CONTROL METHODS AND MANAGEMENT OF WATER POLLUTION IN NIGERIA*

Abstract
Water is used for industrial and municipal purposes. The largest water requirement is for municipal use but the standard of purity required for this purpose is quite different from that demanded for industrial and commercial use. In industrial more than half, the water is used in chemical plants for the purpose of cooling. A large volume of water is also used for the purpose of dilution and making solutions. While for the first purpose the composition of cooling water is of no importance, in the second, the water used should be reasonably pure. Water can be used for direct and indirect purpose. The bulk of the world's water use is for agriculture, industry and electricity. The availability of water, both in quantity and quantity, is one of the prime factors in deciding the growth of towns and cities as well as industries. Therefore, there is need for water resources management and control to avoid pollution, which is the process of planning, developing and managing water resources, in terms of both water quantity and quality across all water uses. It includes institutions, infrastructures, incentives and information systems that support and guide water management and control. This article considered sources of water pollution, types and water pollution, effects of water pollution and various control methods and management of water pollution in Nigeria, amongst others and made necessary recommendations in controlling water pollution in Nigeria.

Keywords: Water, Pollution, Control Method and Management, Nigeria

1. Introduction

It is well known to all that water is the source of life. This therefore means that it must be pure and of good quality. Unfortunately, however, most developing nations discharge their untreated effluent into drainages, water courses or the stream, lake or river, thereby causing marine pollution. Even some industries discharge hot effluent, which though devoid of toxic substances, are dangerous to aquatic and marine life. But for a few cases, signs of water pollution arising from these unwholesome disposal methods are not difficult to identify. The receiving waterways do not possess adequate assimilative capacity for the effluents, therefore coloured rivers or streams can be seen in some parts of Lagos, Aba, Kano, Ibadan, Onitsha, Kaduna and most urban cities. Some of these polluted water courses emit obnoxious fumes. Some contain oil-like and real floating oil from sources of discharge.[1] Funny enough, since in many instances, especially in the rural areas, there is no dependable alternative source of water supply, the people within the vicinity would still depend on it for their drinking and household water usage. The effect of this ugly situation in human health became more prominent at the wake of industrialization in the 21st century. This led to the outbreaks of fever, cholera, dysentery and other diseases in Nigeria due to water pollution from industries and even human and animal excreter. This led to a lot of ugly environmental disasters.[2] With the increasing number of industries and neglect by these industries to install waste treatment facilities, Nigeria may be heading for such unpleasant disasters.[3]

2. Conceptual Clarification

Water Quality Monitoring: There are two basic kinds of water monitoring, which are chemical analysis and biological assessment.[4] Normally, surface water quality is monitored by both ways. However, the ground water is monitored principally by chemical ways except few bacteriological tests. The primary objective of monitoring is to assess the quality of the water and also to assess the chemical or biological contaminations that are harmful for mankind.[5] In addition to conventional water quality monitoring, there are various biological systems of water quality monitoring[6] these systems are also very sensitive and useful. The biotic resources of water bodies are diverse; these include a variety of macrophysics, phytoplankton's, zooplanktons, bacterial and other animal communities.[7] Among this biota, many forms are sensitive to pollutants of water or rather sensitive towards change in water quality. However, there are couple of forms which appears to be tolerant and acting as bio indicator species.[8]

Water Quality Demand: Quality of water demand depends on the type of source, such as rainwater, surface water, ground water, types of terrains and habitats, dissolved substances, chemical, biological and other environmental factors that transported into it.[9] All these varied but inter-dependent parameters have to be taken into account in water quality monitoring methods. Water quality is established from the physical, chemical and biological parameters.[10] Various sources and processes pollute water bodies. While natural and surface waters generally contain low concentration of metals, trace elements from precipitation and leaching, groundwater can be contaminated by pollutants from surrounding land mass.[11] Water quality can be judged from physical, chemical, biological and aesthetic points of

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[1] Report contained in the paper presented by Evans Ania, the Director Generla, Federal Environmental Protection Agency contained in FEPA monograph 2.
[2] As reported in WHO International Standards for Drinking Water-Geneva 2013.
[3] New Nigeria Newspaper June 4 2014.
[4] *Ibid*, p.243.
[5] *Ibid*.
[6] *Ibid*.
[7] *Ibid*, p.308.
[8] *Ibid*.
[9] *Ibid*.
[10] Odor in water is a general sign of pollution by decaying organic matter.
[11] Turbidity is a measure of the attenuation of a beam of light as it passes through a medium. High turbidity in aquatic environments reduces penetration of light into the water and consequently reduces photosynthesis by plankton, algae and vegetation.

