Nigeria
Strategic Options for
Redressing Industrial Pollution

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Industry and Energy Division
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# NIGERIA
STRATEGIC OPTIONS FOR REDRESSING INDUSTRIAL POLLUTION

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This report has been prepared by Jaadip Singh (Task Manager), Indu Hewawasam (AF4IE), and David Moffat (Consultant). The Nigerian Federal Environmental Protection Agency provided considerable input and assistance during all stages of report preparation. The desk study on which the report is based was prepared by David Moffat, utilizing the findings of a mission to Nigeria in June 1992 as well as numerous studies by both local and international experts. A full list of key reports reviewed is indicated in the references section in Volume II of the report. Valuable comments and contributions were provided by Messrs. Jose Sokol, Lead Economist (AF4DR); Anil Somani, Hassan Hassan (ENVPE); David Henley (AF4IN); Abigail Osae-Addo (LATEN); and Professor Osibanjo (Nigeria). WASTEC (Switzerland) provided background papers. Ms. Pamela S. Cubberly provided editorial assistance and Ms. Eleanor H. George and Ms. Lee Swapp provided secretarial support.
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EXECUTIVE SUMMARY

Nigeria has been blessed with an abundance of physical and human resources. The country possesses a wealth of natural resources including major oil and gas deposits, a variety of solid minerals, good agricultural land, a well-developed industrial base, an extensive banking system, a large labor force and a vibrant private sector. However, the country's tremendous potential for growth and development has yet to be fulfilled. Real income and consumption per capita today are scarcely higher than they were in 1971 before the start of the oil booms which provided vast but temporary financial resources. A key constraint has been recent macroeconomic management. Priorities for public spending are widespread and service delivery is poor and deteriorating. Social indicators have been improving somewhat but remain far below acceptable levels and below levels which could have been achieved on the basis of previous expenditures. In the meantime, the environment has been subject to significant stress. Adequate economic policies need to be put in place. There is also an urgent need to put in place, over the medium term, mechanisms that would ensure sustainable development, protecting both the life and health of its inhabitants and the resources of the country. This is the emphasis of this report.

Is Industrial Pollution a Problem in Nigeria?

This report concerns sustainable development in Nigeria: balancing economic development with industrial pollution management to ensure that Nigeria benefits as much as possible from industrial growth. Its immediate objective is to serve as the basis for discussions on addressing industrial pollution in the country. Through analyzing the information available on industrial pollution, the report has identified the most polluted states and the worst polluting industries. The major constraints to managing industrial pollution, including information, institutional capacity, financing, and regulations, are assessed. The report also critically discusses policy issues and options that should be addressed in designing a national industrial pollution strategy. The next step in the process is the development of a government program of action to reduce industrial emissions.

1. During 1986–93, Nigeria's manufacturing sector performance improved sharply. According to National Account estimates, manufacturing's value added increased by 36 percent between 1986 and 1993, implying an annual average growth rate of 4.5 percent. Moreover, Central Bank of Nigeria (CBN) data shows that output in some industries expanded dramatically during 1990–93. This rapid expansion is reflected in the index of production for synthetic fabrics, which has multiplied by more than 18 times since 1986. Sugar confectionery, soft drinks, cotton textiles, and detergents output also experienced significant growth. Approximately 85 percent of Nigeria's industry is small scale, employing 20 or fewer people. Although poorly documented, the small scale sector, much of which is informal, has grown rapidly since the beginning of the economic recession. The small scale industry sector is a particularly important source of pollution because of the difficulty in regulating a very large number of facilities which produce more waste per unit output than larger plants.

2. With improved financial incentives given to international oil companies, Nigeria's oil production expanded from 1.3 to 2.0 million barrels per day between 1987 and 1993. Nigeria's

Note: All references to tables, figures, and graphs that do not appear within the text of Volume I of this report are found in Annex F in Volume II.
gas production also increased significantly since the mid-1980s - during 1986 and 1992 by 67 percent.

3. Although this increased activity has undoubtedly benefitted Nigeria, it is of grave concern that over 80 percent of industries in the country discharge solid, liquid, and gaseous effluent directly into the environment without any prior treatment. A survey of 200 randomly chosen industries indicated that only 18 percent undertake even rudimentary recycling prior to disposal of wastes. This situation points to a growing industrial pollution problem which affects Nigeria's ecosystems and threatens the health of its population.

4. Of the environmental issues that need to be addressed urgently, contamination of water sources has been identified as having the second highest potential to adversely impact the country's GDP (an estimated cost of US$1 billion annually) and place 40 million people at risk, by increasing health costs and productivity losses (through higher incidences of water-related diseases). Water pollution impacts the urban and landless poor most because they are not cognizant of or able to afford defensive sanitary practices. Most Nigerian communities lack water treatment or even water supply facilities and rely on local surface and shallow groundwater supplies even when there is evidence of contamination. Although agricultural and municipal waste contribute the most to water pollution, industrial effluent in the form of direct liquid waste discharges, solid waste dumping into water bodies, and indiscriminate hazardous waste disposal have become a growing problem, especially in the states that contain 80 percent of the nation's industry: Lagos, Rivers, Kano, and Kaduna.

