

Surface Water Source Environment and the Health Effects of Bilharzian Parasites

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Abstract: The environmental quality of natural water supply sources and the effects of a major fresh water parasite (*Bilharzia*) in Nigeria were investigated. The environment of a source of water supply is an indication of its water quality. In Nigeria, the natural water sources are surface (rivers, lakes, springs and ponds) atmospheric, (rainfall) and groundwater sources. The paper shows evidence of increasing water source pollution problem in Nigerian urban environments. Ground water and rainwater sources are less polluted and so can be extracted for domestic uses. Surface water sources should be avoided for they are potential distributors of infectious diseases such as Bilharzioses, the complications of which depend on parasitic count. Hence the control of *Bilharzia* is centered on the reduction of parasites in the local population. Praziquantel, Metrifonate and Oxamiquine with iron supplement are recommended for treatment. The provision of safe source of water supply from bore hole is the most feasible recommendation.

Keywords: Biharzioses, Parasites, Mass Treatment, Symptomotology, Water supply, Source.

INTRODUCTION

The hydrological cycle forms the theoretical basis of water supply sources. The cycle traces the path of water from the oceans to the atmosphere, rivers, ground, lakes, swamps and eventually back to the oceans. The gross operation for the basin hydrological cycle can be expressed as [1]:-

$$P = Q + E + (I, R, M, L, G, S) \dots\dots\dots (1)$$

Where: P is precipitation; I is interception; E is evaporation and transpiration; R Surface storage; Q Surface runoff; M Soil moisture, G ... ground water storage; L Aeration zone storage; and S ... channel storage.

Although the basin hydrological cycle is an open system, the global hydrological cycle is viewed as a closed system [2, 3]. As the water progresses through the various stages of the hydrological cycle, it is affected by many environmental factors that control its ultimate quality. The water can be collected for various uses (drinking, domestic, industrial, agricultural, recreational and other selective uses) at any source or stage in the cycle. However, the quantity and the environmental quality of the water as well as the existence of solid waste and parasites in the source restrict the uses to only a few choices.

THE RESEARCH PROBLEM

For drinking and other domestic purposes, it is essential to choose water resources which provide an adequate supply of unpolluted water in that environment. This is very crucial because water is never found in its pure state in natural environment. Essentially, all water resource system contains substances derived from the natural environment or from the waste products of anthropogenic activities in man's environments.

The environmental quality of surface water resources featured prominently in the debate on the comparative profits of separate and combined sewerage systems in the later periods of 19th century [4, 5]. This interest disappointingly died down before the early 20th century, probably consequent on the temporary improvement in water quality with the advent of internal combustion engine in the developed countries [6].

However, there has been a perceptible shift of interest within the past few years as the realization that measures to ameliorate environmental change and degradation deserve to be accorded a high priority [7]. Nevertheless, the

research interest on water source environmental quality has been relatively one sided, dominated by the more advanced countries and with sub-sahara Africa including Nigeria particularly remaining on the side line [7, 8]. Indeed, the works so far carried out concentrated more efforts on the environmental impacts of solid wastes, coliform group of bacteria, viruses and solids contained in water samples. In contrast very little work has been done on the effect of fresh water parasite such as *bilharzia* on human health in Nigeria. This research problem justifies the need for a paper like this at this very moment when there is an increasing awareness of water related environmental health hazards in every quarter of the globe [1, 9]. This also inform existence of multidisciplinary attack on the problem of portable water supply. This aim and objectives of this paper are based against this background.

Aim and Objectives

The aim of this paper is to assess the environmental quality of our natural water supply source and the effect of a major fresh water parasite on the health of the local population. In other to achieve the aim, the following objectives are designed to:

- Examine the various natural waters supply source and environmental factors affecting their quality;
- Highlight suitable healthy environment in selecting a water source that will yield water that is fit for human consumption.
- Investigate the effect of Bilharzia (major fresh water parasite) in our local water source environment.

Water Supply Sources and the Environment

The environment of a source of water supply is usually an indication of its water quality characteristics. It is also an aid to formative planning in the initial stage of water resource development. In Nigeria, and indeed elsewhere, most of the water used various purposes is obtained from the following source:

- Atmospheric water resources system
- Surface water resources system
- Ground water resources

Let us examine each of the three briefing

Atmospheric Water Resources System

One major elements or input from the atmospheric water resources system is precipitation especially rainfall. In rural environment where atmospheric pollution is not a major problem, when rain water provide an appropriate high quality source of water. Rain water is typically collected from roof tops and store in tanks or cisterns. But because the roof or collection surface is subject to contamination from nesting and frying birds and air borne dust, no one should assume that this source of water that is most suitable for human consumption.

