Indicators of health risks from surface water and groundwater contamination in urban centers of Nigeria

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Abstract This paper examines the surface water and groundwater pollution which results from wastes generated by industrial, commercial and household activities in several urban centers of Nigeria. The various efforts made at promoting standards are described and their effectiveness in achieving desired objectives is evaluated. Other response strategies for reducing the health risks from water contamination are presented. The paper emphasizes the need for (a) improved water quality standards and criteria; (b) effluent and site control guidelines; (c) effective monitoring of industrial discharges; and (d) effective water resources management programmes.

INTRODUCTION

The problems of environmental degradation resulting from rapid industrial development and largely unrestrained urban population growth have been unprecedented in many West African countries. In Nigeria, the post-independent period, particularly the oil boom of the 1970s, has been characterized by a rapid expansion in the urban population and a rapid increase in industrial, commercial and construction activities. This, in turn, has led to a phenomenal increase in the volume and diversity of hazardous wastes and the consequent contamination of water, air and land. This contamination can result in serious illness and, in some cases, death. In particular, both surface water and groundwater have been contaminated by industrial, commercial and household discharges, thus creating the potential for considerable health risks for the urban population. Although there is increasing awareness of these potential risks, little has been done to characterize the pollution in the urban centers of Nigeria or to assess the health risks. It is the purpose of the present paper to address these issues.

THE STUDY APPROACH AND STUDY LOCATIONS

Based on the degree of industrialization, cities in West Africa can be divided into four basic categories: very highly industrialized, highly industrialized, moderately industrialized and poorly industrialized. In this study, examples of the first two categories of cities have been used. These cities include the very highly industrialized cities of Lagos, Kaduna and Port Harcourt and the highly industrialized urban centers of Kano, Ibadan
Lagos is the commercial capital of Nigeria and the most rapidly urbanizing center in West Africa. It also is a center for indiscriminate dumping of refuse. Refuse dumps usually approach the size of large mounds or hills and remain uncollected for several months. The present study evaluates the impacts of industrial establishments on water quality. In addition, results are presented on the quality and possible contamination of groundwater in areas close to refuse tips (landfills) in the Lawanson and Ikeja industrial areas of Lagos.

CHARACTERISTICS OF WASTES

The incidence of environmental pollution caused by solid waste disposal in the urban centers of West Africa varies from city to city. In general, the government residential areas and the planned neighborhoods tend to have less pollution than other neighborhoods, although waste disposal problems are growing in all areas. To the industrialists, waste disposal is a profit reducing activity. Although most of them are well aware of the environmental consequences of any irresponsible disposal of their industrial wastes, they have, in most cases, chosen the cheapest disposal method. Thus, the premises and the immediate environment of a number of the industries are littered with solid wastes of all kinds, especially non-process wastes. Many of the industrial establishments contract out the disposal of their solid wastes to private contractors. In principle, the contractors are required to obtain clearance from the Ministry of Health to dump at approved sites, but, in practice, they indiscriminately dump at any convenient location. Thus, increasing urbanization and the consequent increase in the number of industries generating toxic and hazardous wastes has increased the danger to living resources and human health.

Untreated or partially treated liquid wastes are also discharged from industries onto land and into water bodies. In Jebba and Kaduna, for instance, partially treated discharges are dumped into the rivers Niger and Kaduna, respectively. In Lagos, the discharges are dumped into the open drains from which they flow into the streams and the ocean.

Household and commercial wastes also significantly contribute to health hazards in the urban centers. Problems are especially severe in traditional residential areas with high densities of population and housing. In these areas, the total waste generated is very high, and the methods and frequency of waste collection are very inadequate. Unlike in more advanced countries, there are neither the institutions nor the structural facilities to handle urban wastes in many developing countries like Nigeria. According to the Lagos State Waste Disposal Board, domestic, industrial and commercial wastes constitute about 35%, 38% and 20%, respectively of the total wastes gathered in the Lagos metropolitan area. In all the urban centers of Nigeria, the high density traditional, or old-core, areas normally generate more solid wastes than the newer areas. Indeed, in these areas, it is a common sight to see solid wastes blocking sections of streets and open spaces. Such dumps emit offensive odors and constitute health hazards to neighborhoods. In addition, the leaching of solid wastes into groundwater poses growing health risks for the large urban population that relies on groundwater for domestic use. Worse still, during the rainy season, damaging floods often occur as a result of solid waste blocking gutters and river channels in urban areas.
The characteristics of the wastes in the urban centers vary in time and space and from one urban center to another. For example, a study of the mean percentage composition of some components of solid wastes in the urban centers shows that industrial remnants from paper, tin and metals, and bottles and glasses form a high percentage of solid wastes around the urban centers. Other industrial waste components include food remnants, cartons, plastics and polythene. There is much variation from one urban center to another. For example, the mean percentage of food remnants is higher in Port Harcourt than in Lagos, while the percentages of paper, tin and metals, and bottles and glasses are higher in Lagos than in Port Harcourt. A more detailed spatial analysis of the intra-urban variations in Lagos shows that the largest proportion of food remnants occurs in the Ikeja area while the largest proportion of tin and metals as well as bottles and glasses occurs in the Surulere area of the urban center. The largest proportion of paper occurs in Mushin area, which is one of the old cores of the urban center. Similar differences are found in other urban centers. In all of these cases, the proportions for food remnants are highest.

