

**Municipal Solid Waste Management in Developing Countries:
Nigeria, a Case Study**

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NTRES 314
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26 April 2004

*“The poor state of solid waste management in urban areas [of developing countries] is now not an environmental problem but also a major social handicap.”
(Daskalopoulos et al. 1998).*

Introduction

Municipal solid waste (MSW) is defined non-air and sewage emissions created within and disposed of by a municipality, including household garbage, commercial refuse, construction and demolition debris, dead animals, and abandoned vehicles (Cointreau 1982). The majority of substances composing municipal solid waste include paper, vegetable matter, plastics, metals, textiles, rubber, and glass (USEPA 2003). Municipal solid waste disposal is an enormous concern in developing countries across the world, as poverty, population growth, and high urbanization rates combine with ineffectual and under-funded governments to prevent efficient management of wastes (UNEP 2002, Doan 1998, Cointreau 1982).

There are several factors that set MSW management in developing countries apart from management in industrialized countries. First, the types of materials that compose the majority of the waste are different. In developing countries, there is a much higher proportion of organics, and considerably less plastics (Cointreau 1982). The large amount of organic material makes the waste more dense, with greater moisture and smaller particle size (Cointreau 1982). A second difference is that technologies used in industrialized countries are often inappropriate for developing countries. Even garbage trucks are less effective because of the much heavier, wetter, and more corrosive quality of their burden (Cointreau 1982). Other technologies, such as incinerators, are often far too expensive to be applied in poor nations. Third, developing countries' cities are characterized by unplanned, haphazardly constructed, sprawling slums with narrow roads

that are inaccessible to collection vehicles (UNESCO 2003, Daskalopoulos et al. 1998).

Finally, there is often a much smaller stock of environmental and social capital in developing countries. People are unaware or uncaring of cradle-to-grave solid waste management needs, being more concerned with more immediate problems such as disease and hunger.

Types of Solid Waste Management

The four most common methods of municipal solid waste management are landfilling, incineration, composting and anaerobic digestion. Incineration, composting and anaerobic digestion are volume reducing technologies; ultimately, residues from these methods must be landfilled (Seo et al 2004).

Landfilling is the only true “disposal” method of managing MSW. It is also the most economical, especially in developing countries where it typically involves pitching refuse into a depression or closed mining site (Daskalopoulos et al. 1998). Landfills produce landfill gases and leachate which can harm human and natural systems. Landfill gases (LFGs), produced when methanogens decompose complex molecules, are primarily methane and carbon dioxide (up to 90%), but also include CO, N₂, alcohols, hydrocarbons, organosulfur compounds, and heavy metals (El-Fadel et al. 1997). Leachate forms as water percolates intermittently through the refuse pile, and can contain high levels of nutrients (nitrogen, phosphorous, potassium), heavy metals, toxins such as cyanide, and dissolved organics (El-Fadel et al. 1997).

Incineration is the high-temperature combustion of wastes (EPA 1995b). Non-combustibles must be sorted out before incineration. Benefits of incineration include

reduction of volume of waste and production of energy in the form of electricity and heat (Seo et al. 2004). However, construction and start-up costs of incineration facilities can be prohibitively expensive for developing nations.

Composting and anaerobic digestion use natural microbial organisms to decompose the organic fraction of MSW (Seo et al. 2004). The non-organic fraction must be landfilled or incinerated. These methods reduce the volume of waste that must be landfilled, and end products can potentially be used as agricultural fertilizers, or processed into fuels for motor vehicles (Sonesson et al. 2002). However, like incineration, project implementation can be too expensive for poor communities.

Health and Environmental Impacts of MSW

Assessing the impacts of municipal solid waste management involves consideration of a large number of components. Health impacts include exposure to toxic chemicals through air, water and soil media; exposure to infection and biological contaminants; stress related to odor, noise, vermin and visual amenity; risk of fires, explosions, and subsidence; spills, accidents and transport emissions (Dolk 2002). Environmental impacts can be clustered into six categories: global warming, photochemical oxidant creation, abiotic resource depletion, acidification, eutrophication, and ecotoxicity to water (Seo et al 2004).

