Western Nigeria Journal of Medicine
May/June 2012 Vol. 5

REVIEW ARTICLE

Public Health And Environmental Impact Of Dredging Of Rivers And Major Streams In Osogbo, Southwestern Nigeria

Adebimpe W. O[1], Oladejo S. O[2]

1 Department of Community Medicine, Osun State University, Osogbo, Osun State, Nigeria
2 Department of Biology, College of Education, Ila-Orangun, Osun State, Nigeria

Correspondence to: Adebimpe W. O, email:lekanadebimpe@gmail.com, lekanadebimpe@yahoo.com

Summary

The frequency of flooding in Osogbo metropolis has been alarming in the past with resultant mortality, morbidity, damage to properties and public infrastructure. Dredging activities was carried out on major rivers in Osogbo in the first quarter of 2012 with the objective of sanitizing the environment. In this article, authors examined the benefits of the exercise as well as public and environmental health impacts of unplanned dredging.

Major positive impacts include flood prevention, and beneficial use of dredged material for some productive purposes such as habitat development, shore protection, parks and recreation, reclamation, construction, industrial and agricultural use. Negative impact of unplanned dredging include changes in physical and chemical component of the river water and resultant deleterious effect on surrounding flora and fauna, a filthy environment with potential increased prevalence of communicable diseases, and contamination of wells and surface water. Effects on Land Cover/Land Use may bring about variety of global changes affecting ecological systems, climate change and epidemiology of disease.

It is concluded that sound planning, design, and management of dredging projects are essential if dredged material disposal is to be accomplished with appropriate health and environmental protection. Authors recommend planned and monitored dredging process, proper disposal of the dredged material, and pre and post dredging health and environmental impact assessment by stakeholders involved and affected by the dredging exercise in order to promote healthy living and sustainable environment

Key Words: *Dredging, Health and environment, Impact*

Background

Dredging is an excavation activity or operation usually carried out at least partly underwater, in shallow seas or fresh water areas with the purpose of gathering up bottom sediments and disposing them at a different location. This technique is often used to keep waterways navigable. Early 2012, Osun state Government in Southwestern Nigeria embarked on dredging of the major rivers in the state with a view to 'sanitizing' the environment. Though environmental impact assessment report before the exercise may not be publicly released, both the positive and negative impact of dredging activities on health and environment cannot be over emphasized.

History of dredging

The origins of dredging are lost in antiquity. The first known dredgers were the Phoenicians (modern day Lebanese) who created a worldwide network of ports, using stable ships to carry out dredging activities in rough waters. With modernization, dredging became more technical and purposeful. In the United States, several hundred million cubic yards of sediment must be dredged from waterways and ports each year to improve and maintain the nation's navigation system and to maintain coastal national defense readiness. In Nigeria, the dredging of the River Niger many years ago was the first success recorded after which many registered and licensed companies most especially in the oil rich Niger Delta carried out dredging activities in that region. In 2009, Nigeria started a vast operation to dredge the River Niger to enable boats to carry goods from the Atlantic Ocean to remote villages in the interior. The government said it would bring communities together, secure the flow to hydro-electric plants and ensure "all-year-round navigability". The first dredging activity in Osun state was recently carried out, spanning some selected sections of the four major rivers in the state.