5. A study conducted by the Swiss environmental engineering firm, WASTEC, indicates that the major water pollution concerns are biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, pH, oil and grease, heavy metals, and elevated temperature of water bodies. Wastewater treatment plants are virtually nonexistent; sludge and liquid wastes are typically deposited in open drains, sewer systems, and water bodies without any treatment. The treatment plants that have been built are usually inadequate for the volume and type of waste emanating from the industries concerned or have in many cases broken down. Existing public and industrial sewage systems are in a similar state of disrepair and are often clogged with the solid wastes dumped into them. The WASTEC study reported that underground sewage systems are being built for new industrial estates; however, sewage systems that do not have treatment plants will only conduct the wastewater more efficiently to water bodies. Only a few exceptional industries in Nigeria are reported to conduct primary treatment through sedimentation in open ponds.

6. Current waste disposal methods in Nigeria include codisposal of hazardous and municipal wastes in open, unlined dumps and open burning of solid wastes with municipal wastes. Some companies have built rudimentary incinerators or simply burn wastes in on-site open pits. Incinerators built in Lagos with Japanese funding have proved ineffective and were soon dismantled. Nigeria has no environmentally secure landfills or incinerators. The landfills available are superficially designed, have no facilities for hazardous waste disposal, and are poorly located. Informal recycling is carried out by poor people living near landfills who sort and remove anything saleable or directly usable.

Industrial Activity and Pollution in Key States

7. According to statistics provided by the Lagos State Government, in terms of the impact of industrial pollution, Lagos Lagoon absorbs 10,000 cubic meters per day (the amount of BOD required for a city of 600,000 people). Fish caught in the Lagos Lagoon have high levels of lead, mercury, and arsenic. The highest metal levels were found near the Apapa area, where the industrial estate contains petrochemical, detergent, textile, paper, printing, steel, and brewing facilities as well as vehicle workshops, naval shipyards, thermal power plants,
and a sewage depot. Although data relating to groundwater contamination are not readily available, porous soils and high water tables in the coastal cities increase contaminant transport. Water tested from boreholes in Shagbamu and Oworonshoki contained mercury at levels over 10,000 times the World Health Organization’s (WHO’s) recommended limit.

8. Lagos State has over 60 percent of Nigeria’s industrial activity, including 300 industries on 12 industrial estates. The major polluters are textile, food-processing, metallurgical (electroplating), rubber and plastic, pharmaceutical, chemical, and paint facilities. Five of the industrial estates—Ikeja, Apapa, Ilupeju, Iganmu, and Oshodi—contain the majority of large- and medium-sized industries. A survey carried out of the industries in Lagos revealed that only four performed even primary treatment of effluents. Industries in Lagos generate approximately 8,000 tons of hazardous waste each year. The WASTEC study found that the Lagos State Waste Management Agency (LSWMA) unloaded approximately 105,000 tons of industrial wastes into its landfills in 1991. The LSWMA operates five landfills for municipal and industrial solid-waste disposal.

9. In Rivers State the petroleum industry is the major industry and largest source of pollution. Other industrial activity consists mainly of food processing and plastics, rubber, metallurgical, pharmaceutical, and chemical manufacturing. Oil spills and leaks, which literally occur hundreds of times a year, result in serious degradation of surface water and adjacent wetland and mangrove ecosystems. Between 1976 and 1990, 2.1 million barrels of oil were released in 2,796 recorded oil spills. Some reports state that frequent spills of kerosene and diesel oil from drilling and rural transport are causing even more significant problems than crude oil spills. The petroleum industry, including the refineries, generates most of the 5,500 tons of hazardous waste produced per year in Rivers State. According to the Port Harcourt Environmental Sanitation Authority, neither hazardous nor industrial wastes are separated from municipal solid wastes before disposal in the two municipal waste dumps. The Environmental Protection Agency in the state is placing pressure on the sanitation authority to close the largest dump, which borders a creek in Port Harcourt that is visibly polluted. The authority does not operate any leachate collection systems in either of its landfills. The authority is excavating a new landfill some 20 kilometers outside the city, but the capacity of this landfill to handle the wastes generated by the state is in question.

10. Kano is the center of Nigeria’s tanning industry. Three industrial estates, Bompai, Challawa, and Sharada, hold 70 percent of Nigeria’s tanneries. They also contain a large number of rubber and plastics, food, metallurgical, and manufacturing industries. Liquid effluent from tanneries are high in the heavy metals chromium and cadmium. A study carried out in 1989 found that all 15 tanneries monitored had violated permissible limits for effluent measurements with the exception of pH and temperature. Sixty percent of residents depend on the local rivers and groundwater aquifers for their consumption. Solid wastes from tanneries are excellent breeding grounds for disease vectors and also emit miasmal odors. Kano generates the least amount of hazardous waste per year—1,700 tons—when compared to the other states surveyed.

11. Most of the industries in Kaduna are located on Kaduna South Industrial Estate. They include textile, food, metallurgy, manufacturing, pharmaceutical, and chemical companies. Effluent from the industrial estate flows into Makera, Kakun, Rafin, and Rami creeks, which drain into the Kaduna River, the principal source of drinking water as well as an important fishing area. The government-owned Nigeria National Petroleum Corporation (NNPC) refinery and superphosphate fertilizer plant are also located in Kaduna. The refinery has had several major spills and leaks hydrocarbons. The most recent spill, which occurred in 1989, caused extensive crop damage. The Kaduna State Board found very severe contamination of the water in the river, especially
as it passed through the industrial section of the city. The Kaduna State Environmental Protection Agency estimates that companies add 160 kilograms per day of heavy metals to the river. It is so badly polluted that the superphosphate fertilizer plant needs to clean the water before using it as cooling water, the least demanding of all industrial water uses. Industries produce an estimated 3,400 tons of hazardous wastes annually.