Landfills

Landfills are associated with a plethora of health and social effects. Health and social impacts include odor nuisance; ozone formation (from reaction of NO_x and non-methane organic compounds with sunlight) that can cause pulmonary and central nervous

system damage; fire and explosion hazards from build-up of methane; an increase in the number of vermin (birds, rodents and insects) which act as disease vectors; and ground and air pollution from leachate and landfill gases (Daskalopoulos et al. 1998, El-Fadel et al. 1997, EPA 1995a, Neal and Schubel 1987). Water contamination by leachate can transmit bacteria and diseases. Dr. Emeka Nwanko stated that typhoid fever is a common problem for the people of developing nations because many of them cannot afford to dig wells deep enough to reach fresh aquifers.

There are also many environmental impacts of landfills. Ozone formation can cause decreases in crop yield and plant growth rate. Methane and carbon dioxide are greenhouse gases that contribute to global warming. Methane is twenty times more effective at trapping heat than carbon dioxide, and more persistent in the environment (EPA 1995a). Leachate from the landfill can enter ground water systems, leading to increases in nutrient levels that cause eutrophication (El-Fadel et al. 1997). Finally, bioaccumulation of toxins and heavy metals can occur.

Incineration

Incineration impacts society by production of odors and in the unsightliness of the facility (Garrod and Willis 1998). There is also the potential for surface water pollution from waste waters (used for quenching hot ashes before transport) (EPA 1995b). The most important health and environmental impact is from air emissions, which include particulates, CO, NO_x, acid gases (chlorides and sulfides), volatile organics and mercury. These compounds contribute to bioaccumulation of toxics and acid rain (Daskalopoulos et al. 1998, EPA 1995b). Inhalation of particulate matter poses a health danger: smaller

particles are more likely to carry heavy metals, which run can be retained in lung tissue and enter the bloodstream (Neal and Schubel 1987).

Composting/Anaerobic Digestion

Health and social impacts include noise, odor, and unsightliness (Garrod and Willis 1998). Additionally, many of the microorganisms found in compost are known respiratory sensitizers that can cause a range of respiratory symptoms including allergic rhinitis, asthma, and chronic bronchitis (Swan et al. 2002). Both composting and anaerobic digestions produce biogases, though less than landfills. Composting is aerobic and produces primarily carbon dioxide, while anaerobic digestion produces methane. Both gases contribute to global warming.

Other risks

Recycling can also pose health and environmental risks. Sorting facilities contain high concentrations of dust, bioaerosols and metals. Workers commonly experience itching eyes, sore throats, and respiratory diseases (Gladding 2002). Environmentally speaking, recycling uses a large amount of energy resources (Daskalopoulos et al. 1998).

Health and social side effects are equally as important as environmental impacts when considering MSW management. For people in developing countries, bodily well-being is a far more pressing concern than the fact that open burning of garbage contributes to acid rain or global warming. Outrage over health issues of poor waste management could therefore be a motivating factor towards more sustainable environmental practices, as suggested in Dryzek's discourse on green rationalism.

Nigeria: A Case Study

From an American perspective, the sheer magnitude of the solid waste problem in Nigeria is hard to comprehend. There are no public waste bins, as the amount of trash that accumulates in a matter of hours would be more than waste collectors could haul in a day. Nigerian garbage “dumps” are located on the side of the highway at the fringe of cities and slums. Since there are no means for containment, trash often spreads into the road, blocking traffic. A fair percentage of the trash never makes it as far as the informal dumps; when refuse accumulates, households and businesses pile it in the median of major roads and burn it (Warren, personal experience).

Nigeria is a nation that exemplifies chronic solid waste management problems in conjunction with population growth. It is the most populous country in Africa, with over 120 million residents (World Bank 1996), and over the past 50 years, has had the third largest urban growth rate in the world at 5.51% annually (UNWUP 1999). It is estimated that nearly ten percent of the population (21 million people) live below the national poverty line (World Bank 1996). Since gaining independence from Great Britain in 1960, Nigeria’s government has been controlled by a succession of military dictators. The election in 1999 of Olusegun Obasanjo was the beginning of the first true democracy in Nigeria (Economist 2002), however the country is still known to be extremely corrupt.

The federal government has very little control over environmental regulation as a whole. The Federal Environment Protection Agency (FEPA) was established in 1988 to control the growing problems of waste management and pollution in Nigeria (Onibokun and Kumuyi 2003). Vision 2010 was FEPA’s attempt to address environmental problems in the nation. The report proposed goals to be accomplished by the year 2010 that would

lead toward sustainable development. In regard to solid waste management, the report says the goal is to “achieve not less than 80 percent effective management of the volume of municipal solid waste generated at all levels and ensure environmentally sound management” (Vision 2010 2003). Strategies to achieve this goal include education and awareness programs, developing collaborative approaches to integrative management of MSW, strengthening existing laws and ensuring compliance, and encouraging local and private sector participation. Although this represents a positive, though somewhat undefined, approach to solid waste management, the reality of poverty and government corruption has prevented effective implementation of these plans. There is little to hold the government or the public accountable to the regulations developed by FEPA and Vision 2010 (Bankole 2004).

