



Public health implications of sewage ponds in Kano metropolis, Nigeria

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Received 20 December 2009, accepted 7 April 2010.

Abstract

The urban closed settle zone, Kano metropolis, Nigeria (12°N, 8.5°-8.75°E), is one of the oldest but growing and densely populated cities in Nigeria. That scenario leads to waste disposal and/or its management pressure whose magnitude needs to be assessed from time to time for public health interest. It is partly for this reason that the present document was reported. This was with the aim of identifying the current issues concerning the public health implication of sewage ponds in Kano. The paper gathered that several workers established that ponds containing a large volume of water are scattered around Kano metropolis. The pressure of population explosion that necessitated excavating land for building material as well as for sewage disposal caused it. This leads to injection of domestic and even industrial effluents containing a large quantity of solid and chemical waste products, which converts them into ugly and dirty sites with chasing odour. The site also serves as breeding ground for many disease vectors like snails for schistosomiasis (Bilharzias) and *Fasciola hepatis* in sheep and cattle. Mosquito, which transmit malaria, filarial worms and yellow fever are also not uncommon. Pathogenic microbes such as enterobacteria, fungi, protozoa and viruses are also transmitted. Toxic chemicals and plant (algal) toxins are also cultured in these ponds. This might be partly responsible for many epidemic explosions of various grades. The public health hazard ranged from physical incapacitation or disability to death in some cases. There is a disastrous effect on the people due to disease. The presence of sewage ponds in the city poses real threat to public health. However, efforts are being put at individual, societal and government levels to curtail the menace. The economic stand of the inhabitants should, however, be boosted in any attempt to educate them toward achieving the desired goal. Scientific research should be encouraged and referred to for any meaningful action on environmental and public health. At present, the state is creating awareness through television, radio and public lectures against dangerous infections which have a forbearing with dirty environment. In addition, some nongovernmental organizations (NGOs) such as the Youth Society for the Prevention of Infectious Diseases and Social Vices (YOSPIS) based in Kano, the medicines Sans France (MSF) the WHO, TDR and the UNDP are actively assisting the Kano State Government in this regard.

Key words: Kano, ponds, public health, Nigeria, sewage.

The Kano Metropolis at Geographical Point of View

Talking about the public health implication of sewage ponds in Kano metropolis will require a rational recapitulation of some aspects of human geography of the place first of all. Metropolitan Kano (12°N, 8.5°- 8.75°E) is made up of tripartite urban centers of Kano City only (Birni), Kano Township and Waje district, with its various sub-divisions ¹. McDonnell ² described the city as “a key area of modern Nigeria and one the largest rural-urban complexes in Africa”. Over the centuries it has prospered whereas other cities (e.g. Gumel, Daura, Gaya and Azare its age mates) and even regions of the Western Sudan have remained relatively stable.

The morphology of Kano is a complex one. There is Birnin Kano with the traditional houses, closely built together with little space in between one house and another. Birnin Kano is enclosed by the city Wali, which was constructed in the 12th century A.D. There has been pressure on land around low plot residential building types with one to three story buildings. The majority of the roads within the Kano city wall are narrow. It is within the city wall of which Dala, Gwale and Municipal Local Governments were encompassed that the highest population is recorded in the whole of the Kano closed settled zone ³. Outside the city wall by the northeast is Sabon Gari, where there are concentration of the major commercial activities in Kano. Adjacent to Sabon Gari is the Central

Business District of Kano Metropolis (Abubakar Rimi Market by the old Bata building including Yankura Kuroda). This part constitutes the zone of the migrants to Kano who have established various trade connections with people in Kano as well as outside Kano. The eastern side is the Government Reserved Area (GRA) with individual but more modernized houses and infrastructures having large areas occupying an average area of 1000 m² situated at Nassarawa.

Further away from the Nassarawa GRA ¹ precisely north east of Kano City is Tudunwada settlement. This is largely occupied by the Hausa people from other parts of Nigeria. The principal focal point of Tudunwada is the market, which is the major commercial center of this section of Kano. There are mixtures of both traditional and modern residential buildings. The modern ones are simple story row houses as well as two story buildings with moderate common open spaces.

Falola ⁴ explained that Kano metropolis presents one classic example of the problems of urban primacy in Nigeria, housing almost a quarter of the states population (approximately 2.0 million) as at 1991 ³. It contains 100% of the medium to large-scale modern manufacturing industries, 80% of the banks, 87% of hospitals and more than 90% of the modern houses and commercial ventures,

the only general post office, 3 out of 4 NIPOST head office, 43% of the post offices, all 10 postal agencies and 72% of telephone lines as well as up to 90% of global systems for mobile communication facilities.