Nigerian Industry and Main Sources of Pollution

12. Capacity utilization in Nigerian industry is very low, averaging 35 percent between 1988 and 1991 according to estimates of the Manufacturers Association of Nigeria (MAN). Most Nigerian industrial facilities were installed between the mid-1970s and early 1980s and have not been expanded substantially since then. The use of pollution prevention or control equipment is rare, even in companies operated with foreign collaboration. Even without the addition of pollution abatement equipment, the use of more modern equipment would improve energy efficiency and reduce waste.

13. The Winvent industrial waste prediction model was used in this study to estimate waste production by industrial subsector. The model calculates waste per employee coefficients based on waste generation data from over 7,000 facilities worldwide. For purposes of this study, data were obtained primarily from the 1988 census of Nigerian industry. When better and more recent data were available, they were incorporated into the model. Limitations of waste prediction include the nonavailability of state-specific data, limited data quality of the census, weak information sources particularly with regard to small-scale enterprises, and the grouping of wastes generated from small- through large-scale facilities. Although the absolute numbers predicted by the model may not be accurate, the model is an appropriate tool for estimating the relative waste generation of different industrial subsectors. According to the findings of this exercise, industries producing the largest amounts of hazardous wastes are steel, metal fabrication and finishing, textiles, pharmaceuticals, tanning, oil refining, and paint. Together they are estimated to generate 99 percent of the hazardous wastes generated by the 14 industries reviewed in this report. The largest generators of solid wastes in Nigeria are the steel, food-processing, and tanning industries, which together produce 92 percent of the industrial solid wastes.

14. State-owned corporations dominate or remain important players in several major polluting industries. All five major steel facilities, both fertilizer companies, the aluminum company, several cement firms, three sugar companies, two pulp and paper corporations, and a number of hydrocarbon-based plants owned by NNPC are among the parastatals reviewed in this study. Some of the companies have just undergone commercialization, and others are supposed to be privatized but have yet to implement the process. Although parastatals are not exempt from environmental regulations, environmental agencies often have very limited enforcement power over state industries. Since they are major employers, strict sanctions are politically unacceptable and energy facilities, for example, are untouchable due to political pressures. Nigerian environmental agencies do not have open communication mechanisms for dispute resolution or effective oversight of the parastatals. Since most parastatals have high employment levels and produce essential products, strict enforcement of regulations and penalties is politically unacceptable.

Constraints for Pollution Control and Management

Institutional

15. Industrial pollution control is fragmented among at least two federal agencies and three government levels with no clear designation of responsibilities. Coordination among the various agencies and levels is weak. Division of federal and state responsibilities is a source of disagreement, with Nigeria’s Federal Environmental Protection Agency (FEPA)
preferring a more centralized pollution management process and some of the state EPA’s (SEPA’s) emphasizing more state control.

**Capacity Constraints**

16. Financial, personnel, and technical constraints at all government levels severely limit industrial pollution management capabilities. FEPA is too understaffed to monitor or enforce pollution regulations adequately. Furthermore, the staff is largely untrained in industrial pollution control and the zonal offices lack pollution-monitoring equipment, laboratories, outfitted offices and vehicles. For example, neither the FEPA zonal office nor the Rivers SEPA has a laboratory. As a result, after oil contamination incidents, the authorities need to request that the companies responsible provide soil and water analyses, leading to a conflict of interest.

17. State agencies are also understaffed, particularly in comparison to SEPA’s in other countries. Furthermore, the SEPA’s in Nigeria have insufficient monitoring and laboratory equipment. Even basic needs such as office equipment and vehicles are unmet. One of the principal reasons for the poor resources of the SEPA’s is their dependence on funding from state budgets. The Lagos SEPA, which is considered the strongest of the state-level environmental agencies, has been able to generate substantial revenue through its Pollution Discharge Charge. It has a laboratory funded by its pollution charge system but has yet to equip it. Lagos State is one of the first states to implement regulations requiring environmental impact assessments for all new projects.

**Monitoring and Enforcement**

18. With insufficient resources, FEPA and the state agencies are not able to enforce regulations adequately. WASTEC found that enforcement is generally limited to accidents that cause visible pollution. FEPA has yet to impose any penalties for noncompliance. It is allowing a short-term moratorium for polluters during which it advertises that pollution compliance is mandatory. Until FEPA ends its moratorium on enforcement, companies have little incentive to improve their pollution records. The National Environmental Protection Regulations of 1991 require industries to have a pollution-monitoring unit at each site and to analyze all discharges for monthly reporting to FEPA. Accidental or unusual discharges need to be reported to FEPA within 24 hours. Surveys have found no evidence that any of this type of information—essential for the implementation of any type of monitoring—is being generated by firms. Inadequate equipment and laboratories also hamper monitoring. FEPA will get assistance from the ongoing Nigeria Environmental Management Project to set up two regional laboratories and equip them. In addition, a private medical diagnostic and environmental analysis laboratory is being proposed for Abuja, which would test industrial effluents, concentrating on the oil industry.