In Nigeria, it seems as though no organization is willing to take responsibility for regulation of waste management. For example, in Ibadan, in the western part of the country, jurisdiction over waste management has changed hands several times since the late 1980s (Onibokun and Kumuyi 2003). Although local governments are intended to fund solid waste disposal, less than a quarter of the necessary money was collected in 1994 (Onibokun and Kumuyi 2003). Since state resources are often extremely limited, private companies will often be contracted for waste disposal. However, these companies are frequently no more effective than the state—in Ibadan in 1991, there were twenty-three registered private waste collectors, but only ten were found to be operational (Onibokun 1999).

Lagos, south of Ibadan, demonstrates another obstacle to effective waste management. The city has a population of between twelve and eighteen million people,

the sixth largest city in the world. Between twenty and twenty-five percent of Lagos' budget is allocated to waste management. However, even with proper garbage-collecting trucks, the incredibly dense streets of Lagos make it impossible for the trucks to maneuver through to collect the excessive amounts of trash that are produced in day. In the five other mega-cities of the world (cities with over ten million people), over forty trips are made per day from the city to the dump site. In Lagos, only two trips are possible each day (UNESCO 2003).

Analysis of Municipal Solid Waste Management in Nigeria

Causes behind MSW crisis

In class, we discussed Hempel's drivers of environmental destruction: anthropocentrism, centropocentrism, technological advance, human population growth, poverty, affluence, market failure, and failure to have markets (1996). A major driver of environmental destruction in Nigeria is poverty—people consume and discard materials to eke out a subsistence without regard for environmental impacts. Additionally, finances to build proper disposal facilities are practically non-existent. The effects of poverty are vastly amplified by explosive nationwide and urban population growth. Market failure also plays a role in that environmental costs are not internalized into the cost of living in Nigeria.

Although the government is generally held responsible for solid waste management, there is no system of accountability and oversight which impels the state to work efficiently. For example, it is not uncommon for the government to withhold employees' wages for several months at a time if finances are tight (Nwanko). The

government is plagued by lack of adequate policies and human resources, insufficient facilities, and financial difficulties (Agunwamba 1998). However, candidates for office continue to promise better management, raising expectations which they are then unable to meet (Hughes). People feel entitled to waste collection services, and do not believe that waste management is part of each individual's responsibility (Hughes).

The Three Epochs of Environmental Management

Nigeria's situation can be analyzed in terms of Mazmanian and Kraft's epochs of environmental policy. It is clear that governmental regulations of solid waste management have been utterly ineffective, despite policies defining management goals and minimal legislation. The Nigerian government is currently in the fledgling stage of epoch 1, beginning to pass national regulations for solid waste control. The first epoch is characterized by strong governmental involvement, development of an administrative infrastructure to regulate pollution, establishment of pollution control measures as a national priority, and "end-of-the-pipe" management (Mazmanian and Kraft 2001). However, corruption and constrained finances promise that future regulations will be equally as ineffective as past attempts. Therefore, instead of focusing on government-driven policy, Nigeria should attempt to incorporate aspects of epochs two and three. Epoch two is defined by regulatory flexibility, management of pollution through market-based and collaborative incentives, introduction of pollution prevention, and a shift to an oversight capacity of local and regional governments. Sustainable development is the basis of epoch three, incorporating pollution prevention at the individual, business, and industrial levels, institution-building, and attempts to balance human and natural system needs (Mazmanian and Kraft 2001).

Epoch two introduces market incentives and market redefinition as waste management possibilities. In Nigeria (and many developing countries), there already exists a potential arena in which to develop market incentives. Thousands of people make their living by scavenging recyclable materials from open waste dumps (Kasseva and Mbuligue 2000). Currently, the job pays little, exploits the individuals who make their living in this way, and is extremely hazardous. There is significant increase in diseases contracted by landfill scavengers, and AIDS and other blood diseases from hazardous medical wastes are a high risk (Kasseva and Mbuligue 2000).