Rationale for dredging

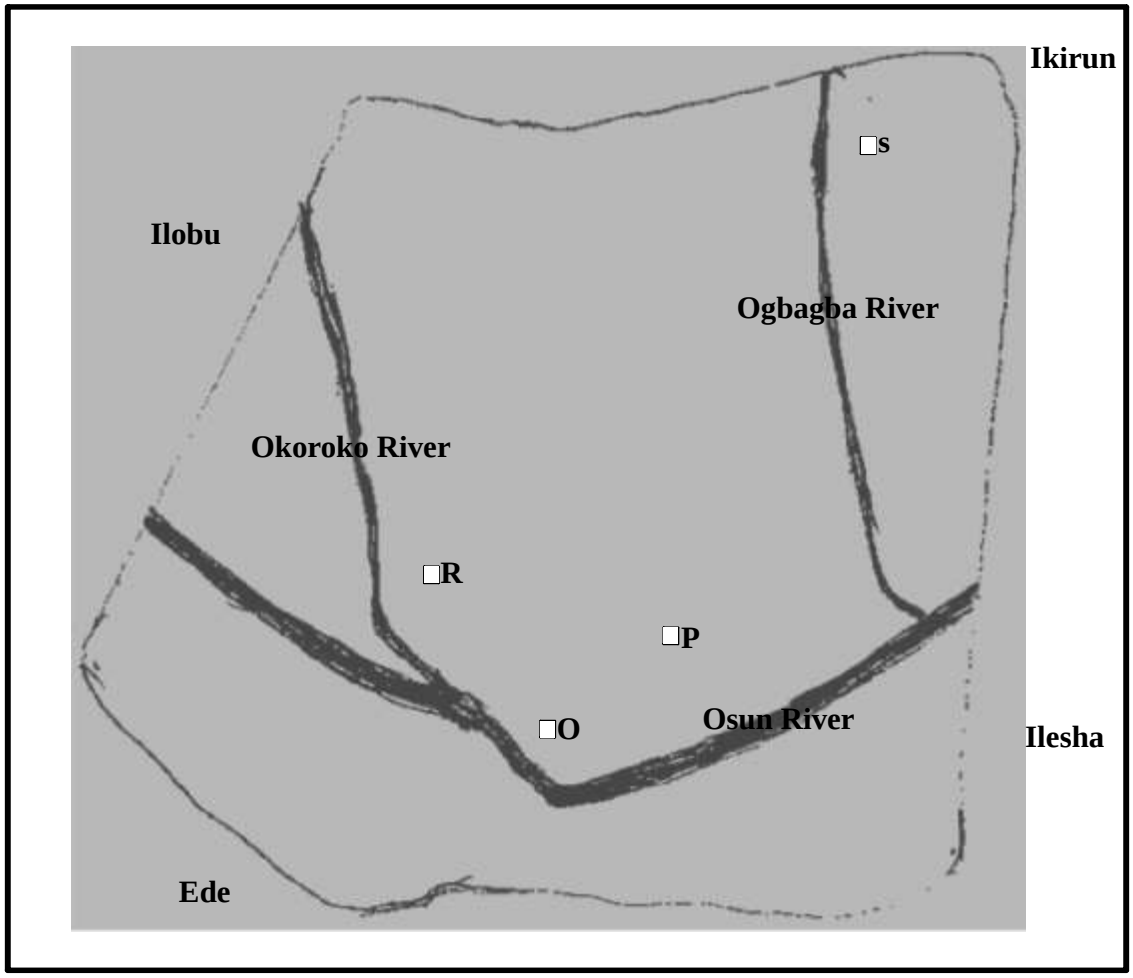
The processes of eutrophication, sedimentation and pollution usually lead to collection and passage of rough, dirty and heavily polluted water, and this in turn give rise to environmental health, social and economic concerns. Consequently dredging activities are carried out to help to reduce aquatic vegetation growth by lowering the river bed below photic zone (the depth of water in a lake, river, sea or ocean, which is exposed to sufficient sunlight to allow photosynthesis to take place). This in turn will help in dealing with nutrient loading, increase the habitat of fishes and reduce the breeding ground for mosquitoes.[1]

The prevalence of flooding in Osogbo metropolis has been alarming in the past few years. The resultant mortality, morbidity, damage to properties and public infrastructure was pronounced in 2010, to the extent that the National Emergency Management Authority (NEMA) in Nigeria had to come to the aid of the state government and affected residents. Relief measures carried out were essentially in the form of food, drugs, shelter and immediate needs for those affected. The four major rivers transecting the city were observed to be full of debris, with blocked channels, and plants grown on the surface and along the banks of the rivers. These could have caused obstruction to the flow of water and subsequent flooding.

In addition, some residents are in the habit of dumping refuse at the river bank, and some industries also do discharge their agricultural products and wastes in water. This would automatically have influence on physical and chemical component of the river water, as well as deleterious effect on surrounding flora and fauna. Osogbo and environmental restoration bid

Osogbo is located on latitude $7^{o}30^{1}$ North and 4^{0} 30^{1}East, in the derived Savanna Zone of Southwestern Nigeria. The area experiences two seasons, the dry season (November to March) and the wet season (April to October). Osogbo as the State Capital of Osun State enjoys basic social amenities such as electricity, pipe borne water and road networks. Yorubas are the major residents and they are mainly farmers, Civil Servants and traders. Some of the rivers and streams that have been causing heavy flooding in the state capital were identified as Osun, Okoroko, and Ogbagba rivers and adjoining streams. The major rivers transecting the city are shown in Figure I