view. Physical parameters for water quality are odor,[12] turbidity,[13] particulate matter,[14] temperature,[15] and color.[16] Of these, the important parameters in evacuating water quality index are turbidity, dissolved oxygen and organic matter. The concept of water quality is capable of a number of different interpretations, which must be disquieted.[17] Most uses of the term 'water quality' intend this to refer to the contamination status, physical modification, catchment land use, biological and geomorphologic nature, and conservation value of water. However, it is also commonly used in a broader sense to encompass landscape, recreational, economic and cultural attributes.[18]

3. Water Pollution

Water pollution is defined as 'the addition of any substance to water or changing of water's physical and chemical characteristics in any way which interferes with its use for legitimate purpose'.[19] Water pollution is one thing that has become common in contemporary industrial world. According to the celebrated case of *Shell Petroleum Development Company v. Otoko & Ors*,[20] any undesirable change in the characteristics of water amounts to water pollution. It is thus, the poor quality of water, which adversely affects the user of water for agricultural, domestic, industrial and other uses.[21] The availability of water supply adequate in term of both quality and quantity is essential to human existence. Pure water does not exist in nature. Rainwater collects impurities from air.[22] Streams and rivers collect impurities from surface runoff and through the waste discharge on these sources[23] Similar is the case with ground water. While water quality in old days was judged through the physical senses of sight, taste and smell, now with development of biological, chemical and medical science. Water quality can be measured and its effects on human health and wellbeing can be determined. Water intended for drinking purpose should be free from chemical concentrations and other micro-organisms which are hazardous to human health because presence of micro-organism, decaying vegetation and other organic matter impart odour and tastes to water.[24]

An initial issue in relation to water quality is as to what water quality is given the contrast previously drawn between cause and effect, that is, between substance that is introduced and its impact upon the aquatic environment. Another important distinction which needs to be stressed is that between categorization of waters according to their potential uses and the determination of minimum physical, chemical and biological parameters which enable water to be used for a particular use.[25] Significant differences exist between the exercise, first, of allocating particular waters to potential use categories and, second, the scientific determination of qualitative requirements for such categories. The contrast between these exercises is not always aided by the terminology in which quality issues are discusses by different commentators.[26]

4. Sources of Water Pollution

These problem areas have already been pointed out, yet it is pertinent to streamline the major contributors to water pollution, which include the following:

Sewage Wastes: The most ravaging in domestic water pollution are those incidental to the use of water in diluting the carrying-off of sewage in the villages. This sewage pollution in rural areas poses serious danger and is the major cause of diseases.[27]

Industrial Wastes: This is also a major harbinger of pollution of water courses and rivers. The ugly leftovers of industrialization are resultant discharge of toxic industrial effects in water channels especially in urban neighborhoods.

Chemical Effluents: The chemical industry is a major contributor to the poor state of our environment. For example, household detergents and insecticides, which ultimately find their way into the streams by the process of surface run-off and rill erosion. According to investigation reports, in 2014 noxious chemical wastes, dyes and other trade effluents grossly polluted eight wells examined to the extent that they were rendered unusable in Lagos Nigeria.[28]

Agricultural Sector Source: Nigerian farmers use gamalin 20 for spraying of cocoa and other cash crop trees, which finally drain to the streams. Also, the Federal Government agricultural policies like operation feed-the-nation,[29] Green-Revolution[30] and Food-for-All by the year 2000[31] became opportunities for high-powered, chemical, insecticide, pesticide, weediccile and fertilizer abuses. These