Scavengers and other entrepreneurs potentially provide an important source of social capital. Programs could succeed if peoples' economic well-being was involved. In the mid-1990s, the Peace Corps developed the Urban Environmental Management Project with the government of the Cote d'Ivoire. The goals were to develop locally-based waste management services, and to strengthen cooperation among neighborhoods, municipal employees, and public/private organizations. Young entrepreneurial volunteers were trained and educated to collect and transport household trash to intermediary points, from which municipal workers would then transport it to the final dumpsite (Doan 1998). Similar programs could be used to encourage source separation and recycling and composting. Agunwamba estimates that efficient recycling and composting programs could save 18.6% in waste management costs and 57.7% in landfill avoidance costs (1998). The key is to create markets and market incentives to encourage scavenging, recycling, and composting. There is already high demand for scavenged materials (Kasseva and Mbuligue 2000), and since MSW in developing countries has such a large proportion of organic material, composting could be an effective option to

reduce waste volume. Additionally, composted material could be used as fertilizer, if a market were developed for its sale. Recycling and composting embody epoch two's stress on pollution prevention.

A final important aspect of epoch two management is the relegation of local and regional governments to an oversight function, monitoring the waste disposal efforts of community-based or private companies. Freed from having to develop MSW programs, the government could use its funds to ensure that private and community organizations operate satisfactorily, making these organizations accountable to the needs of the people. Fines for non-compliance could be imposed, and might even earn money for future investments in oversight functions.

Epoch three moves toward sustainable development. This balanced approach to governance is based strongly on community and organizational involvement. Strong institutions on all levels of government (state, local, community), with high levels of integration and overlap, are necessary. Investment and participation from all sectors is important for success. There are many stakeholders in the MSW management issue: state and regional governments, private sector interests, national and international non-governmental organizations (NGOs), national and international investors, and communities. Unfortunately, there has historically been a paucity of international involvement in social and environmental issues in Nigeria (Nwanko). However, the past decade has seen the formation of several environmental organizations that attract funds for management projects to the country (Vision 2010 1996). Additionally, community identification plays an important social role in Nigeria, despite its being composed of a large number of different ethnic groups (Warren personal experience).

It is difficult to address the issues of community and organizational participation and strengthening institutions because these efforts take a long time, and may see significant setbacks throughout the process. In the United States, waste removal itself is a form of institution, interwoven into the fabric of our society. Community participation may be relatively easy to ensure; the people living in Nigeria are dealing with MSW problems directly and profoundly. Given training and reasonable solutions they would likely be very willing to spend time and effort managing MSW. The most arduous task, however, will be gaining the trust of the people. True accountability (for example, by making private and community management answerable to the government) will require commitment on behalf of all stakeholders. Additionally, we believe that education at all levels is an important starting-place in practical, effective, lasting municipal solid waste management.

Conclusion

Waste management plays an integral role in human activity. Not only does it involve rational decision making about whether to bury, burn, recycle, or produce less waste, it must also consider impacts to health, society, and the environment. Assessing the benefits and costs of various waste management policies and projects is complex because it involves numerous, interconnected economic, social, and biological components. The barriers to effective MSW management are not simply lack of policy, but lack of infrastructure, education, social awareness of problems and solutions, and lack of institutions promoting sustainable actions. Barrett et al. (2001) recommend that the

“conservation community” needs to invest in research to work out institutional design questions, and in building and linking conservation institutions.

These needs are real—education and cooperation are fundamentally necessary for progress to be made in any environmental issue. Ultimately, policies designed for institution-building, increasing awareness, and market restructuring may even create success stories in a number of environmental issues. However, the main texts we have read in class, and the discourses we have used to analyze the Nigerian municipal waste problem, were developed by analyzing systems in industrialized nations. Despite movement toward market and community-based programs, policy in these countries still relies on the threat of government intervention. Many developing nations have created legislation based in such discourses, but they lack governmental power. Such policies are unrealistic for the problems of population, poverty, and economic instability found in developing nations (Hughes), and can cause as much damage as good. Nwanko says that these policies are the “result of institutional arrogance plus personal good intentions.”

Change will not come from legislation or policy statements, nor from the promises of government officials. Instead, it must come from incremental efforts, working from many starting points in the markets and communities. For example, a first step could be design of a garbage truck explicitly for the dense wastes of developed countries, or the organization of a community group that transports garbage to an intermediary point, or helping several young entrepreneurs open a company that sells scavenged materials. These are the realistic actions to take, and the actions that in the long run can lead to strong institutions, interwoven business and community interests, and perhaps even to well-designed, practical government regulation.

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