In spite of the resilient features of Kano urban structure the walled city, the areas of the new city outside the city walls have taken on the social class and ethnic segregation patterns association with dependent city¹. Northeastwardly, adjacent to the walls is Fagge, which started up as a trans-Saharan camel camp since the 19th century. Its Syrian quarters mainly have inhabitants, which historically performed intermediary trading functions between the large trading companies and the Hausa population. Next is Sabon Gari, a residential area for southern Nigeria, usually Christians and some Muslim migrants to Kano. They were originally brought to Sabon Gari by the British to perform clerical roles in the colonial bureaucracy and economy. Tudunwada of Kano was an early settlement for migrants, usually Muslims, who were porters and ex-soldiers of the colonial army. The author narrated that, together with Gwagwarwa and Gama, Tudunwada forms the 29th century urban area of northern Nigerian migrants. Occupationally, it is composed of urban wage labourers, petty traders and craftsmen. The colonial elites, administrators and representatives of trading companies reside in Nassarawa, a government residential area, in which the most influential civil servants, managerial classes and the government executives reside. The area also houses the Kano State Government House.

It is fascinating to realize that most of the settlements eject their sewage into what is today known as sewage pond, the present Kano metropolitan residential quarters that evacuate their domestic effluents from each house pouring into the main storm sewers. Exception to that was at the Nassarawa Government reserve areas, (GRA), Gadonkaya, Sulaiman Crescent, Zoo road and the main Sabon Gari market and the neighbouring commercial centers. Other government parastatals, such as the Campuses of the Bayero University, possess a more standard (modern) way of sewage disposal system. Ponds were originally not known to serve as sewage systems but merely as pit burrows. However, with increasing population density which leads to congestion of houses and a resultant high release of waste water, refuse and even "night soil" (faecal matter), these previously attractive ponds have now been turned to be a collection of garbage and recalcitrant polythene as well as plastic matter which chases away any on-looker with its unbecoming odour and poignant or rather nuisance site. These characteristics of sewage ponds are known to cause serious health havoc to its neighbouring inhabitants even to downgrade their original usefulness enjoyed by the people around them. It is therefore imperative to attempt to look at the nature and type of ponds, their ecological and/or biological importance as well as their cultural purposes before going on to cite an overview on the health hazards imposed on the public by the sewage ponds prevalent around this historic and commercially important city of the present day Nigeria.

Nature and Uses of Ponds

A pond can be visualized as an artificial (e.g. planned fish pond) and sometimes natural water reservoir that develops around human settlement or around streams or river basin. It resembles a dam only that it does not necessarily exist along a river course (tributary or distributor). In most of the instances a pond emerges whenever

men dug the ground for the purpose of obtaining earth, mud or clay for the purpose of building houses. The resulting pit burrow becomes a pond which usually traps an enormous amount of rain water and/or sewage coming from the neighboring settlements.

In rural areas, these pit burrows/ponds also serve the function of a source of domestic water, in addition to their role as source of building materials⁵. The use of pond water for irrigation, fishing and recreation ground for those that wade into swim are also what makes them indispensable to many people of both rural and urban areas. It will be logical to say that these ponds wherever they are function also as buffers to the dangers of flooding specially in the rainy season. This is especially observed in Kano metropolis at quarters that lack the modern drainage systems⁶. Sometimes, however, these ponds too tend to overflow into their neighboring house(s) and can lead to many disastrous consequences such as collapse of houses and contamination of the environment and agricultural produce. This is where the greatest health risk ensue, the implication of which is discussed in the next section.

Ecologically speaking, Indabawa and Muktar⁷ reported that ponds containing a large volume of water are now scattered all around Kano City. More so, domestic and presently even industrial effluents, containing a large quantity of waste and organic and inorganic chemicals that may serve as nutrient for aquatic plants, animals and microorganisms, find their way into these ponds. As a result they distort the aesthetic value of these waters as they become polluted. The actual source of pollution is the sewerages from where these water reservoirs in the city get their name as sewage/ponds.