**Regulatory Aspects and Economic Incentives**

19. Nigeria has a sound legislative and regulatory framework for controlling industrial pollution. It enables the federal and state governments to establish the necessary environmental agencies and industrial discharge standards and also creates an appropriate monitoring, enforcement, and legal prosecution process for polluters. The guidelines state that each state should adopt FEPA’s standards as their minimum standards. All four of the industrialized states have developed their own standards, which tend to be stricter than FEPA’s limits. The regulations are contained in disparate regulations for health, drainage, and sanitation, which inhibit a coordinated approach to industrial pollution abatement. Industries complain that effluent standards, which mainly reflect U.S. standards, are not appropriate for Nigerian conditions. FEPA may eventually revise the regulations to make them more compatible with Nigerian conditions. The promise of future relaxed limits, however, reduces the incentive of industries to comply with the current limits.
20. A major limit to the effectiveness of current regulations to reduce pollution is the absence of economic incentives. Other than the Lagos and Kano pollution charge programs, market-based incentives for pollution control do not exist. The lack of incentives is further exacerbated by excessively low energy, water, and waste disposal charges. In addition, no subsidy programs, such as tax credits, grants, or lines of credit, exist to provide a positive incentive for industry to abate pollution.

**Policy Constraints**

21. Industrial and economic development policies often have unintended and indirectly detrimental environmental impacts. Industrial policy influences industrial pollution in three ways. First, it affects the speed and type of industrial expansion. Second, policies can distort decision making on whether industrial by-products are treated as wastes or recycled and reused. Third, subsidies of inputs to the production process cause excessive use of whatever is being subsidized. Policy failures in these areas are common in Nigeria.

22. Tariffs and other trade barriers, which remain substantial in Nigeria, increase the incidence of pollution. Protectionism reduces competition, allowing firms to be less efficient and less cost-conscious. Firms are less concerned about minimizing input costs and tend to use nonoptimal amounts of resources. Pollution abatement is directly affected by duties on pollution control equipment that range from 30–40 percent, considerably increasing the cost of compliance with regulations.

23. Energy subsidies, particularly in the form of petroleum product prices that are well below world market levels, create numerous environmental costs. In 1992, Nigeria had the lowest domestic petroleum prices in the world - 4 cents per liter or 13% of the European average. In October 1994, this subsidy was significantly reduced as petroleum prices were increased to 50 cents a litre at the official exchange rate. Since industries do not pay the full cost of consuming energy, the incentive for them to conserve is dissipated. Low petroleum prices lead to nonoptimal domestic consumption, which reduces reserves and ultimately the volume of hydrocarbons that can be sold for export. In addition to the accelerated depletion of a nonrenewable resource, increased pollution results from direct oil contamination and increased air pollution from excessive use of petroleum for transportation and energy production.

24. Water prices, which are also much lower than the cost of purification and wastewater treatment, act as de facto subsidies and lead to equally wasteful practices. For example, in Lagos State many industries pay a flat rate regardless of the amount of water used. Even in Kaduna State, which charges all industries according to their water consumption, user charges cover only 65 to 70% of total costs of water supply including capital recovery. In the absence of adequate incentives, industries have little reason to limit their water intake or recycle water within their facilities.

25. Both weak enforcement of waste disposal regulations and disposal prices that do not include the social costs of unregulated dumping allow firms to treat waste disposal costs as externalities. When a firm’s waste disposal costs do not incorporate the social costs of disposal, it has no economic incentive to dispose of the wastes in an acceptable manner or to reduce the amount of waste it generates. Consequently, companies typically discharge wastes into unlined pits or the nearest water body. Waste disposal contractors often charge very low rates because they illegally dump wastes. In Port Harcourt, solid waste fees charged to industries cover only the cost of waste containers, not the collection and disposal costs.

**Financial and Other Constraints Faced by Industries**

26. Fiscal policies on credit and exchange rates affect the cost of capital and indirectly the magnitude of industrial pollution. In Nigeria, only
10 percent of commercial loans mature in ten years or more and 70 percent have a maturity of six or fewer months. In addition, although commercial lending rates averaged 32.8% in 1993 through the Central Bank of Nigeria keeping the spread at 5% above average funding costs, commercial and merchant bank breaches of this regulation were widespread. However no information on the higher parallel rates is available. Short terms and high interest rates for most commercial lending limits borrowing by most companies to financing only the most attractive investments. Except for some cost-reducing pollution prevention processes, the majority of pollution abatement investments do not attract potential borrowers; firms face enough difficulties financing traditional plant expansion without having to worry about attempting to secure loans for pollution abatement equipment.

Lack of information also plays a critical role in perpetuating uneconomic pollution practices. In the absence of information on pollution prevention or control alternatives, firms are not able to be environmentally responsible or run efficient and cost-effective operations. For example, the National Fertilizer Company (NAFCON) fertilizer plant allowed sulfur to escape as sulfur dioxide (SO₂) rather than recover it as sulfuric acid. Without a price or additional charge that forces the company to internalize the social cost of the SO₂, the private benefits of capturing the sulfur are exceeded by the private costs; so the firm decides to emit the pollutant. Fortunately in this case, however, the world price of sulfuric acid was higher than the costs of recovering the sulfur; the firm eventually decided to commission a sulfur recovery process.