[12]Particulate matters are based upon absorption, condensation or other thermodynamic parameters.
[13] Temperature is an important parameter controlling many of the physical, chemical and biological processes taking place in water.
[14]Transparency of water is a measure of depth penetration of light. This parameter depends on the presence of coloring matter and turbidity due to organic or inorganic contaminants. Color of water, free from suspended matter, can be estimated semi-quantitatively by comparing samples with standard solutions of potassium chromate of different dilutions. It can be more accurately determined by a colorimetric method.
[15] On regional water, see water supply (Water Quality) Regulations, 1989.
[16] National Water Council, 1978.
[17]PJ Boon and DL Howell, 'Freshwater Quality Defining the Indefinable' (1997) p.48.
[18]*Ibid*
[19]A Omaka, *Fundamental of Maritime, Admiralty and International Water Law* (Lagos, Princeton & Associates publishing Co Ltd, 2018)p.212.
[20] *Ibid*, p.214.
[21] *Ibid.*
[22]RK Jain and SS Rao, *Industrial Safety, Health and Environment Management System* (3rd ed., Khanna Publishers, 2011) p.1019.
[23]*Ibid.*
[24]W Howarth and D McGillivary, *Water Pollution and Water Quality Law* (Shaw & Sons Limited, 2001) p.19.
[25]*Ibid.*
[26] Water Resources Act 1991, ss. 82-84. Previously ss.104-106, water Act.
[27] Agriculture Policy of the Regime of General Olusegun Obasanjo (1976-1979).
[28] Agricultural Policy of the Regime of President Shehu Shagari (1979-1983).
[29] Agricultural Policy of the Regime of General Ibrahim Babangida (1985-1993).
[30] DA Ijalaye, on Environmental Law in Nigeria, seminar organized by the Federal Ministry of Housing and Environment on October 13-14 1992. Punch newspaper, march 8, 1980, p.6.
[31] Punch Newspaper, March 8, 1980, p.6.

chemical compounds when dangerously concentrated, progressively accumulate in land and sea animals moving up the food chain. The effect has led to a ban of their use by many countries.[32]

Oil and Gas Discharges: The case of dangerous liquids like oil, gas and other petroleum products that escape out of pipelines, especially in the Niger Delta should not be over emphasized. These oil and gas spillages eventually find their way to water courses killing fishes and other marine life; and making the water unfit for human consumption and useful for agriculture. A case in point is the 1980 leakage of petroleum in the Niger Delta. It was reported[33] that an oil rig belonging to Texaco Overseas (Nig) Ltd burst and made a grave devastating damage.

5. Types of Water Pollution

Water pollution may be divided into five categories on the basis of sources and storages of water, which are:

Ground Water Pollution: The ground water is most prime water which has multipurpose uses ranging from drinking to industrial and agricultural uses.[34] The quality requirement varies distinctly with respect to the specific uses. Ground water contamination is generally irreversible, i.e. once it is contaminated, it is difficult to restore the original water quality of the aquifer.[35] Excessive mineralization of ground water degrades water quality producing an objectionable taste, odour and excessive hardness. Although the soil mantle through which water passes as an adsorbent retaining a large part of colloidal and soluble ions with its cation exchange capacity, but ground water is not completely free from the menace of chronic pollution.

Surface Water Pollution: Surface water comes in direct contain with the atmosphere, seasonal, streams, rivulets, and surface drains. So there occurs a continuous exchange of dissolved and atmospheric gases while the waters are added through water conveyances. Major lake, rivers, reservoirs of the world are now getting polluted by various ways and thereby poising threat to the survivability of the life system on these diverse water bodies. There are a number of routes of entry of pollutants to the surface water. Regular monitoring of these contaminating routes and their effective protective action plan has to be evolved for better conservation of surface water resources in future.[36]

Lack Water Pollution: Coastal lakes and estuaries cover about hectares of water areas. The rapid pace of industrialization and urbanization has posed a serious threat to these vast varieties of water resources.[37]

River Water Pollution: Today, pollution of water resources have been most exploited due to increasing population, industrialization, urbanization, increasing living standards and broad spheres of human activities.[38]

Sea Water Pollution: Oceans are the major sources of water supply in the world. More than 70% of the earth's surface is covered by water basis within this vast liquid expanse lines in exhaustible amount of food, mineral, energy, salinity gradients besides coal, oil and gas. In this pursuit, by mismanaging or by over exploitation, man's activities are largely responsible for measurable and detrimental effects on the aquatic environment.[39] Oil pollution in the sea appears to be the main factor which poses serious threat to the marine ecosystem and fisheries of the world. Now, the oil pollution of harbors, bays, rivers, beaches and open oceans has been increasing tremendously every day.