Figure I



These rivers were dredged at various entry points within the metropolis until the river water was able to flow freely while the dredged materials were deposited at the river banks. In addition, the State government in early 2012 declared a weekly environmental sanitation exercise for different groups and the total inhabitants of the state to last for about three months. This was coupled with the employment of a sanitation team tagged “O Clean” and saddled with the responsibility of cleaning up the capital city and removing the dredged materials most of which were dumped by the river and road side, where they can be easily dispersed by wind, vehicles, motorist and passers by, thus making the environment filthy.

The Dredging Process

Dredging operations involve the removal of bed materials and associated vegetation from a river channel; or simply under water evacuations to establish a channel to improve navigation and commercial activities. A **dredge** is a device for scraping or sucking the seabed. It is used for cleaning up and removing accumulated refuse and dirts. A **dredger** is a ship or boat equipped with a dredge, the terms are sometimes interchanged. The excavation process commonly referred to as "dredging" involves the removal of sediments in its natural (new-work construction) or recently deposited (maintenance) condition, either mechanically or

hydraulically. After the sediment has been excavated, it is transported from the dredging site to the placement site or disposal area. This transport operation, in many cases, is accomplished by the dredge itself or by using additional equipment such as barges, scows, and pipelines with booster pumps.

Once the dredged material has been collected and transported, the final step in the dredging process is placement of the materials in open-water, near shore, or upland locations. In design and implementation of any dredging project, each part of the dredging process must be closely coordinated to ensure a successful dredging operation. Dredging can produce materials for land reclamation or other purposes (usually construction-related) but can also create disturbance in aquatic ecosystems, often with adverse impacts.

When the State government rolled out her heavy duty dredgers in February 2012 in preparation for flood prevention in the upcoming rainy season, residents of Osogbo, most especially areas near the rivers, were not caught un-aware but were surprised at the types and length of activities carried out by the dredgers. This exercise was completed after some weeks of daily operations in which all the major rivers were involved. As the removal or excavation, transport, and placement of dredged sediments constitutes the primary components of the "dredging process," most of the excavated materials were found along the banks of the rivers and in some cases along road sides. This may have implications for health and environment, apart from the various beneficial effects of the dredging exercise itself.

Health and Environmental Impacts of Dredging

The potential environmental effects of maintenance dredging can come firstly as a result of the dredging process itself and secondly as a result of the disposal of the dredged material. Some of these health and environmental effects should be taken into consideration before, during and after the dredging process.

(1) Physicochemical changes in the component of the environment: Dredging has been variously reported to cause changes in the physicochemical environment. [2] Post dredging studies have shown that pH, Conductivity, Nitrate, Phosphate, Chlorine,, Calcium, Magnesium, Lead, Iron, Zinc, Manganese, Copper, Aluminum and Cadmium, for both surface and sediment samples; and alkalinity, turbidity, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) for water samples only are likely to change following dredging activities. [2]

The assessment of the result of a dredging exercise in Warri River later revealed that the pH of the dredged canal decreased from 7.2 to 4.0, Dissolved Oxygen (DO) station, partially dredged station and dredged station decreased considerably from 6.0 mg/l to 0.4 mg/l, BOD_5 increased from 1.0 mg/l to 18.0 mg/l., while Nitrate and alkalinity values also decreased. [3]

Result of post dredging monitoring revealed that water quality improved significantly after six months, pH and Dissolved Oxygen (DO) appreciated while Chemical Oxygen Demand (COD) and Biological Oxygen Demand ($BOD_{5)}$ depreciated to values close to pre-dredging concentrations. [3] All these have implications for the interaction, growth and survival of the flora and fauna existing in the dredge environment as well as public health of the residents near the dredging area. Dredging virtually affects all components of the environment including zooplankton [4] and vegetation. [5] It is expected that such parameters will be measured by the relevant Government agency in Osogbo Osun State within six

months of the dredging exercise, in order to assess the extent of physico-chemical changes in the surrounding soil and water bodies.