Cisterns are subject to infiltration as well as leakage. Problems with infiltration can pose a very severe problem as sewage disposal can flow into the cistern when the water level in the cistern is low.

As a result, rain water must always be disinfected before it is consumed by man. Hence periodic inspection of the cistern is highly recommended with annual cleaning to remove any sediment that has accumulated.

The cistern should be sized to provide a sufficient supply of water during the dry season (November to early March inclusive). In many situations, this will restrict the reliability of using rain water as a year-round source of water. The quantity (Q) of water available can be calculated by a modified version of Rational Method [10]:

$$Q = CDA \text{-----} (2)$$

Where: Q is the quantity of water available (m³)

C is a coefficient (dimensionless ranging from 0.0 to 1.0)

D is the annual seasonal average rainfall (in m).

A is the surface area of the collecting surface (in m²)

Provisions should be made for screening out large particles and keeping out small animals in the design of any storage system [10].

Surface Water Resources and the Environment

Surface water resources consist of the following as classified by Chukwu [3]:

(i) Springs (ii) Rivers (iii) Lakes and reservoirs (iv) ponds (v) estuaries (vi) oceans.

4.2 (i) Springs

A spring is a point in the hydrological cycle where ground water meets the land surface and flows into a stream. The water quality at the surfacing point is usually excellent as the water has percolated through thick strata of soil. In this process of percolation, the water picks dissolved minerals (such as calcium, magnesium and iron) and is purified of biological pathogens, (disease producing organisms) such as *Bilharzia*. The spring will manifest water of varying quantity and quality determined by the hydro-geologic formation in the environment such as the type of aquifer system. A continuously flowing spring that is always clear can be a good source of drinking water [3,5].

In selecting any spring, as a source of water supply, limestone topography (i.e. Kharst environment) should be carefully avoided. Good examples are found in Akamkpa LGA of Cross River State as well as parts of Ebonyi State especially Nkalagu region. These areas contain sink holes or depressions through which surface drainage is transported to ground water. Water flowing into the ground water by this path bypasses the percolation process that purifies it. Hence springs in these environments produce poor quality water and must therefore be treated appropriately if it must be used for domestic purposes.

Rivers

Rivers are surface streams. Most human settlements are founded close to a source of surface water supply and route-network as these two factors often determine their habitability. In many villages of Nigeria, the source of water supply is surface stream which is usually put into multiple uses that are often not only conflicting but also overtaxing the stream.

Chloride, sulphate and bicarbonate are the common concentrated anions in river water. In the unpolluted rural areas, nitrate concentrations are low except where organic contaminants drain to the river. All river contain some gases in solution. In rivers unpolluted by oxygen-demanding wastes, the dissolved oxygen concentration will be near saturation. Diurnal variation is great, exceeding 100% saturation just before dark and lowest before sunrise consequent upon the photosynthetic processes of algae and other aquatic organisms. Low concentration of dissolved oxygen exists in certain periods of the year. Carbon-dioxide is usually present in river water (about 10ppm).

Although in the rural environment, hydrogen sulfide, methane, sulfur-dioxide and ammonia are not usually found in river water, in an urban environment and industrial area, below outfalls which discharge sewage or industrial wastes these gases occur. Normal unpolluted river water will show a 5-day, 20⁰C biochemical oxygen demand (BOD) of 1 to 2ppm. Below waste outfalls this value may be higher.

The pH value of water is usually 7 or slightly higher but very low pH value of 5 or less are typical of rivers which drain coal mining and similar environments like Enugu urban area. Colour in river water is often below 50ppm, though higher concentrations accompany drainage from swamps or from industrial waste contaminants. Turbidity and suspended solids contents of river water vary greatly with runoff and soil conditions in the local environment of the drainage basin. Evidence points that nuclear explosion have been reflected in the pattern of radio activity pollution in river water resulting from the deposition of radio-active particles from the atmosphere [11, 3].

Fresh water parasites especially *Bilharzias* (*Schistoma*) and *E-coli* are the most prevalent in many parts of Nigeria including Ebonyi, Benue and Kaduna states to mention a few [12, 13]. Calm surface streams are the worst affected source by *Bilharzia*. Urban streams in Nigeria are heavily polluted. The risk to the health of population can well be imagine especially as water treatment is inadequate in many states of Nigeria.