6. Behaviors of Pollutants in Water Bodies

Pollutants adversely affect the ecology of the water body. Water bodies comprise of mobile systems such as run-offs, streams, estuaries, and rivers; and stationary systems such as ponds and lakes.[40] Their behavior depends on the types of water as different types of water bodies have varied physicochemical dynamism, geographical terrain, pollutants and flora and fauna. Of them, the most important parameter is dissolved oxygen.[41] Decrease in the dissolved oxygen (DO) is one of the adverse effects of pollutants on a water body. The DO is an essential factor for the survival of aquatic organisms. Decrease in it is, in fact, a positive indicator of water pollution and stressful survival of aquatic organisms. The primary cause for DO depletion is the presence of organic matter.[42] Polluted water diminishes or destroys aquatic population and increases algal growth. The ecology of flowing water bodies differ from that of stationary water bodies and, the effects of pollutants in the two systems are also different. The flowing waters have let as well as outlet for pollutants and pollutants are diluted and dispersed one to flow. On the other hand, stationary waters have only in flow and no out flow. Hence, concentration of pollutants gradually increases in these water bodies, but their effects are localized.[43] Behavior of pollutants in a water body depends on the type of water body, physicochemical dynamics of the water body, and the geographical terrain, and the pollutants and organisms present in the water body. The most important parameter in a water body is the amount of dissolved oxygen and the behavior of pollutants is different in mobile and stationary water bodies.

[32]Sanyra, *opcit*, p.236.
[33] Bhatia, opcit, p.191.
[34] Santra, *opcit*
[35] Bhatia, *opcit* 196.
[36] *Ibid*, p.197.
[37] *Ibid*.
[38] P Narayanan, *Environmental Pollution: Principles, Analysis and Control* (CBS Publishers Ltd, 2011) p.167.
[39] *Ibid.*
[40] *Ibid.*
[41] *Ibid.*
[42]Santra, *opcit*, p.240.
[43] *Ibid*, p.241.

7. Effect of Selected Water Bodies

Organic Matter:[44] Decomposition of organic matter by microorganisms in water can lead to partial or total deoxygenation. Low oxygen levels are particularly damaging to river communities where fish and specialized river invertebrates require consistent high oxygen levels. Small still-water bodies have highly variable oxygen levels, and support communities adapted to these conditions. These may be harmed by organic pollution, but the effects are less easy to detect.

Thermal Pollution:[45] temperatures above the normal range can exacerbate the effects of organic matter pollution and may make heated water, particularly which polluted with organic matter, uninhabitable by many forms of aquatic life.

Acidification:[46] toxic materials brought into solution are directly injurious to many fresh-water animals and have diverse biological effects including changes in the abundance, biomass and diversity of invertebrates, plants, fish and amphibians. Effects are greatest in the uplands and areas of lowlands and the most significant commercial effect is the decline of fish population.[47]

Eutrophication:[48] this reflects in enhanced plant growth, followed by the decay of this plant material and subsequent oxygen depletion of the water. In many cases, enrichment by nitrogen and phosphorous is accompanied by addition of organic wastes which exacerbate the deoxygenating problem. It is primarily a threat to communities of standing wastes but may affect slow-flowing and highly regulated rivers. Phosphorus is generally considered to be the principal entrophicating agent in temperate fresh-waters. However, once a system is rich in phosphorous, nitrates may become the main factor controlling aquati8c productivity and these conditions tend to promote the growth of undesirable, nitrogen-fixing blue-green algae.

Silt:[49] Silt may contain organic matter and hence, have a high biochemical oxygen demand. It often carries materials and absorbed pollutants. Abrasive effects in rivers may kill fish through gill damage. Reduction of height by suspended sediment inhibits the growth of macrophytes, and may favour algal dominance.

Metals, microorganics and other harmful materials:[50] Polluting effects are diverse. Toxicity data are available for very few chemicals, but many have detrimental effects on aquatic life, some at levels considerably below those which cause immediate death. Some toxins may accumulate up the food chain or have synergistic effects.

Oils and Grease:[51] they deoxygenate water as they broken down. Oil can blanket the water surface, inhibiting oxygen diffusion, and may directly coat plants and animals, causing injury and death. Oils contain many carcinogens, such as polycyclic aromatics and phenols, which mix with water and po8ison aquatic life.

8. Effect of Water Pollution on Human Health

On a worldwide scale, the pollution of water supplies is probably responsible for more human illness than any other environment influence. The diseases so transmitted are chiefly one to microorganisms and parasites. Among the various water-borne diseases, the notable examples are cholera and schistosomiases.[52] A good number of enteric viruses were found in water, which happens to infect various organs of human being.