(2) A filthy environment: After recent dredging in the state, we observed debris most especially excavated soil particles littering the bank of the rivers and also especially the roadsides. This could be as a result of non-designation of specific site for disposal of dredged materials. Within short period of time, some residents in the state turned the areas with disposed dredged materials into domestic refuse dump sites. These made Osogbo environment filthy immediately after the completion of the dredging exercise, because these refuse dumps were easily dispersed by wind and motor vehicles. In addition, hydrogen sulphide gas generated from the refuse heaped on the excavated dredged materials gave the environment a bad odour.

(3) **Potentials for increased prevalence of communicable diseases:** As a result of the filthy environment brought about by unplanned disposal of dredged materials and indiscriminate refuse dumping at these sites, there could be an increase in the prevalence of communicable diseases. These refuse collections could contaminate surface soil and underground water, attract breeding of houseflies and act as sources of occurrences of diarrhoeal diseases such as Typhoid and Cholera. The waste heaps can also serve as breeding sites for mosquitoes and consequently increase the prevalence of vector borne diseases. Such breeding sites would have both indirect and direct impact on the epidemiology of malaria in the city and the health systems, especially because Osogbo is a malaria endemic area in Nigeria. [6] Though dredging brings about an improvement in flow of water and its speed, it may lead to an increase and change in pattern of the epidemiology of diseases associated with fast flowing rivers such as onchocerchiasis

(4) **Altered topography**: A post dredging exercise worry in Osogbo is that some of the excavated soil particles may be returned into the river, mostly by activities of residents as they walk by the river banks and on bridges. However, the abandonment of the resulting dredged material could lead to a number of other environmental changes including altered topography and hydrology, acidification and water contamination, which could result in vegetation damage and fish kills. The traditional low land slanted topography of Osogbo could have been altered if not for the timely intervention of the State environmental sanitation team which cleared these debris and excavated soil within a short time to prevent adverse environmental and health effects on the citizenry.

(5) Flood from high water speed: After the recent dredging, speed and movement of water became improved and flood was un-likely to occur in the areas near the dredged areas within the city. However, far and remote areas distal to the dredge areas could witness flood easily from high speed of water. Rural agricultural areas may not be left out as farmland may be washed away by water. More so, some of these rural agrarian communities may not be aware or earlier notified of the upcoming dredging exercise for which they could have prepared. Houses along the banks of the rivers could have part of the solid structures surrounding their house foundation washed away by water. These may lead to building collapse and its antecedent effects of mortality and morbidity. Studies in Nigeria have shown that about 200 sq km of wetland was impacted as a result of

dredging induced hydrological changes, coastal erosion and retreat in the Niger Delta, [7,8] thus putting pressure on quality and quantity of water available for human use. These possible incidences have not been formally reported within the six months after the dredging exercise in Osogbo

(6) Water contamination with heavy metals: After a dredging exercise, as we recently had in Osogbo metropolis, there is a possibility of river water as well as dredged solids contaminating community water sources, mostly wells and tap water. Seepage of dredged contents into these water sources is also possible and this could affect quality of water consumed by residents most especially those who live along dredged rivers. Contamination with heavy metals and short-term increase in the level of suspended sediment can give rise to changes in water quality which can also affect marine flora and fauna, both favourably and unfavourably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants depending upon the nature of the material in the dredging area.

In humans, similar impact of dredged material disposal, largely depends on the nature of the material (inorganic, organically enriched or contaminated) and the characteristics of the disposal area (accumulative or dispersive areas). Release of toxic chemicals (including heavy metals and **Poly Chlorinated Biphenyls** PCB) from bottom sediments into the water column is also a great possibility and of significant concern.

People may be exposed to soils contaminated with PCBs in low-lying areas adjacent to the rivers that flood frequently, or to areas on the inside of large bends of the river, or backwater areas. A study has shown that dredging in sensitive environments can be accompanied by ecological impacts such as impairment of water quality from contamination by heavy metals. [9] Common adverse health effects from PCB exposures include nausea, headaches, eye and throat irritation, dizziness, loss of balance, mood changes, neurological problems, eyes and skin irritation, shortened menstrual cycles and cancers.[10] Lead poisoning is a dangerous outcome for people exposed to either organic and inorganic lead. Common presentations include weakness and fatigue, tingling sensation and numbness in the arms or legs among other manifestations in the central nervous system [11] These possible effects have neither been studied nor formally reported within the six months after the dredging exercise in Osogbo

(7) Effects on Land Cover/Land Use (LC/LU) in Osogbo.