Biological Characteristics of Sewage Ponds of Kano Nigeria

The easiest sites where sewage ponds can be located in Kano City include Hauren Wanki, Hauren Shanu, Kofar Naisa, Gwale, DanAgundi, Kofar Nassarawa, Kabuga, Dala, Yan-Gurasa, Dukawa and Ayagi quarters. Other reknown ones include Kwarin Gogau in Yakasai Tudun Maliki along court road near mortgage bank and many at Tarauni, Brigade, Fagge as well as Kofar Wambai quarters. This is to mention but a few⁷. Their water appears viscously turbid and somewhat greenish, hence biologically rich in algal bloom, including *Anabaena flos-aque*, *Microcystis*, *Pandorina spirogyra* and others that are too numerous to mention here and are toxicologically risky to aquatic animals and man.

Among the common higher green plants are *Pistia stratiotes* (water lettuce - "Kainuwa" Hausa) and water lilies⁸. In many instances these plants overgrow to occupy most of the available water surface. There are so many higher grasses and herbs within and around the pond that contributed to the seemingly evergreen vegetation around these sewage ponds.

The population and variety of the microbial flora in this type of enriched water body is immense. Virtually all categories of bacteria ranging from pathogenic to the harmless but ecologically useful ones are found. Commonly, the harmless but useful bacteria found in these waters include nitrogen fixing bacteria such as *Azotobacter*, *Nitrobacter*, *Nitrosomonas*, *Rhizobium* etc. There are sulphur bacteria, cellulomonas, hydrosomonas as well as the uncountable types of bacteria⁹.

The pathogenic bacteria common in sewage ponds include the popular family Enterobacteriaceae, which comprises the genera *Escherichia*, *Citrobacter*, *Klebsiella*, *Enterobacter*, *Proteus*, *Salmonella*, *Shigella* and *Campylobacter*. The genera *Vibrio*,

Pseudomonas and *Clostridium* are also known epidemiologically and are associated with sewage ponds ⁵.

Some of the representatives of Mycobiota, that is the fungal flora, are *Aspergillus* spp., Basidiomycetes, Streptomycetes, *Rhizopus*, *Mucor*, yeasts, *Micromonospora*, *Microcystis*, *Trichophyton* and *Penicillium*. Their role in the recycling of matter (biogeochemical cycles) and causation of plant and animal diseases attracts attention ⁹.

At the fauna point of view, sewage waters carry various phyla of animals, namely pathogenic protozoa, for example *Entamoeba* (cysts), *Opalina* and *Giardia*. The nonpathogenic protozoa include common *Amoeba*, *Mastigamoeba*, *Paramecium*, *Stentor*, *Nyctotherus* and *Euglena* ¹⁰.

The sewage ponds around Kano are of fresh water types and so do not ecologically give a good adaptive condition to the Poriferans and Coelenterates. Many members of the phylum Platyhelminthes are biologically known to be associated with sewage waters. This is because many of them have human being as their final host and so can reach the water by the way of faeces and urine which form the bulk of sewage. The eggs and larvae of *Schistosoma*, *Fasciola haematobium*, *Diphylobothrium latum*, *Hymenolepis nana* and tapeworms are a classificatory example.

The Nematelminthes ¹⁰ that are commonly linked to sewage ponds include eggs and larvae of *Dracunculus medinensis* (Guineaworm), the common worm *Ancylostoma duodenale*, *Trichuris trichiura*, *Trichinella* and *Ascaris lumbricoides*. Their implication on human health is very common in developing world ¹¹.

Annelids, for example earthworm, *Terrestrialis lumbricoides* and *Hirudo medicinalis* (Matsatsaku Hausa) leach, respectively, represent the useful/harmless and the harmful species of the phylum ¹².

There is a vast array of molluscan species in these water bodies, namely the common land snail *Achatina achatina*, *Bulinus* group, *Biomphalaria* and *Bivalves*. Among this group the intermediate hosts for *Schistosoma haematobium* and *S. mansoni*, causative agents of deadly bilharzias, are found. Also the intermediate host (snail) for *Fasciola haematobium* of sheep and goat are usually found ¹³.

Another group of animal hosts that is thriving actively in the sewage pond is the phylum Arthropoda. This consists of the popular classes Insecta, Arachnida, Crustacean, Diplopoda and Chilopoda. For the insects, sewage pond becomes a breeding site for example housefly *Musca domestica*, whose developing larvae (the maggot) creates a chasing site around the water body. The housefly itself can partake in the dissemination of bacterial pathogens, especially enteric bacteria and viruses.

The position of *Anopheles* mosquito in ponds as a vector for malarial protozoa *Plasmodium falciparum* is well known. Mafe ¹⁴ reported that *Anopheles* and *Culex* mosquitoes are also involved in the transmission of filarial parasite *Wuchereria bancrofti*, respectively, in the urban and rural areas associated with ponds. The giant water bugs are attracted to ponds rich in small insects and fish.