9. Ecological Effect of Water Pollution

Ecological[53] is the study of the water interrelationship between living communities and their non-living environments. All pollutants, atmospheric and land-based invariably enter water bodies by direct discharge, precipitation and run-offs. Water bodies, thus, become sinks as well as carries of pollutants. Water pollution has made ecological impact, as it is an important raw material in photosynthesis and hydrological processes. Water pollutants impart to it undesirable properties like odor, turbidity and retardation of photosynthesis, deoxygenation and entrophication and thermal pollution. In addition, thermal stress has profound physical, chemical and biological effects on all organisms. Turbidity blocks sunlight reaching deeper into the water bodies (lakes) and retards photosynthesis in aquatic trace elements deteriorate the water bodies. All pollutants, atmospheric and land-based invariably enter the water systems. Water bodies become sinks as well as carriers of waters and pollutants.[54] As water is the most important requirement for vegetation and living organisms, deleterious changes in its quality will have direct short-term and long-term effects on ecosystems.

10. Stream Pollution and Self Purification

The effect of steam pollution on the biochemical activities with self-purification may be the same as that for sewage or may differ materially.[55] The general types of bacteria may be differentiated in a stream, namely the native water population and the pollutional forms. In the biochemical oxidation of the pollution, the caliform organisms play only a minor role. The native water forms are most active in this respect.[56] It is to be expected that the numbers of water forms increase as a result of pollution and during the period when active biochemical oxidation is taking place. Observations on the numbers of bacterial in a polluted stream either by plate counts or of

[44] *Ibid*.
[45] *Ibid.*
[46] *Ibid.*
[47] *Ibid*.
[48] *Ibid*.
[49] *Ibid*.
[50] Santra, *opcit,* p.258.
[51] Narayanan, *opcit,* p.155.
[52] *Ibid*, p.156.
[53] Bhatia, *opcit,*129
[54] *Ibid*, p.1130
[55] *Ibid*.
[56] Santra, *opcit,* p.268.

the califorms organisms, therefore, indicate the same general trend. Attempts to predict the changes in bacteria numbers in streams form laboratory studies are not as quantitatively applicable as in the case of deoxygenation. The forces that affect decrease of bacterial numbers in the streams are sedimentation, protozoa, food supply, temperature, sunlight, bacteriophage and industrial wastes.[57]

11. Marine and Coastal Pollution

Contaminants from land reach the marine environment by a variety of pathways. The coastline is a complex regime comprising bays, estuaries, and large semi-enclosed areas where human populations and industrial development are concentrated.[58] Rivers act as large scale collectors and carriers of wastewaters from diverse sources within their drainage basins and off-load then to the sea. Thus, rivers can be regarded as major points sources of mixed contaminants, the inputs of which depend on the contaminate load of the rivers and on the physic-chemical and biological transformations taking place in the river itself and especially in the estuaries and the near- shore zone.[59] Although a relationship between human population increase and environmental change has long been recognized, attempts have been made only recently to assess the cumulative impacts of land developments in the coastal zone by recording their physical, chemical and biological consequences. This requires knowledge of trends in water quality and understanding of the management of aquatic habitats. Equally important is the economic analysis of damages to natural resources and human health against which the cost of control measures will need to be justified.[60] The recreational use of coastal waters for various leisure activities such as bathing, swimming, driving, boating, surfing, and fishing is increasing. With the world-wide presume to open up new locations for tourist development, pristine wetlands and swamps are seeing developed as recreational beaches and harbours for small vessels for commercial and domestic activities. As well as structural engineering alterations to beaches themselves, the immediate hinter land is built up with hotels and support infrastructure. The resulting restructuring along the coastline disrupts traditional fisheries, interferes with marine life and eliminates important habitats.[61] The widespread consequences of all these developments are increasingly recognized. As a result, areas of high sensitivity or of specific interest are being designated for protection through zoning and planning procedures. However, what remains to be done is to reconcile conflicting demands when major alterations of the coastal strip are envisaged.[62] Indeed, planning the development of the coastline as a whole, as is already being done in a number of countries, should be under taken more widely.[63] International guidelines, including criteria and standards world provide valuable assistance in such planning in different geographical areas, but awareness, resources and political will are needed if the health of the resident and the transient populations, the survival of marine wild life and the functional intercity of the vital land-sea interface are to be maintained.[64]