Strategic Approach for Industrial Pollution Abatement

Nigeria has made substantial progress in establishing environmental legislation and regulations, in creating FEPA as a knowledgeable and effective public environmental agency, and in establishing SEPAs in most states; however, additional steps are now necessary to begin making an actual physical impact on industrial pollution that is still occurring at high levels, especially in the states of Lagos, Rivers, Kaduna, and Kano. Table I presents the key policy objectives and proposed actions to implement the objectives on the ground. Critical decisions now need to be taken as a basis for developing a coherent strategy that makes the most effective use of the limited resources available to Nigeria for improving environmental conditions.

Conceptual Policy Framework

29. This strategy should be based on the following general principles, which have wide international acceptance as the most effective means of dealing with environmental degradation:

(a) any pollution management strategy should adhere to a pollution management hierarchy that emphasizes waste prevention and reduction over recovery and recycling, with treatment and burial the least desirable level of hierarchy. This principle is based on the observation that it is almost always less expensive and more effective to prevent pollution in the first place than to deal with pollution after it occurs;

(b) strategic options should focus on addressing the "worst first" principle by tackling the worst areas and worst polluting industrial subsectors first to obtain maximum efficiency of resource use; and

(c) incentives and penalties should be based on the "polluter pays" principle, whereby firms are required to pay all or at least a substantial part of the social costs of their activities.

Policy choices need to be made in the following areas and action taken to implement the strategy that results from those choices. These include:

(a) Adequacy of the Legal and Regulatory Framework. Generally, the legal and regulatory framework on the environment in Nigeria appears to be adequate, with possible
changes limited to a community right-to-know regulation and the integration of market-based incentives into current regulations.

(b) Concentration of Environmental Resources. Application of the "worst first" principle is essential to maximize the impact of Nigeria's limited administrative and financial resources. Geographic concentration should be on the four states with major polluting industries (Lagos, Rivers, Kaduna, and Kano), and within those states the major polluting industries (steel, metal fabrication, refineries, tanneries, textiles, and food processing) should receive the most vigorous attention first.

(c) Adequacy of Industrial Standards. The industrial standards promulgated in 1991 and modified by the various states should be reviewed quickly and modified as necessary prior to vigorous enforcement. Also, the policy of allowing each state to strengthen its own standards beyond the national standards should be reviewed.

(d) Subsidies. Elimination of the subsidies on production inputs is the most efficient way to reduce the overall level of waste disposal. Means should be found to make national decision makers aware of the environmental cost that is incurred by subsidizing energy, water, petroleum products, and the like.

(e) Pollution Charges and Penalties. It is now time to put into effect an adequate level of charges for the disposal of solid waste and wastewater. The level of charges should be high enough to cover at least the full cost of effective disposal. Also, penalties should be established for violations of environmental standards that are progressively higher as discharges rise and lower as pollutants fall below the established standard. Revenues from penalties should be used to cover the operating costs of the environmental agencies. New charges and penalties should be thoroughly explained to the industry ahead of time and should be increased over a period of time toward the marginal social costs of pollution.

(f) Monitoring and Enforcement. Decisions are needed to confirm that enforcement of regulations and collection of fines will remain a state function. Special attention is needed on how environmental regulations applying to parastatal operations can be enforced. Also, the relationship between FEPA and state laboratory facilities as well as the possible role of private laboratories need clarification to avoid duplication.

(g) Joint Treatment Facilities. The placement, design, and operation of joint treatment facilities need to be agreed on. Generally, state ownership of joint treatment plants is not recommended due to conflicts of interest with the state enforcement role. Also, in Nigeria, landfilling to dispose of hazardous waste is generally more appropriate than incineration except in cases where a high water table makes this solution not feasible.

(h) Financing Requirements. The establishment of charges and fines that are strictly enforced will necessitate investment in improved processing or treatment facilities. A decision is needed on a possible role for the government of Nigeria in making a line of credit available for pollution control investments for those companies that cannot secure financing from the commercial credit markets. This type of financing is frequently attractive to aid agencies that provide concessional financing.

Institutional Issues

31. The strategy also requires some related decisions regarding the institutional arrangements for environmental management, including:

(a) The Role of FEPA. FEPA's role in policymaking is well established, but its role in enforcement, especially regarding laboratory operations and in states where SEPA are not yet well established, is less clear. Parastatal enforcement may also require FEPA assistance.

(b) The Role of SEPA. The role of SEPA as the responsible agency for carrying out all aspects
of pollution management in their states should be emphasized, and SEPAs should be staffed and equipped accordingly.