Lakes and Reservoirs

Bacterial concentrations in lakes and reservoirs are reduced due to the unfavorable bacteriological environment plus long period of detention. Turbidity is reduced by sedimentation of suspended particles in the comparative quiescence of the impoundments. The bleaching action of sunlight is responsible for removing colour from water retained in lakes and reservoirs. However, during the dry seasons of the year in Nigeria, water in lakes and reservoirs exhibit objectionable taste and odours, oxygen concentration. It also shows high concentration of iron, manganese and hydrogen sulfide [3]. All these undesirable effects on water quality are caused by thermal stratification of lakes and reservoirs during various seasons of the year [11, 5]. Many of the problems associated with the variations of water quality with depth are overcome by the selective withdrawal of water by multiple level intakes. In Nigeria, lakes and reservoirs may be counted as one of the most accessible supply of water in the local environment but it is also one of the most vulnerable to contamination. Like calm rivers, lakes and reservoirs can be sources of many diseases. Treatment of lake and reservoir water is therefore very necessary to remove harmful substances and disease organisms.

Estuaries

An estuary may be described as that reach of a surface stream where the stream water mixes with and dilutes sea water [3]. In the riverine regions of Nigeria like Cross River, (2000). In the riverine regions of Nigeria like Cross River,

Akwa Ibom, Bayelsa and Delta States, estuary forms one of the major sources of water supply to the local populations. The general water characteristics of an estuary are determined by the relative qualities of the two waters present in the mixture.

The upper limit of an estuary is often not fixed but moves according to river inflow, tidal actions wind forces. In the upper frontier of an estuary, the water exhibits the quality river inflow, tidal actions wind forces. In the upper frontier of an estuary, the water exhibits the quality characteristics of the inflowing river, though there is increased salinity of the water. In the lower portions of the estuary, the water quality characteristics resemble those of sea water but the total dissolved solids concentration is lower.

Stratification in deep sheltered estuaries resulting from salinity and temperature variations is stable in wet season. In shallower portions, the mixing forces of the tidal current tidal current destroy the stratification and mix the waters of varying densities. The pH value of estuarine water is greater than 7 and often higher than that of the river flowing into the estuary. Estuarine water is buffered and resists changes in pH on the addition of acids or bases.

Oceans

Oceans are the main interest of oceanographers. The only ocean accessible to Nigerian southern borders is the Atlantic Ocean. Its water quality characteristics are important for many purposes like fisheries management, effects on ocean – going vessels, off shore structures and it offers a means of investigating the dynamics of oceanic circulation. Furthermore, advances in the conversion of saline water to potable water have focused attention on oceanic water as a possible source of potable water supplies in the coastal regions [3].

The total dissolved solids content of sea water averages about 34500 ppm. Of this total, chloride is about 55 per cent (about 19,000ppm) and sodium, 30 percent (about 10,500ppm) [11, 5]. Other ionic concentrations in coastal water include sulphate, magnesium, calcium and potassium in descending order of magnitude of concentration. The water quality characteristics of interest to the oceanographer are basically salinity and chlorinity. Salinity is calculated from chlorinity by the formula [11]:-

$$S = 0.03 + 1.805C \quad (3)$$

Where S is salinity; C is chorinity. Both characteristics are in parts per thousand (gms/kg).

The overall evaluation of sea water quality characteristics is complicated belonging to the oceanographer and not the focus of hydrologists and health workers.

Ground Water

The quality of water available from underground aquifers may be superior in many respects to the quality of surface water. For instance if a stream is located in a sand and gravel stratum, supply of suitable drinking water might be obtained easily by drilling or digging a well into the aquifer that recharges the river. Since surface streams define the lowest hydraulic gradient in an area, a well dug into sand and gravel aquifer will typically draw water from the highland areas. If these areas have not undergone extensive development or become polluted (such as by solid waste dumps and landfills), they will provide high quality water.

Ground water from limestone strata may be contaminated. Depending on local hydro-geological conditions however the water may contain undesirably high levels of iron, manganese and salt giving it objectionable quality characteristics which must be recognized. There is no option but to obtain representative samples of the specific supply for analysis and evaluation. In some cases, the water may come from underground beds of peat and decaying vegetation and poor quality coal formation which contributed colour producing organic matter to the supply. Contamination may also result from the application of reclaimed wastes to recharge ground water supplies [3].