12. The Federal Water Quality Standard in Nigeria

The law regulating water quality standard in Nigeria is NESREA[65]. NESREA Act[66] seeks to tackle the problem of clean and potable water supplies for all purpose necessary for human activity. This it intends to achieve through setting of standards and regulations. The section also employs penal sanctions in terms of fires and imprisonment to defer violators. Protection of public health and welfare is the operative words of the section which seeks to enhance the provision of quality water supply. NESREA[67] is empowered to establish effluent limitations for new point sources, review existing point sources and make regulations on effluent limitations, on existing and new point sources, for the protection of human, animal, marine and plant life. Penal sanctions in terms of fines and imprisonment are provided for. NESREA[68] is also empowered to make regulations for the purpose of protecting public health and promotion of sound environmental sanitation. Violations of the provisions of regulations are guilty of an offence punishable under the Act. While section 26 provides for land resources and watershed quality and imposes fine jail term on violators, section 27 provides for the law regulating discharge of hazardous substances and related offences. To constitute an offence, the discharge of hazardous substance must be in the air, land, waters, or the joining shorelines.

For the purposes of determining what substances are hazardous and such hazardous substances the discharge of which shall be harmful to public health or welfare, the president can exercise his discretion and authority under the Act through the ministers, experts and professionals in the Agency or the Federal ministry of Environment, who shall act in the president's name.[69] Except where a person can prove that a discharge was caused solely by a natural discharge or an act of war or by sabotage, such person or corporate body shall be liable. Where the discharge of hazardous substances is caused directly by natural causes without human intervention in "circumstances which no human foresight can provide against and of which human prudence is not bound to recognize the possibility,[70] the defence of act of God, that is natural disaster or an act of war or by sabotage applies. This defence of act of God was recognized as far back as 1866 in the *locus classicus* of *Rylands v. Fletcher*,[71] and was applied in *Niclolas v. Marsland*[72] where judgment was given for the defendant and the court held that the defendant ought not to be liable for an extraordinary act of nature which not reasonably be anticipated. The fact that a discharge of hazardous substances was caused through a natural disaster or an act of war or by sabotage is no excuse to a person or an owner or operator who brought the hazardous substances there. He must prove that a discharge was caused solely by such

[57] *Ibid*.
[58] *Ibid*, p.268.
[59] *Ibid.*
[60] *Ibid.*
[61] *Ibid.*
[62] *Ibid.*
[63] *Ibid*, p.250.
[64] *Ibid.*
[65] National Environmental Standards and Regulations Enforcement Agency,.
[66] Ss.23-25.
[67] S.27(5), *Ibid.*
[68] *Tennent v. Earl of Glasgow* (1864) 2M.H.L. 22.
[69] (1866) L.R1 EX 265,280.
[70] (1876) 22 EX. D.1.
[71]Although nitrate sensitive areas were introduced under the water Act 1989 primarily to address compliance with the nitrate parameter in the drinking water quality directive, nitrate sensitive areas are discussed together with nitrate vulnerable zones designated under directive. 91/676/EEC, since both have wider environmental implications than drinking water quality.
[72] Directive 98/83/EC. Notably, the directive was adopted under Article 130 of the European community Treaty (now Article 175 EC).

natural causes. In effect, if a discharge is not caused by natural disaster or an act of war or by sabotage, a person or an owner or operator has no defence and must be held liable.

13. Water Pollution Control Methods and Management

Water pollution has become a global problem partly because of the population explosion and partly due to the phenomenal advance in industrialization. Water pollution creates several detrimental health hazards all over the world. Water pollution has adversely affected the aquatic flora and fauna in rivers, lakes, streams and ponds, etc. however, instances are too numerous, varied and common to warrant special attention, that it has become necessary to prevent and control water pollution against its ill-effects not only on man's health but the cost of medicine and medical attention, cost of hospitalization, as well as indirect economic costs such as reduced crop production, damage to flora and fauna and perhaps the unquantifiable contribution to the deterioration of the quality of life.[73] The following are the control methods as follows:

Water Treatment System: The waste water treatment or sewage treatment is a broad term that applies to any process, operation or combination of processes and operations that can reduce the objectionable properties of water-carried waste and render it less dangerous and repulsive to man.[74] Thus, the waste water should be traced before its ultimate disposal in order to reduce the spread of communicable diseases and prevent the pollution of surface and ground water.[75] Method of treatment is a combination of physical, chemical and biological processes. The application of the physical forces predominates, while the chemical or biological activities are also involved. The physical forces consist of screening, mixing, flocculation, sedimentation, flotation, etc.[76] chemical processes are those in which removal of contaminants are brought by chemical activity. Biological processes are those in which the removal of contaminants is brought above by biological activity.[77] Sometimes, the waste water is also subject to tertiary treatment, also known as advanced treatment, with the aim of removing the pollutants, not removed in primary and secondary treatment.[78] In addition to the various stages of treatment of wastewater mentioned above, the processing and disposal of sludge obtained from the above treatment methods is of equal important. Disposal of the accumulated waste sludge is a major economic factor since the cost of its processing is about one third of that involved in the treatment plants.[79]

Wastewater Management: There are three constituents and interrelated aspects of wastewater management:

Collection: Collection of domestic and individual wastewater is best achieved by a fully developed sewage or water carriage system. Servers are commonly laid in straight lines, man holes being provided at all changes of direction, gradient and diameter. With the modern developments in other fields, many changes have been made in wastewater collection, notable amongst them being the photogrammetric and computer techniques to the design of sewers, the improvement of construction materials, and the application of computers in the control of storm sewers.

Treatment: This has been fully discussed under the wastewater treatment system. It is important to note that the form of treatment normally adopted f provide consist of providing an environment in which naturals process of decay can be intensified and controlled so as to take place in the least objectionable manner. [80]

Disposal/Re-use:[81] After treatment, the problems of disposal arise. The most important recent trend in the field of disposal is the establishment of increasingly stringent requirements to protect the environment. Currently used effluent disposal methods are dilution in streams and rivers, land application and re-use in agriculture and irrigation.

14. Conclusion and Recommendations

Water is fundamental basic need for sustaining human economic activities providing water in the adequate quantity and quality, and at the right time and place, has thus been a constant endeavour of all civilizations. The emerging situation, however, is one of water shortages, whether as a result of over-exploitation for limited localized purposes or because of inadequate management strategies. Nigeria is endowed with vast water and law resources, comprising wide range of physiographical and climatic variation which gives rise to a very complex weather pattern, influencing the overall main source of water in the country, in space and time. The global water problems are attaining serious dimension because of the rapidly changing social, economic, political and environmental conditions. The coming generations are going to face water problems which are more complex than what we are facing today. Agricultural sector uses the lions' share of water, while water is treated as a free and inexhaustible commodity. Coupled with the demand from industry and urbanization, there is severe pressure on water. As a sign of water stress is becoming more pronounced, and issues relating to water are assuming political overtones, ways and means are being looked for increasing the performance of the irrigation system. Water is needed in all aspect of life. The general objective is to make certain that adequate supplies of water of good quality are maintained for the entire population, while preserving the hydrological, biological and chemical functions of eco-systems adapting human activities within the capacity limits of nature. Innovative technologies are needed to fully utilize limited water resources and to safeguard those resources against pollution.

This article recommends National Water Policy that recognizes water as one of the crucial elements in developing planning. The policy document, *inter alia*, should lay down planning and development of the precious natural resources in that water needs to be governed by the national perspective. Resources planning, in case of water, have to be done for hydrological unit such as drainage basin as a whole

[73] Bhatia, *opcit*, 51.
[74] *Ibid.*
[75] *Ibid*, p.171.
[76] *Ibid.*
[77] *Ibid.*
[78] *Ibid.*
[79] *Ibid.*
[80] RK Jain and SS Rao, *Industrial Safety, Health and Environmental Management System*, (3rd ed., New Delhi¸ Khanna Publishers, 2011)p.1027.
[81] *Ibid.*

or for a sub-basin. All individual developmental projects and proposals should be formulated by the states and considered within the framework of such an overall plan for a basin or sub-basin so that the best possible combination of options can be made. Transfer of water from one river to another, especially if it involves inter-state transfer has always been a sensitive issue amongst the states. Water should be made available to water-short areas by transfer from other areas including from one river basin to another, based on a national perspective, after taking into account the requirements of areas/basins. Water allocation in an irrigation system should be done so that disparities in the availability between head-reach and tail-end farms and between large and small farms should be obviated by adoption of a rotational water distribution system and supply of water on a volumetric basis subject to certain ceilings. For implementing the above programmes, appropriate organizations should be established for planned development and management of river basin as a whole to ensure control and avoid pollution.