Temporal changes also occur in the components of solid wastes in an urban center. For example, in 1969, food remnants formed about 9% of the solid waste composition in the old town and about 70% in the new town of Ibadan. By 1982, these proportions had decreased to 7% and 27%, respectively. Similarly, in 1969, bottles and glasses formed only 1% and 2%, respectively, whereas in 1982 they formed about 6% and 10%.

SURFACE WATER CONTAMINATION

An example of the environmental impact of industrial pollution on surface water can be illustrated with the study of the Nigerian Paper Mill in Jebba. In this study, it was found that a major offending pollutant is colored settleable solids (pulp fibre) that precipitate into the River Niger a few metres downstream of the discharge point. However, because the volume of the effluent is small compared with the volume of the river, the adverse effects of the effluents are localized to the immediate vicinity of the discharge point. The pH from combined factory effluent was relatively low (4.4); consequently the pH downstream of the discharge was reduced. Similarly, because the total solids from the combined factory effluents were high, these pollutants were increased downstream, particularly within a distance of about 50 m from the discharge point. Concentrations of dissolved solids, suspended solids, magnesium, sodium, manganese and iron also increased downstream of the mill.

Health risks from surface water contamination can also be illustrated with the effects of textile industries in Kaduna, Kano and Lagos. In all these cases, the effects on the receiving rivers and streams include coloration, high pH, high total solid contents and relatively high values of sodium, magnesium, calcium, manganese and iron. Because much of the population in the country depends upon streams and rivers for their daily water requirements, there is clearly a need to ensure the monitoring of the effluents discharged into these streams and river.

On 6 May 1979, the *Sunday Times* of Nigeria carried a story which was captioned "Danger Feared Over Water From Estate." This story was referring to the Ikeja Industrial Estate of Lagos. According to this article, the cause of the danger was the hot, foul-
smelling water which gushed out in different colors from the Wemabod Effluent Treatment Plant. The effects of the effluents of this plant were devastating on both surface water and groundwater. For example, the waste discharged into the Shasha and Iyalaro streams of the Industrial Estate had a major environmental impact on the water in both streams. Indeed, as perceived by the inhabitants living around the streams, the color of Iyalaro stream changed daily, hence, the name "Iyalaro" (the mother who dyes) stream. This stream, as well as many others in the industrial estates of the Lagos Metropolitan area, eventually empties its waters into the Lagos lagoon. Thus, the environmental effects of the pollutants on surface water were felt far away from the point of discharge of these pollutants.

GROUNDWATER CONTAMINATION

As for surface water, industrial pollution has severe environmental consequences on groundwater. For example, in a study of the effects of the effluents from the Wemabod Effluent Treatment Plant referred to above, many wells were so polluted that they could no longer produce potable water to the residents of the Ikeja Industrial Estate.

Recently, a study was carried out on the quality of possible contamination of groundwater around areas close to refuse dumps in the Lagos metropolitan area. Results indicated that several water supply wells in Lawanson residential area and the Ikeja industrial area have high concentrations of iron and mercury (exceeding WHO standards). The Ikeja industrial area, however, has relatively lower concentrations of these metals than the Lawanson residential area. Assuming that, in general, Lagos metropolitan areas have similar natural concentrations of these metals, the results suggest that water quality differences may be the result of the large number of refuse dumps in the residential areas.

REDUCING HEALTH RISKS FROM DRINKING WATER CONTAMINATION

In order to reduce contamination of drinking water, it is essential to regularly evaluate and efficiently dispose of wastes. In West Africa in general, and Nigeria in particular, private and public efforts have been made to develop programs for tackling the waste management problems. Unfortunately, none of these efforts have been adequate. In the public waste management disposal systems, the establishment and use of different varieties of waste disposal units have been established in different cities of Nigeria. Such "waste disposal units" occur at the local Council, as well as the State and the Federal Government levels. At the Local Council level, for instance, such units usually are the operational section of the Health Department. They are responsible for locating public garbage collection depots in different parts of the city where residents collect their wastes. The units also are responsible for ensuring that collected wastes are disposed of. However, these arrangements generally break down or are completely non-functional.

For example, waste disposal units face serious operational problems, such as lack of sufficient funds for operations, high costs of collection and transportation of wastes to final disposal sites, shortage of personnel and use of obsolete equipment for
collection. In fact, much of the equipment used is not designed for and not suitable for the country's physical and social conditions. When such equipment breaks down, as it often does, there are no parts for repairs. Indeed, the broken equipment sometimes constitute significant solid wastes themselves. In addition, unfavorable weather conditions make collection of wastes very difficult and sometimes impossible. The result of these difficulties is a serious health threat.