Ground water contains higher dissolved solids concentrations than surface waters of the same local environment. Majority of the minerals contribute to hardness (calcium and magnesium) and alkalinity (bicarbonate, carbonate and hydroxide) due to increased concentration of carbon dioxide in the ground water. Hydrogen sulfide may be found in some well waters in populous urban centres like Onitsha, Lagos, Kano, Enugu and Ibadan. It must also be noted that overdraft on the groundwater aquifer as currently obtainable in many part of Calabar, Lagos and other coastal towns may result to contamination of the ground water supplies by salty sea water intrusion. Groundwater can be extracted at any point in the geologic formation but the depth and type of cover over the groundwater determine the feasibility of constructing a well for the water supply.

Water from a well has a constant quality. If the well is properly constructed to eliminate surface pollutants, it can provide an excellent source of drinking water to the local population.

Water Source Selection

For surface or ground water supply, the point of water withdrawal should be made as far upstream as possible and attention should be paid to the use of land in the immediate environment of the basin and the possibility of polluting the water source. Problems with unreliable water quality can be largely reduced by avoiding environments that will likely be contaminated by the following:-

- Municipal sewage
- Domestic sewage
- Ground garbage
- Synthetic detergents
- Industrial wastes
- Radioactive materials
- Agricultural/livestock wastes
- Insecticides, pesticides and herbicides
- Oil and coal fields and similar sources of water contaminants.

The most important step in developing a potable water supply system is the selection of the highest quality water source in that environment.

Although it is very difficult to describe in precise terms a particular source of water as superior to another, ground water supplies and rain water have a greater chance of being free of serious pollutants than does surface water resource system. Surface water supply sources in Nigeria especially lakes and sluggish rivers may harbor fresh water pathogenic organisms such as *Schistosoma*. Of the surface water resources, springs that provide clear water under all conditions and located in environments devoid of numerous sinkholes are preferred to other surface water sources. The local environmental factors affecting the water quality must always be evaluated and the local health and environmental management authorities should be called upon to investigate and approve the desirability of the chosen water source.

Characteristics of Fresh Water Parasites and Their Effects on Man's Health/Environment

One of the most devastating fresh water pathogenic organisms in many parts of Nigerian environment is *Bilharzias (Schistosoma)*. It causes a 'water based' helminthic disease known as *Bilharzioses* [16, 3]. This is why we have chosen it as a case study. *Escherichia Coli (E-Coli)* and mosquitoes are used as indicators of water borne and water related diseases respectively. While the former causes typhoid fever, diarrhea and cholera, the latter carries a parasite (the plasmodium) that causes malaria fever. The input of viruses derived from human, animal and plant sources into the surface water resource is largely unknown and underestimated [17, 8].

Bilharzioses (also Schistosomiasis) refer to a category of diseases which are epidemiologically, clinically and parasitically different and caused by fresh water parasites of the trematode (flat worm) family spp. *Schistosoma*.

Mott [9] and Chukwu [3] explained that this disease is associated with the personal habits and livelihood requiring daily and frequent contact with fresh water resource systems. In Nigeria (for instance, Benue and Ebonyi States particularly the Abakaliki region) several thousands of people are affected in such regions, high rates of population growth, illiteracy and poverty form barriers against effective control measures [13]. The transmission of these parasites is hindered by some unfavourable environmental conditions but conducive micro environments often exists.

The eggs of the worm are excreted in human faeces or urine which comes in contact with a favourable habitat in the form of water resource system especially clam surface water bodies such lake in which a suitable species of fresh water snail is found. Living habits and people's use of water for various purposes (bathing, fishing, agricultural activities, laundry and even reception) leads to the contamination of the environment. Infected people release eggs into the water resource system. The eggs open in water and release a small parasite (*Miracidium*) which does a wild swimming with the cilia surrounding its body. In the event of contact with a compatible fresh water mollusk, the *miracidium* penetrates the organism. Otherwise, it dies off before 12 hours, after birth. The parasite undergoes numerous divisions which take about 4-7 weeks or more to develop into *cercaria* (a larva) [3].

Outside the mollusk, the *cercariae* which have a long forked tail can live a maximum of 48 hours. They swim and can penetrate the skin of an immersed person in a question of seconds with its tail falling off. Within 12 days, the *cercaria* manages to enter the blood vessel causing itching, but most infected people do not notice anything at all. Within

a few weeks, the parasite becomes a long worm, (male and female) remain united for life (5-40 years). More than ten scores of egg can be produced within 24 hours depending on species and the cycle begins again.