Members of the class Crustacea that may easily be found in the sewage ponds can be exemplified by the crab *Daphnia magnum*, and the Cyclops Copepod. Cyclops act as the intermediate host for Guinea worm parasite *Dracunculus medinensis* ¹⁵.

The Diplopoda commonly called millipedes are one of the benthos

(staying near the base) invertebrates of the pond. They are non-poisonous and are usually seen in the early evening moving along slowly on their fingerlike legs. They are entirely vegetarian and are timid. They roll themselves into tight balls when alarmed and squirt an irritating fluid from "stink glands" situated on the side of the rounded body to repel enemies. They are considered as pond decomposers ¹².

The somewhat 10 inches or more in length nocturnal carnivorous hunters with fewer number of legs than the millipedes are the centipedes. They can be found within the decaying matter around the substratum of the pond. They are, however, poisonous to man and animals ¹⁵.

High up a little from the arthropods is the group of Echinodermata, for example sea urchins, sea cucumber, sand dollars, sea lily, sea stars and sea biscuits. All these are marine and therefore not found in fresh water ponds.

The vertebral phyla that can be found in sewage water are pisces comprising of the fish like *Tilapia zilli*, the African mudfish and the catfish *Clarias gariepinus*. These serve a great size of the human population with fish proteins whose savory frying attracts anybody passing by to the extent of salivation especially during a rainy evening ¹⁶.

The amphibians, namely frogs and toads, are also naturally adapted to these water bodies for availability of food, shelter and water for breeding activity. The reptiles that often visit the ponds include lizards and tortoises. Seldom snakes and crocodiles are seen. These are very feared considering their well known tendencies.

Mammals and birds are occasional visitors for water and food. They are for example goats, sheep and cattle that graze around the ponds.

Although no report was yet available on the ecology of viruses inside the sewage ponds of Kano metropolis, we cannot preclude the fact that so many Enteroviruses, Rotavirus, influenza and para influenza virus, perhaps measles, and Poxvirus can be found in these waters. It is possible to come across Arboviruses, especially those that relate with the *Aedes* mosquitoes or other arthropods that dwell in these water bodies.

Looking back at the enumerated biological composition of the sewage ponds, it will be scientific to conclude based on available data that these ponds are bound to be responsible at least in part to disease outbreaks in many parts of the settlements around Kano ³.

An Overview on the Health Hazards of Sewage Ponds in Kano Metropolis, Nigeria

The preceding sections have shown beyond doubt that sewage ponds (not only) in Kano are highly polluted with domestic and industrial effluents. This will suffice it to say that the ponds are a reserve of pathogenic bacteria, fungi, protozoa, annelids, arthropods, mollusks, reptiles, rodents, toxic algae and viruses. Of course toxic organic and inorganic chemicals are inclusive. In one way or the other, even if man did not drink the water directly, the poor hygienic and environmental sanitation as well as the use of water for irrigating vegetable items exposed him to these disease etiological agents. We can remember that the relished tilapia, the catfish and mudfish sourced from waters are suspected to be well loaded with pathogens, poisonous algae and toxic chemicals ¹⁷. Thus eating them rampantly may pose a health risk.

It is surprising to note that many of the major sewage around the city are well connected with the main rivers emerging from Kano metropolis, in a nutshell, Getsi River¹⁸, which drains the north western and north eastern Kano metropolis. This is remarkably seen around Kofar Ruwa, with its main tributary from Goron Dutse and Dala hills through to Jakara, Kurmi (city) market is a typical example. This river receives most of the domestic effluents from the city to move eastwardly into Gwammaja to Mayanka (abattoir) then crossing Katsina road to meander into Nomansland. There it gave rise to irrigated plains that draw their water from the sewage it carries along. This river became the water source upon which Minjibir Dam in Minjibir Local Government area about 60 km from Kano City depends¹⁸.