(c) The Role of the Municipal Agencies. Municipal agencies responsible for water supply, sewerage, and solid waste disposal should be encouraged to put in place and collect user charges that cover the full cost of the services provided. The revenues from the higher fees should in turn be retained by these agencies so that they can in turn provide more effective services.
Table I: Agenda for Key Policy Objectives and Proposed Actions

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<td>1. Reduction of pollution from the most significant industrial subsectors (steel works, metallurgy, food processing, tanneries, textiles, pharmaceuticals, petroleum refineries, paint) in the most industrialized states (Lagos, Rivers, Kano, Kaduna) and major facilities outside of the most industrialized states.</td>
<td>Limited data on sources. Lack of knowledge of international best practices and shortage of technical expertise in industries. Limited institutional capacity (inadequate expertise, lack of equipment, reliance on limited state budget allocations). Inappropriate regulatory framework. State ownership of many of the largest facilities. Limited financing because of a lack of a viable and stable macroeconomic framework.</td>
<td>Prepare industrial emissions inventory studies in the most industrialized states and for other major facilities. Provide technical assistance and training in industrial environmental management best practices to SEPAs and targeted industries. Incorporate incentives into regulatory framework. Establish and enforce realistic compliance schedules for target industries, including parastatals.</td>
<td>Enforce regulations for the development of joint treatment plants for industrial estates and on-site waste treatment for large facilities. Enforce regulations for solid waste source reduction, collection, recycling, and disposal.</td>
</tr>
<tr>
<td>2. Additional issues associated with the management of hazardous waste in the most industrialized states.</td>
<td>As above.</td>
<td>In addition to actions above: Review waste reduction, recycling, and disposal options (including landfills, incinerators, and solidification). Implement hazardous waste tracking and information management system.</td>
<td>In addition to actions above: Provide the framework for the establishment of secure landfills, solidification programs, and hazardous waste treatment centers.</td>
</tr>
<tr>
<td>3. Reduction of pollution from new facilities.</td>
<td>Limited capacity to enforce existing regulations. Lack of information on international best practices and shortage of technical expertise. Limited financing because of a lack of a viable and stable macroeconomic framework.</td>
<td>Improve enforcement of existing regulations by empowering FEPA and SEPAs to require EIAs for all major facilities and by enhancing land use zoning expertise in SEPAs and municipalities. Assist industries to undertake EIAs. Provide access to information on abatement strategies and technology. Achieve and maintain a viable and stable macroeconomic framework.</td>
<td></td>
</tr>
<tr>
<td>4. Correct policies and eliminate distortions which exacerbate pollution.</td>
<td>Limited understanding of the linkages between environmental degradation and inefficient policies. Energy, water, and waste treatment subsidies. Inappropriate macroeconomic policies.</td>
<td>Introduce polluter pays principle by moving towards full pricing of all industrial inputs and user charges. Considerably reduce tariffs on pollution abatement equipment from current levels of 30-40%. Achieve and maintain a viable and stable macroeconomic framework.</td>
<td></td>
</tr>
</tbody>
</table>

1/ Timetable to be determined at the industrial pollution management workshop in Abuja.
<table>
<thead>
<tr>
<th>Policy Objectives</th>
<th>Major Constraints</th>
<th>Proposed Short Term Actions</th>
<th>Proposed Medium Term Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Improvement of the legal and the regulatory environment.</td>
<td>Absence of market based incentives. Inappropriate national and state regulations. Lack of community right to know legislation. Uncoordinated government pollution management between federal, state, and municipal agencies.</td>
<td>Commission environmental economic studies reviewing the regulatory environment. Define roles of pollution control agencies. Introduce market based incentives into the regulatory framework, beginning with wastewater charges, increased prices for hazardous substances inputs, and incentives to concentrate industry in industrial estates.</td>
<td>Promulgate community right to know legislation.</td>
</tr>
<tr>
<td>7. Assessment of the extent of pollution from small scale industry.</td>
<td>Lack of information on sources. Inadequate recognition of the significance of SSI pollution.</td>
<td>Evaluate the impact of pollution from SSI and identify cost-effective methods of reducing it.</td>
<td>Formulate and implement SSI pollution reduction strategy.</td>
</tr>
</tbody>
</table>
1.1 Although little quantitative information on the extent of industrial pollution on a national scale is available, the data that exist point to a growing problem that threatens the health of Nigeria’s ecosystems and people. Over 80 percent of industries in Nigeria discharge solid, liquid, and gaseous effluent directly into the environment without any treatment (Osae-Addo 1992, 1). Furthermore, only 18 percent of industries perform even rudimentary recycling before disposing of wastes. Expanding urban populations exacerbate the impact of industrial pollution as people are forced to live in crowded, unsanitary communities near industries. Although data for complete environmental risk assessments are not currently available, spatial and environmental priorities are evident from the information at hand. Spatially, both FEPA and the World Bank have determined that degradation of environmental quality from industrial pollution is most severe in the four states that contain 80 percent of the nation’s industry: Lagos, Rivers, Kano, and Kaduna (Osae-Addo 1991, 1). Except for localized problems from individual factories, water degradation is in most areas a more critical problem than air pollution; however, in heavily populated areas such as Lagos, air pollution may be more critical than water contamination. The discussion of national-level industrial pollution is divided by media: water pollution, solid and hazardous waste, and air pollution. The importance of combating industrial pollution immediately is shown by a report commissioned by the Overseas Development Administration, which concludes that FEPA should focus its resources on pollution control and waste management during its early years (Environmental Resources 1991, ix).