It is eggs produced by the female and not really the adult worms themselves which cause lesions of the bladder, intestines and many other organs.

The distribution of the parasites is not homogenous within one country. The variation is governed by the climatic conditions, the body of water and peculiar geographic environments all of which determine the presence of the compatible snail species [3]. Irrigation projects, canals and dams as well as migration of the infected people favour the distribution of *schistosomiasis* by creating new sites for breeding.

In rural areas of Ebonyi and Benue States, children below 16 years of age and women are the most commonly infected [13]. Attracted by the water resource systems, they have the most frequent contact with *schistosomiasis* larvae at the source. However, Mott [9] is of the view that partial immunity water implies that the adults (majority of whom is infected from childhood) are seldom reinfected.

Species and Distribution of Fresh Water Parasite (Bilharzia)

Bilharzioses are caused by many species of *bilharzias*, viz:

- *Bilharzia Masoni*
- *Bilharzia Mekongi*
- *Bilharzia Intercalatum*
- *Bilharzia Haematobium*
- *Bilharzia Japonicum*

- ***Bilharzia Masoni***

This species of parasite is found in Africa, in the Arabian peninsula, on some Caribbean Islands, in Surinam and in Brazil.

The endemic zones of *B. Haematobium* and *B. Mansoni* overlap to a reasonable degree. Dual infectious of these parasites are usually found in Africa and in the Arabian peninsula [5].

- ***Bilharzia Mekongi***

This is a very aggressive species especially hepatosplenic aggression. It is found in the Mekong Delta.

- ***Bilharzia Intercalatum***

This species is mostly found in central Africa especially in Equatorial Guinea (the most affected area).

- ***Bilharzia Haematobium***

B. Haematobium has been indicated as the only species that creates urinary *Schistosomiasis*. Its distribution include large areas of intertropical African and Madagascar all along the Nile Valley and along the eastern shores of Mediterranean and South Africa. On the northern part of Africa, and in the Arabian Peninsula, some small colonies are also present.

- ***Bilharzia Japonicum***

B. Japonicum and *B. Mekongi* are the most worrisome and aggressive species of the parasites. It is found entirely in the Asian countries like Philippines, Indonesia and China.

SYMPTOMATOLOGY OF BILHARZIOSIS

The mortality rate of *Bilharziosis* is comparatively low and cases of complication often require hospitalization. Majority of the patients suffering from *Bilharzioses* do not manifest any symptoms of the disease, although they can still show some signs of nutritional deficiency and anemia. Serious signs of *Bilharziosis* which may be classified into three are restricted to the infected population and often depend on the degree of infection, the numerical strength of the produced eggs by the adult *Schistosoma* and the ability of the human organ to cope with or react to the eggs.

- **Intestinal *Bilharziosis***

The initial symptoms of intestinal *Bilharzioses* are periodic dysentery and chronic diarrhea, constipation and abdominal pain. *B. Mekongi*, *B. Intercalatum*, *B. Mansoni* and *B. Japonicum* are the four species which cause this disease.

• **Hepatsplenic Bilharziosis**

This disease is characteristics by manifestation of hepatohegaly or splenomegaly resulting from the obstruction of portal circulation by granulomas in the liver. Portal Hypertension gives rise to esophageal varices that may begin to bleed excessively. The infected person may manifest a dropsy of the abdomen (known as ascite) plus a decrease in the protein content of the blood. All these may eventually lead to a generalized Odema [9]. The eggs of *B. Mekongi*, *B. Japonicum* and *B. Mansoni* are the major culprits. The infections of *B. Japonicum* are complicated by a hepatohegaly as the numerical strength of the eggs produced is very high and their litte size ensure their spread to a vast area. Cirrhosis and cerebra involvement attacks can also manifest.

• **Urinary Bilharziosis**

Miction pain and hematuria are the most prevalent and minor signs of the disease. The formation of granulomas around the eggs can obstruct the ureters leading to hydronephrosis. A common chronic bacteria is present and may even cause real infection that may give rise to pyelonephritis. Renal insufficiency is a rare complication [9] although calcification of the bladder may result to other complications such as bladder contraction, large stone formation in the bladder and urethral reflux tumour may develop in the bladder after 2-3 decades of illness or mostly s such as bladder contraction, large stone formation in the bladder and urethral reflux tumour may develop in the bladder after 2-3 decades of illness or mostly from 30 to 40 years of age.