Coming back to the south central Kano metropolis, there is a somewhat linear head to tail formation of Gwale, Hauren Wanki, Hauren Shanu and Gadonkaya ponds by the side of the city old wall. Muktar and Deeni¹⁷ established that River Salanta, located nearly on Latitude 11°30'N and Longitude 8°38'E, the eleventh catchments river in the Kano south-central metropolis, with its inlets: on from west, down north eastern Rinji and Salanta villages; also captures the sewage ponds complex by way of the second tributary at about 1.0 km east of Gadon kaya gate. These eastern and western tributaries confluenced at Sharada Phase III and flows from north to south with an average speed of about 0.45 m per second. This covers a total area of 5518 hectares and a total distance of about 7.0 km through gently sloping contours (1450-1550 m) to its discharge point at river Tatsawarki. This finally joins the main river Challawa, one of the major sources for the Kano municipal and Wudil zone water¹⁹.

Along the courses of Salanta river, additional effluents from the neighbour settlements such as Sharada, Shagari quarters, Gurungawa, Unguwar Kwari as well as from tanneries, confectionaries, bottling companies, plastic metal and soap making industries add up to pollute the river the more. However, this river was observed to be extensively utilized by humans for domestic and agricultural purposes¹⁸. In previous studies^{17,18,20} very high mesophilic bacterial, fungal and coliform counts were observed in these two major rivers Getsi and Salanta. This may pose danger not only to the inhabitants (humans, plants and animals of Kano metropolis but even at arts of Jigawa, Bauchi and Yobe States.

Untreated disposed sewage, unorthodox fishing and other water related activities are major ways of contaminating these ponds and streams¹⁹. Personal communication with the inhabitants around the ponds and rivers claimed that gastroenteritis epidemics perhaps due to contamination with toxins of algal cyanobacteria, viruses, coliform and faecal bacteria and protozoa were not uncommon.

The idea of Boyde²¹ could also be used here to explain that fish and vegetables around the ponds and their linking rivers were probably becoming highly concentrated with carcinogenic nitrate and other toxins in addition to the microbial pathogens and might be responsible in part to the explosively repeated epidemics that proves difficult to abate. Even in the year 2003²² over flooding of many of these ponds, especially in the midst of the rainy period (Aug. Sept.), is often suspected as one of the mechanism for the dissemination of gastroenteritis outbreak in some parts of the study area and even beyond.

Restrospective Reports of Outbreaks of Enteric Infections and Their Inflictions in Kano

The report of Mukhtar *et al.*³ showed that epidemics of diarrhea with or without blood, typhoid and paratyphoid fever, salmonellosis, streptococcal and staphylococcal food poisoning and cholera occurred explosively in 1988, 1990, 1994 and 1996. These drew the attention of the Local Governments, State, Federal Ministry of Health and even the World Health Organization, for control of the menace. The study indicates that perhaps Enterobacteria are one of the most important etiological agents. The outbreaks were noted to be very often, usually during the rainy seasons, perhaps because of flooding and overflowing effect of these sewage ponds and their streams into households, wells and on farmed vegetable items. Report as at 2001 showed that a total of 231,981 individuals were reported to be afflicted, out of which 2,836 died. This, however, excludes possibly thousands of many unreported cases as well as the outcried epidemic of the year 2003 and 2009 which was not yet ascertained at the time of compiling this report.

The enterobacterial, viral and protozoal epidemics poses a serious threat not only on human and animal health but also on the economy, social and moral qualities of the people living in the affected areas. Kano was said to be deserted by business people and diplomats coming from other states in Nigeria or from other countries abroad in 1996 for gastroenteritis epidemic of the year. Unexpectedly its citizens were deterred of visas to Saudi Arabia in 1995 even for pilgrimage, one of the popular Islamic religious obligations. For the same reason the hosting of Junior World Cup in Nigeria (1995) was not a reality. This does not include the economic loss of manpower in terms of workers and laborers that could have contributed in boosting the economy of the state and the country at large.

Fungal diseases related to contact with the water of the sewage ponds:

Although information regarding sewage ponds and dissemination of fungal diseases, for example dermatitis (Trichopyton) and urinary tract fungal infection such as candiditis around Kano, were scanty at the time of preparing this chapter²⁴, it was observed that *Tinea capitis*, *Tinea pedis*, *Tinea corporis* and *Tinea angium* causes tineasis in these areas. *Trichophyton soudanese*, *Microsporum audouinii*, *Penicillium* spp., *Aspergillus* spp. and *Candida albicans* can be contracted from these water bodies. Even though fungal diseases are somewhat silent than the more violent bacterial, viral or protozoa outbreaks, their effect on man is serious and in many instances a chronic health problem¹⁰.