Water Pollution

1.2 The World Bank report “Toward the Development of an Environmental Action Plan for Nigeria” determined that water contamination has the second highest potential for future negative impact on the GDP (estimated at US$1 billion annually) and puts 40 million people at risk (Western Africa Department, May 1990, vi). Water pollution impacts the urban and landless poor most because they are not educated about or able to afford defensive sanitary practices. Most Nigerian communities lack water treatment or even water supply facilities and rely on local surface and shallow groundwater supplies even when they are contaminated. Although agricultural and municipal wastes contribute the largest amount of water pollution, industrial effluents in the form of direct liquid waste discharges, solid waste dumping into water bodies, and indiscriminate hazardous waste disposal are growing problems for both surface and groundwater quality. In the agricultural sector, pesticide residues from field runoff and inappropriate use and disposal of containers are a major environmental concern.

1.3 In the case of industrial pollution, the major water pollution concerns are BOD, COD, suspended solids, pH, oil and grease, heavy metals, and elevated temperature. Wastewater treatment plants are virtually nonexistent, and sludges and liquid wastes are typically deposited in open drains, sewer systems, and water bodies without any treatment. The treatment plants that have been built are usually inadequate for the volume and type of waste they are expected to treat or else they have broken down. The public and industrial sewage systems that do exist are in a similar state of disrepair and are often clogged with the solid wastes dumped into them (Massey 1992, 20). A WASTEC report (Massey 1992, 20, 29) noted that underground sewage systems are being built on new industrial estates and that a study of industrial sewage systems for 12 industrial areas in Lagos was being conducted in 1992; however, sewage systems without treatment plants will only conduct the wastewater more
efficiently to water bodies. Consequently, to be of significant value, these studies should include studies of wastewater treatment options. The suitability of the sewage systems for the wastes being generated and the degree of commitment to implement and operate them is not known. Historical examples from industrial estates, including the Wemabod system at the Ikeja industrial estate, are not favorable. Exceptional industries in Nigeria conduct primary treatment through sedimentation in open ponds.

1.4 Constant high water temperatures throughout the year combined with organic waste loading enhance the growth of algae and pathogens. Industrial organic wastes act as nutrients for algae and aquatic plants. Depending on the characteristics of individual water bodies, this combination causes eutrophication and low oxygen levels with fish population declines and species composition shifts. The impact of industrial water pollution depends on the specific industry using the water body and the assimilative capacity of the water body for the effluents being discharged. The dry season, with its minimum flow regime, is the most important period for control of surface water pollution. Pollution during this period causes more severe problems because with less water the absorptive capacity for pollutants and threshold levels of water bodies are much lower. In five southwestern rivers monitored by Oluwande and others (1983, 960), flow ratios between wet and dry seasons ranged from 10,000:1 to 1,000,000:1. The reduced water volume during the dry season exacerbates algae growth and eutrophication. One state reported to the FEPA National Technical Committee that breweries continue to discharge into streams that completely dry up during the dry season leaving septic effluent ponds near rural communities (FEPA 1991, 23). The wet season brings its own characteristic pollution problems. For instance, heavy erosion significantly increases suspended and dissolved materials carried by rivers. Initial runoff from roads can be heavily contaminated with oil and grease, metals, pesticides, and animal and human waste. Wet season rains disrupt the rudimentary pollution control measures in place through storm water incursions that overload transport and treatment systems (Obisanjo in Aina and Adedipe 1992, 97).

1.5 Groundwater issues in Nigeria are not well documented. Excessive groundwater use by consumers and industries have caused saltwater intrusion into groundwater reservoirs in coastal cities, such as Lagos and Port Harcourt (Egboka and others 1989, 64). Overconsumption has the potential to lower water tables and cause land subsidence in Lagos and Port Harcourt because they are built on sandy, alluvial soils (Janathan 1990, 6). The porous soils and high water table in the coastal cities increase contaminant transport. Oil spills and leaks have also contaminated groundwater around Port Harcourt. Coastal water contamination in Nigeria is equally poorly understood; however, with 70 percent of Nigerian industry located in coastal areas, industrial pollution of marine environments needs to be addressed (Osibanjo in Aina and Adedipe 1992, 96).

Hazardous and Solid Wastes

1.6 Industries producing the largest amounts of hazardous wastes in Nigeria are steel, metal fabrication and finishing, textiles, pharmaceuticals, tanning, oil refining, and paint. Together they are estimated to generate 99 percent of hazardous wastes produced by the 14 industries reviewed in this report. Estimates of hazardous waste production in the four states are presented in Figure F-1, Vol. II. The largest generators of solid wastes in Nigeria are the steel, food-processing, and tanning industries, which produce 92 percent of the industrial solid wastes. The current, completely inadequate waste disposal methods include codisposal of hazardous and municipal waste in open, unlined dumps and open burning of solid wastes with municipal wastes (Osae-Addo 1992, 6). Some companies have built rudimentary incinerators or simply burn wastes in on-site open pits. Wastes that produce hazardous by-products when burned, such as tires, are routinely included (Massey 1992, 26). Nigeria has no environmentally secure landfills or incinerators. The landfills available are superficially designed,
have no facilities for hazardous waste disposal, and are poorly located. WASTEC reported that studies for two secure landfills were being conducted in 1992 in Lagos State (Massey 1992, 29). Incinerators were built in Lagos in the mid-1980s with Japanese funding, but they proved ineffective and were soon dismantled. Extensive informal recycling by poor people living near landfills occurs throughout the country. They sort and remove anything saleable or directly usable (plastic bottles, textiles, wood, etc). Other groups of poor people remove wastes directly from plant sites for use or resale (Massey 1992, 15).