Control of Fresh Water Parasite – Bilharziosis

The control of fresh water parasite diseases (*Bilharziosis*) usually takes the form of antibilharzian treatment which may result to a very remarkable improvement. However, surgery may be required in some complications involving intestinal perforations, polyps and bladder stone. In the case of anemia, iron supplement should be recommended for a minimum of 90 days. Adequate and appropriate antibiotic treatment should be prescribed for infection associated to urinary

Bilharziosis

The patient should be monitored to ensue complete treatment and if eggs are excreted or a hematuria exists after 60 days of treatment another complete treatment must be embarked upon. The health worker should also take cognizance of the period of contagion and the local population of the endemic environment should be treated en mass at the end of the peak period. At the present the drug of choice although expensive for the treatment of different types of bilharizes is known as praziquantel Mott [9] one dose of administration because of its efficiency and efficacy can be sufficient to totally eradicate adult *Bilharzias*. Of the patients who remain carriers after treatment, there is a great decreases in the numerical strength (See Table 1).

Table-1: Treatment of bilharziosis

S/N	Type of parasite	Single dose (mg/kg)	Initial cure rate (%)	Reduction in egg content after 1 year (%)
1	S. Haematbium	40	80-95	90-95
2	S. Mansoni	40	60-90	95
3	Mixed: S. Haematobium + S. Mansoni	40	60-75	S.Haematobium S. Mansoni
4	S. Interacalatum	40	60-80	95
5	S.Japonicum	40 (4)	60-80	95
6	S.Mekongi	40 (4)	60-80	95

Source: Adapted from UNICEF [14]

In the absence of eggs in the urine and in stool after about 25 weeks cure is considered total [15]. In certain badly infected environments, the dosage should be increased to 60mg/kg. There are also two other antibilharzians known as Metrifonate and oxamiquine. Their indications, dosage, contra-indications and side effects are summarized in Table 2. The side effects of former anti-bilharziosis drugs are more common and more severe than those of the three newer drugs shown in Table 2. These older drugs which are now being discouraged include niridazole, lucanthone and hycanthone.

Mass treatment is especially encouraged for most local populations infected are usually very poor with generally a per capita income of about \$200.00 per annum or less.

Other measures of control are also recommended such as environmental mass education and public enlightenment on the importance of wearing shoes, construction and promotion of latrines and eradication of fresh water snails in the endemic environment. A reduction in the parasitic count of the infected population decreases the number of

severe cases. School children are usually affected and systematic treatment of children by mobilizing their mothers is highly recommended. If bilharziosis and intestinal helminthiasis occur simultaneously, the two treatments should be spaced a week apart to prevent adverse reactions or interactions [15].

This systematic treatment should also be complemented by nutrition programmes. Treatment every 24 or 36 months is adequate to reduce the risk of developing a serious bilharziosis disease in the local environment.

Summary and Conclusions

Though this work has shown that there is complex interrelationship between the quality of water supply source environment and human health, the following overall summary and conclusions can be drawn from the paper.

Table-2: treatment of bilharzioseis with drugs currently recommended by WHO

pS/N	Drug	Indications	Dosage	Contra-indications	Side effects
1.	Praziquantel	Bilharziosis	1. Generally one does of 4Cmg/kg 1. For S. Japnicum and S. Mekongi in some regions: 60mg/kg in 2 doses at 4 hr interval	Pregnancy	Uncommon and usually mild, headaches dizziness, abdominal pain and nausea
2	Metrifonate	Urinary bilharziosis (S. Haematobium)	3 doses of 7,5mg/kg at 2 weeks intervals	1. Subjects exposed to organo-phosphorus insecticide 2. Pregnancy	Headache dizziness nausea and abdominal
3	Oxamiquine	Interestinal bilharziosis (S. Mansoni)	1. Nigeria and W. African the Caribbean: Adults:- One dose of 15mg; children (weighing less than 30kg) – 10mg/kg twice daily for 1 day.	1. Epilepsy 2. Pregnancy	1. Vertigo, headache, vomiting and diarrhea 2. Rarely” hallucinations, excitations and convulsions
			3. Central Africa, E. Africa and Arabian Peninsula: 15mg/kg twice daily for 1 day		
			Egypt, South Africa and Zimbabwe:- 15mg/kg twice daily for 2 days		

Sources: Adapted from: WHO [15], UNICEF Prescriber [14] and Chukwu [5].