Platyhelminthic diseases associated with sewage ponds:

Schistosomiasis: Mukhtar *et al.*²⁵ reported that sewage ponds with their luxuriant grasses and herbaceous vegetations make a good habitat for *Volinus* snails, which serve as the intermediate host for the Miracidium or the Schistosomula of the *Schistosoma haematobium* or *S. mansoni*. This trematode causes epidemics of *Schistosoma haematobium* (bilharzia). Transmission is probably by fishermen and children from endemic areas. Eggs from the long live female adult schistosome are expelled through faeces and or urine of the infected person into the pond which distributes them into other users of the water during fishing, swimming or irrigation activities. These people suffer clinical morbidity or disability, while

a few people are killed. Its sapping chronic effects, however, make it of major consequent disability adjusted life years (DALYS) lost, 37.5% of hepatic dysfunction among children in Nigeria was attributed to schistosomiasis¹⁴.

The liver fluke disease: This is actually a disease of domestic animals (sheep, goat and cattle). The disease is commonly called fasciolitis caused by a trematode *Fasciola hepatica* whose intermediate host is a sewage pond associated snail called *Lymnaea truncatula*. The ecology of this snail around Kano metropolitan is, however, scanty²⁶, and this calls for a fresh research. It is, however, obvious that in one way or the other the domestic animals of the area that are freerange system probably harbour the disease. This may therefore create a latent economic loss in sheep husbandry.

The tapeworm disease: The people of Kano are already aware of a disease of man popularly referred to as worm infestation. Parasitologically, platyhelminthes of the class Cestodea are one of the causal agents. The common ones are *Tinea solium* and *T. saginata* whose intermediate hosts are sheep or cow and pig, respectively. It is beyond reasonable doubt that the secondary (intermediate) hosts consume grasses and the sewage water which may be rich with the infested human faeces loaded with mature eggs of these worms. This implies that as long as their meat is not properly cooked, any susceptible person becomes infested¹¹. *Diplobothrium latum*, the largest fish tapeworm of man, has not received adequate attention as regards to its distribution in the fishes caught from these water bodies. The detail of its ravaging effect is therefore outside the scope of this write up. Further research is therefore recommended on so many other worms of the phylum Platyhelminthes. The ravaging effects of tapeworms ranged from a general weakness, general ill health, leaning, nausea, vomiting, gastroenteritis, anaemia, immune compromise and sometimes death. The disease which is also very common, though so many individuals could not know that they have worms, contributes very largely in reducing the magnitude of labour force and intellectual output, thus leading to poor educational attainment, low economies and poor economic growth. These are some of the health hazards due to worms.

The nemathelminthes disease: The most dangerous members of this phylum are among the members of Nematodea, example of which are the Guinea worm disease causing parasite *Dracunculus medinensis*, pinworm agent *Trichuris trichura*, whipworm agent *Trichinella* spp., the snake worm *Ancylostoma duodenale*, *Necator americana* and *Ascaris lumbricoides* which causes ascariis. The resultant is ill health, poor growth in children, leaning, anaemia, diarrhea and dementia, various grades of gastroenteritis and poor performance in the daily human endeavours from class market to the farm as well as the deleterious consequences of these worms. Guinea worm is, however, not common in Kano metropolitan for an increase activity of the fight against Guinea worm disease unlike the other kinds of worm infestations.

Malaria: Malaria is a serious and well known pandemic caused by blood protozoa of the class apicomplexa formerly sporozoa¹² *Plasmodium falciparum*. This is transmitted by *Anopheles gambiae* complex of mosquito vectors. It is responsible for the

death of about one million children in Africa each year¹⁴. The presence of *Pistia statioles* L. encourages ponds are a prolific abode of mosquito vectors of yellow fever and malaria⁸. Sewage ponds are a prolific abode of mosquito breeding and the high relative humidity it creates may increase the longevity of the mosquitoes and hence their high probability in transmission¹⁴. The malarial scourge is ranked as the most common epidemic known to Kano people, which correlates positively with what is seemingly found in other areas with moist humid and warm mosquito breeding places of the world²⁵. Its high pyrexia and in some instances fatal consequences throughout the warm tropical countries of the world made it to be ranked as the most widely distributed parasitic disease, which WHO/TDR referred to as pandemic.

Filariasis: Infection with filarial parasites namely *Wuchereria bancrofti* leads to hydrocoel, which is noted with the enlargement of the scrotum, acute fever, inflammation of the lymphatic system and the bronchial asthmatic condition called tropical pulmonary eosinophilia. These presentations are not uncommon with some residents of Kano. This is most probable as the parasite is transmitted by *Anopheles* mosquitoes in rural areas, in latrines, sewage and ditches¹⁴. The adults of several centimeters long in lymph vessels causes the blockage of these ducts to lead to elephantiasis (enlarge body parts specially lower limbs). The microfilariae (young ones) also remain in the body and may die after 6 months to 2 years. They move secrete and excrete and die as foreign bodies thereby eliciting obnoxious immunological damage and pacing an enormous burden in the infected host.