The potential change in land cover and land use as a result of dredging, may bring about variety of global changes affecting ecological systems and epidemiology of disease.[10] Most part of the water ways, rivers and streams in the metropolis are blocked by inadequate dumping of excavated materials from dredged sites, indiscriminate dumping of domestic refuse and erection of buildings along the river water ways.Since the area of land covered by the city still remain unchanged, the land available for beneficial use becomes reduced in size, with negative implications on agriculture, housing and nutrition.

We must therefore put the necessary mitigating measures in place as stipulated by Environmental Impact Assessment and engage in sustainable land use pattern, pollute less and conserve more of our environment towards sustainable growth. This would lead to a reduction in community health risks and enhance better quality of life. The Global Land Cover Facility (GLCF) software analysis could assist

towards this direction of community mapping and forecast, and prove the effectiveness of dredging as mitigating measures.[10]

Beneficial Effects of Dredging

The potential benefits of dredging operations should not be overlooked, and all emphasis placed on adverse environmental and health effects

Flood prevention and free water movements: Dredging can help to increase channel depth and therefore increase its capacity for carrying water. The removal of contaminated sediments and their relocation to safe, contained areas, should lead to possible improvement of water quality. While most rivers in Osogbo have been widened and water now moves freely within the dredged rivers, it is expected that the flooding that usually comes with the rainy season in Osogbo would be a thing of the past most especially if dredging could be done on a continuous basis.

Beneficial uses: Dredged material can be used for some productive purpose. Some of these include habitat development, shore protection, parks and recreation, reclamation, construction, industrial and agricultural use. Beneficial use options should be given full and equal consideration with other alternatives. Beneficial varieties of dredging include

a. Capital dredging: This is dredging carried out to create a new harbour, berth or waterway, or to deepen existing facilities in order to allow larger ships access.

b. Maintenance dredging: This is dredging to deepen or maintain navigable waterways or channels which are threatened to become silted with the passage of time.

c. ***Land reclamation:*** includes dredging to mine sand, clay or rock from the seabed and using it to construct new land elsewhere. The material may also be used for flood or erosion control.

d. ***Beach nourishment:*** involves mining sand offshore and placing on a beach to replace sand eroded by storms or wave action.

e. Harvesting materials: dredging sediment for elements like gold, diamonds or other valuable trace substances.

On a global level, dredging contributes to the economy and tourism. Without the many and almost non-stop dredging operations world wide, much of the world's commerce would be impaired, often within a few months, since much of world's goods travel by ship, and need to access harbours or seas via channels. Recreational boating also would be constrained to the smallest vessels.

Recommendations for Public Health

(1) Pre and post dredging environmental Impact Assessment: To better understand the extent of impacts of dredging on living things and the environment, it is important to carry out a pre and post dredging impact assessments. This will also help to prepare for mitigation measures in case any significant consequences are for-seen. Report of such assessments should be communicated to all stakeholders including residents

(2) **Physico-chemical studies**; There is a need to carry out these studies pre and post dredging exercise. The need for study of public water sources most especially wells for PCB, lead and other contaminants is essential

(3) **Improved and sustained sanitation exercise**: This should take place on regular basis to prevent contamination of water and surface soil with dredged disposable materials. Sanitation workers should ensure that refuse indiscriminately dumped near dredged sites are removed

(4) **General health education and promotion:** The entire public should receive regular health education for behavioural change towards dredging related issues. This could reduce cases of indiscriminate dumping of refuse, building of houses close to river banks as well as boost awareness of possible health and environmental effects of dredging most especially among rural dwellers.

(5) P**roper industrial waste management:** Dumping and discharge of agricultural wastes and industrial effluents into city rivers by industries should be discouraged. Industries should be encouraged to compact and recycle their waste products

(6) Protection of Public water sources: In an environment like ours where most wells do not satisfy the WHO standard for well construction, and where public tap water pipes may become open, it is important to protect public water sources and prevent occurrences of diarrhoeal diseases and contamination by toxic chemicals

(7) Disease surveillance around dredged areas: Due to the possibility of outbreak of communicable disease following unplanned dredging exercise, it is important for the State health authority to commence and continue disease surveillance efforts in communities near dredged areas. Such efforts should specially target diarrhoeal diseases (most especially typhoid and cholera), vector borne diseases (most especially malaria) and lead poisoning

(8) Disaster preparedness and prevention: Government needs to strengthen disaster preparedness and response. More importantly, steps should be taken towards flood prevention most especially in rural areas far from the dredged areas. Legislation prohibiting building of houses near rivers and activities blocking river water channels need to be put in place by concerned authority.