In Nigeria, most the water used for different purposes is obtained from atmospheric, surface and ground water resources. The major groups of water pollution in Nigerian environments are found to be solid wastes and domestic sewage and other oxygen demanding wastes, industrial wastes, pesticide, insecticides and herbicides and herbicides, plant nutrients, eroded sediments, oil and coal products, detergent and ground garbage. The paper shows evidence of widespread and increasing surface water pollution problem in both Nigerian rural and urban environments. Ground water and rain water sources are less polluted and so are recommended for drinking and domestic uses.

Surface water resources with the possible exception of spring water should be avoided for they possess the potential to act as life support (friendly servant) and distributor of infectious concurrently without a clear-cut dichotomy between them. *Bilharzioses* complications depend on parasitic count and some cause anemia. Children in the endemic environments are mostly infected. Control of bilharzias is centered on the reduction of parasites in the population to stop further complications. Praziquantel, Metrifonate, and oxamiquine are recommended by WHO [15] for mass and systematic treatment with iron supplement. The provision of safe drinking and domestic water supplies from bore holes (groundwater source) is the most feasible recommendation in all situations especially in the early phases of large scale treatment.

REFERENCES

1. Baird AJ. Continuity in hydrological systems. Contemporary hydrology: towards holistic environmental science. 1997:25-58.
2. WARD RC, ROBINSON M. *Principles of Hydrology* Mc-Graw Hill Publishers, London. 1990.

3. CHUKWU KE. "Water Resources and the Environment" in Obasikene, I. J. Adinna E. N. and Uzoechi, I. F. A. (eds) (2000): *Man and the Environment*. Computer Edge Pub. & G15 Division. 2000.
4. Peirce CS. The essential Peirce, volume 2: Selected philosophical writings, 1893-1913. The Peirce Edition Project. 1998.
5. Chukwu KE. "Water Supply Systems and Environmental Health" *Environmental, Sanitation and Human Existence*, Dept. of Community Medicine, UNTH, Enugu. 1999; 16pp.
6. Salau OA, Opara-Nadi OA, Swennen R. Effects of mulching on soil properties, growth and yield of plantain on a tropical ultisol in southeastern Nigeria. *Soil and Tillage Research*. 1992 Feb 1;23(1-2):73-93.
7. Zwarts L, Beukering PV, Koné B, Wymenga E, Taylor D. The economic and ecological effects of water management choices in the Upper Niger River: development of decision support methods. *Water Resources Development*. 2006 Mar 1;22(1):135-56.
8. Chukwu KE. Effects of Enugu Urban Environment on the Water Quality of Streams in Nyaba Catchment Area of south Eastern Nigeria. Unpublished Ph. D Thesis. University of Nigeria, Nsukka. 2010.
9. Staa AV. Myth and metronidazole in Manila: the popularity of drugs among prescribers and dispensers in the treatment of diarrhoea. *Myth and metronidazole in Manila: the popularity of drugs among prescribers and dispensers in the treatment of diarrhoea.* 1993.
10. Hubbs SA. Understanding water supply and treatment for individual and small community systems. *Volunteers in Technical Assistance*; 1985.
11. POWELL ST. "Quality of Water" in CHOW, V. T. (ed) *Handbook of Applied Hydrology*. Mc-Graw Hill: New York. 1963; 19-1-9-37.
12. Smith VG. The effect of pollution in a small stream near Samaru in Northern Nigeria. *Savanna*. 1975;2:155-75.
13. UNICEF and FGN. *Analysis of Situation of Children and Women in Benue State, Nigeria*. A country programme of Co-operation between UNICEF and FGN; Benue State, Nigeria. 1995.
14. UNICEF. "Guidelines on the rational use of drugs in basic health services". Prescriber: UNICEF in co-operation with Prescrire LA Revue: France, 1993; 6 pp. I-VIII + 1 – 8.
15. World health organization. *WHO Model Prescribing Information – Drugs used in parasitic diseases* (2nd ed.) WHO – Geneva. 1993; 116-119.
16. Kinnesley D. *Coming Clean: The Politics of Water and the Environment*. Pengium Books Ltd: Harmondsworth. 1994.
17. Badenoch I. *Report of the Group of Experts on Cryptosporidium in Water Supplies*. HMSO: London. 1990.