Leptospirosis (haemorrhagic jaundice): The skunk (“Jaba”, Hausa) and giant rats (gafiya) are rodents that expose themselves first among all animals that associate with the sewage ponds for obvious reasons of shelter near the water and for feeding at an undisturbed condition over there. These rodents become infected with spirochaetes bacteria such as *Leptospira*. *Borrelia* is free living in freshwater sewage, which becomes pathogenic in man as rodents transmit them by zoonosis. The other group is the genus *Treponema* that is an obligate parasitic bacterium and causes syphilis for example. The last one is therefore not common with sewage water¹⁰.

Sewage as a Means for Transmission of Antimicrobial Resistance in the Populations

The sewage water that enters our main rivers Challawa and Minjibir may transmit drug resistant pathogens to communities who consume the raw water of these rivers. This is because crossresistance is very common especially among Enterobacteria inside environmental waters. This is known to create a serious challenge to clinicians and public health sector officials²⁷.

Transforming the Surrounding Environment into a Dirty and Ugly Site

The sewage ponds produce untold odour and stinky environment which every sensible person and even higher domestic animal detest. As wind blows in the direction of the neighbouring houses the chasing odour of these sewage ponds makes many to refuse being in that location. Anomalies ranging from nausea, vomiting, headache and stomachache are some of the unreported but

obvious ailments created by the ugly nature of the surroundings of sewage ponds. Thus we can easily say that the environment is made unaesthetic by outlook, smell and other human activities around the ponds. These places can be regarded as city jungles full of horrific and recalcitrant waste matter ranging from human faeces, garbage, refuse to even human parts as many of the ponds encroached some cemeteries, the evidence of which can be observed at Gwale, Hauren Shanu, Goron dutse and Dala ponds.

Present Control and Preventive Strategies

It is obvious that the existence of sewage ponds in the midst of a densely populated city like Kano, poses a real threat to the public health, above all, the Kano State and the Nigerian health sector in general. The National Environmental Sanitation Scheme initiated and enforced by the Federal Government of Nigeria since 1983 during the general Muhammadu Buhari regime must be appreciated³. Had it been the programme coupled with the War Against Indiscipline (WAI) not abolished by the democratic government of Chief Olusegun Obasanjo, the current objectionable state of those sewage ponds could have been converted into a recreational and purely fishing and irrigation source with less tendency to transmit disease.

In spite of that, the people in themselves are lackadaisical with respect to environmental sanitation and personal hygiene. These people dump sewage and refuse anywhere since nobody will deter them from doing so and partly because they refuse to remember the simple and/or traditional way of treating the waste matter into harmless before disposal. This is not to talk of more modern techniques, which appear to them as complex and very costly.

It cannot be forgotten, however, that near the end of 2001, as well as 2004 - 2009, The Kano State Government has contracted the services of WASCO, an environmental sanitation private company, in conjunction with Ministry of Environment to participate in making the city clean. This included the treatment and clearing of sewage ponds. If such programme is maintained by way of adequate funding and supervision, the desired goal of a clean and healthy environment may be achieved.

There are two modern sewage treatment plants, one at Tunkuntawa by Gidan Zoo and the other at Normans land, designed to receive and treat sewage, respectively, from south western, south eastern and north western as well as north eastern Kano metropolis since 1975. The major impediment, however, is that these plants are not as functional as before. Even if they are functional, most of the sewers that bring sewage from many parts of Kano City have now been blocked with refuse disposed intentionally by the inhabitants themselves, as soon as they learnt that the WAI pressure has been lifted in the year 1999. The careless attitude was responsible for the blocked of virtually all the smaller as well as the main gutters of the city drainage system.

It is also important to note that the state governments do give contracts for the building of modern sewers although the contractors defy this standard requirement and they open gutters which become easily clogged with recalcitrant polythene bags and soil.