(9) Identification of alternatives: Sound planning, design, and management of projects are essential if dredged material disposal is to be accomplished with appropriate environmental protection and in an efficient manner. The selection of a preferred alternative for dredged material management must be based on weighing and balancing of a number of considerations that include environmental acceptability, technical feasibility, and economics.

(10) Regulation of dredging exercise and activities of dredging companies: The nature of dredging operations and possible environmental impacts demand that dredging operations should be closely regulated. The majority of marine dredging operations (and the disposal of the dredged material) will require that appropriate licenses are obtained from the relevant regulatory authorities.

(11) Holistic public health approach to dredging exercises: In instances where alternatives to dredging is not an option, stakeholders in dredging should work together to ensure implementation of standard dredging codes and rules, and adopt multi sectoral approach to protection of public health and environment, health promotion and prevention of mortality and morbidity

Conclusion

Dredging may have both negative and positive effects. Their ill effects on health and environment are enormous if not properly managed. Dredging and disposal of contaminated sediment can adversely affect water quality, aquatic and terrestrial organisms. In addition, dredge spoils may contain toxic chemicals that may have adverse effect on the disposal area. While commending the State government for taking the initiative to dredge the rivers, government should be encouraged to add on

pre and post dredging environmental and health impact assessment on a continuous basis, with reports of such assessments communicated to appropriate quarters.

References

1. **Njoku, G and Acho, O. Nworie** River Dredging Controversy: Reducing the Overload Dallas, Texas, USA. 2010
2. **Umunnakwe J. E, Nnaji A.O and Ejimmaduekwu P.I.** Preliminary Assessment of Some Physicochemical Parameters During Dredging of Nworie River, Owerri. Pakistan Journal of Nutrition, 2011; 10 (3): 269-273.
3. **Ohimain, E.I**. Environmental Impacts of Dredging and Canalization in the Niger Delta. Paper presented at the 2008 Annual workshop of the Nigerian Mining and Geosciences Society, Port Harcourt.
4. **Ohimain, E. I, Imoobe, T.O.T and Benka-Coker M.O.** Impacts of dredging on zoo-plankton communities of Warri River, Niger Delta. African Journal of Environmental Pollution and Health, 2002; 1: 37 - 45
5. **Fagbami, A. A, Udo E.J and Odu. C.T.I.** Vegetation damage in an oilfield in the Niger Delta of Nigeria. Journal of Tropical Ecology, 1988; 4 : 61-75
6. **Adefioye, O.A, Adeyeba, O.A, Hassan, W.O and Oyeniran, O.A**. Prevalence of malaria parasite infection among pregnant women in Osogbo, Southwest Nigeria. American –Eurasian Journal of Scientific Research, 2007; 2(1): 43-45.
7. **World Bank.** Defining an Environmental Development strategy for the Niger Delta, 1995, Volume 1. West Central Africa Department, World Bank, Washington DC.
8. **Ashton-Jones, N.** The Human Ecology of the Niger Delta. An ERA Handbook Environmental Right Action (ERA), 1998 Benin City.
9. **Ade Sobande and Associates.** Dredging Impact Study. A report submitted to Shell Petroleum Development Company of Nigeria (SPDC), 1998 Warri.
10. **Schantz S.L, Gasior D.M, Polverejan E, Mc Caffrey R. J.** Impairments of memory and learning in older adults exposed to poly chlorinated biphenyls via consumption of Great lakes fish. Environ Health perspectives, 2001;109:605-611
11. **Lee B.K, Ahn K.D, Lee S.S, Lee J/S, Kim Y/B, Schwartz B/S.** A comparism of different lead biomarkers in their relationship with lead related symptoms. Int Arch Occup Environ health, 2000;73: 298-304
12. **Oladejo, S. O. Morenikeji O. A. and. Salami A. T.** Application of Geographic Information System (GIS) in the assessment of human water contact patterns in relation to Schistosomiasis infection in five rural communities in Osun State, Southwest Nigeria. NISEB Journal, 2011: 129-134.