.   This will lead to sustainable development in Nigeria.

Conclusion
The problems associated with water pollution have the capabilities to disrupt life on earth to a great extent. It is ultimately for all to be informed, responsible and involved when it comes to problems we face with water in order to achieve sustainable development. We must learn about methods of disposing harmful household wastes so that they do not end up in our water ways. Farmers should use alternatives to chemicals to prevent washing chemicals into the water.   Working together, we can reduce water pollution both locally and internationally.

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