Furthermore, the economic status of most of the inhabitants is too meager to give them the opportunity of carrying their solid waste very far outside the city rather than dump them in a nearby backyard pond or refuse dump site around houses. Since there is need for waste disposal through sewage ponds which goes into

rivers, there is equally need for water protection even for natural life conservation and ensuring good environmental quality and not to mention their roles as our major source of drinking water. At the part of the two very important rivers that unavoidably drain the sewage pond waters of the southern central and north eastern Kano metropolis Salanta and Getsi into greater river of Challawa, Hadejia and Jamaare and Minjibir Dam, respectively, a substantial government effort is being made in the treatment of the water for domestic purposes. At one time³, the Federal Government of Nigeria, in its effort to root out the recurrent epidemics due to sewage contaminated domestic and irrigation water, has declared 1,329 million Naira to Kano State which on the other hand added 16 million Naira for the purchase of drugs to distribute to all hospitals for patients at subsidized price through the Petroleum Trust Fund (PTF).

Five million Naira was given to Kano and Lagos States in 1996 to complete their water treatment and drainage projects for public health improvement. The contribution of the Emirate Council which charged the ward heads with the responsibility of checking unauthorized digging out of pit burrows within the metropolis should be appreciated. This will augur well in stopping the increasing number of sewage ponds especially in Kano.

At present the function of our Environmental Health Workers and Officers (EHAs and EHOs) was resuscitated. This will give them a full mandate of making sure that our environment is maintained clean and devoid of serious disease vectors such as for malaria, typhoid and gastroenteritis all due to unnecessary number of sewage ponds²⁹. Thus, the ringing idea for the provision of health education and boosting of economic status among the populace is the major way that would invariably aid not only Kano but the developing urban centers to attain an improved public health.

Conclusions

Ponds containing a large volume of water are scattered around Kano metropolis. The pressure of population explosion that necessitated excavating land for building material as well as for sewage disposal caused it. This leads to injection of domestic and even industrial effluents containing a large quantity of solid and chemical waste products, which converts them into ugly and dirty sites with chasing odour. The site also serves as breeding ground for many disease vectors like snails for schistosomiasis (bilharzias) *Fasciola hepatis* in sheep and cattle. Mosquitos, which transmit malaria, filarial worms and yellow fever, are also not uncommon. Pathogenic bacteria such as enterobacteria, fungi, protozoa and viruses are also transmitted. Toxic chemicals and plant (algal) toxins are also cultured in these ponds.

This might be partly responsible for many epidemic explosions of various grades. The public health hazard ranged from physical incapacitation or disability to death in some cases. There is disastrous effect on the people due to disease. The presence of sewage ponds in the city poses real threat to public health. However, efforts are being put at individual, societal and government to curtail the menace. The economic stand of the inhabitants should be boosted in any attempt to educate them toward the achievement of the desired goal. Scientific research should be encouraged and referred to for any meaningful action on environmental and public health. At present, the state is creating awareness through television, radio and public lectures against

dangerous infections which have a forbearing with dirty environment. In addition, some nongovernmental organizations (NGOs) such as the Youth Society for the Prevention of Infectious Disease and Social Vices (YOSPIS) based in Kano are doing a lot in this regard. International agencies including the French government (MSF), Belgique Duprestrat in collaboration with UNICEF, WHO, TDR, UNDP and the World Bank assisted programmes are actively assisting the Kano State government to go well along the public health direction³.

Recommendations

- i. Public enlightenment on the health risks imposed by untreated wastes but dumped into sewage ponds in our urban centers should be intensified.
- ii. The Ministry of Environment and the Environmental Protection Agency of Kano State must expedite action towards proper siting of sewage ponds.
- iii. The State Government should provide more funds as to establish more sewage treatment plants in Kano City (Indeed none is available and functional at the time of this write up). If this is done sewage ponds can easily disappear.
- iv. Before accomplishing these strategies, more attention should be given to hospitals for health facilitates such as chemotherapeutics.
- v. People should be encouraged to construct sewage and or septic tanks as well as water system toilets. This is, however, only possible if the economy of the common man has improved significantly.
- vi. Proper town planning must be put in place.
- vii. The WASCO (Waste Disposal Service Company) since 2003 and Refuse Disposal and Management Agency (2003-2009) that presently tried to keep Kano clean should be mandated with the responsibility of keeping our sewage ponds clean as well. This is meanwhile subject to proper finances from the state and local governments.
- viii. Herbicides, mosquitocides and molluscicide should be used around the still existing pond to control grasses and vegetation, prevent transmission of malaria and filariasis and yellow fever by mosquitoes as well as preventing schistosomiasis transmission.
- ix. Scientific researches beneficial to our environment should always be sponsored by the national and international governmental and non-governmental agencies.

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