In some parts of the urban centers, the door-to-door method of solid waste collection is used. This method is not commonly employed, however, because of the difficult access to residential areas and the costs of vehicles and maintenance. Even in the very few areas where the method is being used and where accessibility is less problematic, there are additional difficulties related to the lack of standardized waste collection bins/bags. Many different types of containers are used in storing wastes, which makes collection laborious and time consuming. There also are problems resulting from congested streets, which reduce the number of pick-ups that can be completed in a day. Thus, the door-to-door collection technique of waste disposal is usually a very difficult, uneconomic venture.

On the state and national level, the first meaningful step to address environmental protection was taken in 1977 when the Federal Government established the Ministry of Housing and Environment. In 1981, the Federal Environmental Protection bill was passed, but had little or no impact on the country's waste or water contamination problems. It was not until 1983 that the seriousness of environmental pollution, particularly the unsanitary disposal of wastes, became recognized in government circles, and the concept of the "War Against Indiscipline" (WAI) was introduced. WAI was aimed at thoroughly cleaning and sanitizing the Nigerian society and creating a social order based on discipline, patriotism, honesty and self-reliance. Environmental sanitation was one of the issues targeted in the program, along with punctuality, orderliness (queuing) and elimination of corruption. Unfortunately, like many similar programs, the concept of WAI and its operational strategies could not cope with the rapidly increasing waste problems in the urban centers. The next move was the declaration of every last Saturday of the month as an "Environmental Sanitation Day." Under this program, the government imposed an "environmental curfew," which restricts the movement of people on environmental sanitation day and requires every individual to stay in his/her house or compound between 7:00 am and 10:00 am to clean up his/her surroundings. The wastes generated during the exercise are supposed to be promptly collected and disposed of by the environmental sanitation task forces set up in each administrative unit area. Unfortunately, several days or even weeks after each exercise, heaps of uncollected wastes commonly are seen in many cities. In addition, many people do not engage in any cleaning activity during the period. Thus while the "rituals" continue, the urban centers are not getting cleaner. Indeed, the government seems to be losing the battle in the "War Against Indiscipline."

The private institutional arrangements of solid waste management system differ from the public systems in many ways. For example, the public system is administered as an essential public social service, while the private institutional arrangement is a contractual arrangement between a private firm or establishment and the individual beneficiary (the refuse generator). Moreover, the public service is free while there is a user charge for the private system. Also, while the public service arrangement is supposed to cover the whole city comprehensively or to concentrate on areas where the rate of solid waste
generation is highest, the spatial scope of private arrangements depends on affordability. Consequently, the private arrangement is restricted to the Government Reservation Areas (GRAs) and some high- and medium-income neighborhoods. There are, of course, hybrid arrangements, whereby a public organization such as a local council or a state’s Ministry works in collaboration with a private company on a contractual basis. However, such private arrangements, though normally more efficient than the strictly public system, are usually profit-oriented and sometimes out of the reach of the majority of urban dwellers. They also are usually open to corruption. In general, although the use of the private institutional arrangements usually provides better results than the public service arrangements, the problems associated with the private arrangements limit their effectiveness in creating a clean urban environment.

CONCLUSION

Health is wealth and the environment is the life support system, the resource for creating wealth. The recent trends of increase in land, water and air pollution and their consequences for human health present a frightening picture. In West Africa, millions of people die every year from diarrhea and other diseases, largely as a result of contaminated food or water. In addition, millions of people suffer from debilitating intestinal parasitic infestations or from illnesses linked with water contamination and lack of sanitation. In particular, many urban dwellers are regularly exposed to high levels of water contamination which exceed the WHO standards.

The present study illustrates the fact that the consequences of solid waste disposal, poor sewage, unsanitary conditions and the perennial problems of unsafe water supply are some of the most important causes of health risks in many urban centers of West Africa. The national and state water policies and the various regulations on pollution abatement, effluent limitation and hazardous and solid waste management are instruments for safeguarding the health of the populace and the survival of future generations. Unfortunately, the various policies and regulations have not been effective. There is an urgent need to implement the various government programs and to ensure their effectiveness and efficiency. There is need for greater government commitment, particularly in the "War Against Indiscipline," as it relates to environmental sanitation. Water quality standards, effluent and site controls and effective monitoring requirements must be enforced and effective water resources management programs must be developed.

It is also important to emphasize the need for research on the environmental impacts of wastes and the characteristics and health consequences of water contamination. Long-term data collection on relevant environmental parameters and monitoring of the effectiveness of policies or programmes are also needed. Considerable success can be achieved if the public is made to participate in the planning and implementation of the relevant policies and programmes. Such participation requires improved public awareness of the health risks of water contamination. In particular, community leaders must be involved in educating the people on the impacts of wastes and the need to remove wastes as rapidly as possible. Such public involvement could, for example, increase motivation for effect use of communal refuse depots and create the possibility of achieving greater efficiency and wider participation in the user-charge method of waste disposal.
Finally, it may be noted that considerable progress can be achieved through collaboration, cooperation and coordination among researchers, policy makers, planners and the public.

All arms of the governments must recognize the need for effective implementation of their policies and programmes. They must recognize the need for an environment of a quality that will permit a life of dignity and well being for the present and future generations.