**Air Pollution**

1.7 Air is the least documented media for pollution transport. Air pollution is not monitored by any government agency and is rarely monitored by polluting industries (Osae-Addo 1991, 21). Air pollutants of concern are SO₂, nitrogen oxide (NOₓ), particulate matter, and heavy metals. At the national level, industrial emissions are second to vehicular emissions in contributing to urban air pollution problems. In specific areas, industrial plant sources cause the majority of air quality degradation. Localized air pollution problems include cement kiln dust, SO₂ from the fertilizer plants in Kaduna and Rivers States, multiple pollutants from the NNPC refineries, and gas flaring in the coastal region. Industrial furnaces, boilers, and thousands of private electrical generators also contribute to air pollution (Adegbulugbe and Dayo 1990, 17).

**Pollution Problems in Selected States**

**Lagos State**

1.8 Over 60 percent of Nigeria's industrial activity, including 300 industries on 12 industrial estates, is located in Lagos. The major polluters in the city are textile, food-processing, metallurgical (electroplating), rubber and plastic, pharmaceutical and chemical, and paint facilities. Five of the industrial estates, Ikeja, Apapa, Ilupeju, Iganmu, and Oshodi, contain the majority of large- and medium-sized industries (see Table I, Volume II, Annex F). Almost no wastewatere is treated in the state. In a consultant's survey of industries in Lagos, of the 11 firms that responded, only four performed even primary treatment on their effluents. Water consumption and effluent discharge is listed by company in Table 2, Volume II, Annex F to give an impression of the size and types of waste being produced by individual companies (Osae-Addo 1991, 13). Industries in Lagos generate approximately 8,000 tons of hazardous waste each year.

1.9 In terms of the impact of industrial pollution, Lagos Lagoon absorbs 10,000 cubic meters of industrial effluent per day, including 30 metric tons of BOD (the amount of BOD required for a city of 600,000 people) (Lagos State Government in Osae-Addo 1992, 3). Fish caught in Lagos Lagoon have high levels of lead, mercury, and arsenic (Osuide 1990, 8); however, a study of sediment metal concentrations (lead, zinc, nickel, chromium, and copper) did not find them to be substantially elevated for a coastal city area. The study did determine a correlation between metal levels and concentration of industry and population. The highest metal levels were found near Apapa and correlate well with the heavy concentration of industry and population in that area (see Table 3 and Map IBRD 26090, Vol. II). The Apapa industrial estate contains petrochemical, detergent, textile, paper, printing, steel, and brewing facilities, as well as vehicle workshops, naval shipyards, thermal power plants, and a sewage depot. Metal concentrations were lower in the lightly industrialized Victoria Island area and lowest in the shipping quays area (Ihenyen 1991). Pollution and overfishing have combined to reduce fish catches from 1,000,000 kilograms in 1980 to 100,000 kilograms in 1990 (Lagos SEPA in Osae-Addo 1992, 1). The high water table and sandy soil of the Lagos area allow liquid pollutants to leach easily into the groundwater, which is a major source of drinking water. The concentration of specific pollutants in boreholes can reach hazardous levels. For example, water tested from boreholes in Shagbamu Street and Oworonshoki contained mercury at levels over 10,000 times the WHO recommended...
limit (14.85 versus 0.001 milligrams per liter) (Osuiide 1990, 8).

1.10 In addition to chronic environmental and health problems from industrial pollution, acute pollution crises occur. Although far from the scale of the Bhopal accident, the effluent spill at the Wemabod Estate industrial treatment plant in 1979 caused significant local problems. The overflow of partially treated industrial effluent severely contaminated boreholes, the only local source of drinking water, and weakened the foundations of houses in the area. Wemabod stopped functioning as a waste treatment facility in the mid-1970s and continues to add to the state's chronic pollution problems. Today, even though companies in the estate are statutorily required to connect to the plant, they discharge untreated wastes into the Shasha River (Agunbiade 1989, 19). The poor quality of the effluent and resulting river degradation is illustrated by Table 4, Vol. I1 (FEPA 1991, 90). The main effect of the industrial estate effluent is creation of an anoxic environment downstream. The discharge of large amounts of organic material has resulted in no dissolved oxygen and high BOD figures. Thermal pollution, with effluent temperatures recorded as high as 50°C from insufficient cooling of wastewater is another environmental problem from the estate. Textile wastes have given the river a permanent bluish-green color (NEST 1991, 84). Biotic effects of the pollution loading are vegetation die-offs along the river bank and the absence of fish within three kilometers downstream of the effluent discharge points (NEST 1991, 85). The Nihon Suido Consultants' water sampling results from 1992 (1992, 84) confirm the poor quality of the industrial wastewater from Ikeja (see Table 5, Vol. II).

1.11 The LSWMA operates five landfills for municipal and industrial solid waste disposal. The bulk of the industrial wastes dumped are cotton fibers from textile plants, packing cardboard, tires, and process sludges containing asbestos. In 1991, LSWMA unloaded approximately 105,000 tons of industrial wastes into its landfills (Massey 1992, 31).

Rivers State

1.12 The petroleum industry is the major industry and largest polluter in Rivers State. The Industrial Directory lists over 500 companies; most of them employ fewer than ten people, while 112 companies employ more than 50 workers (Linden 1993, 12). The medium- and large-scale industries are concentrated on the Trans Amadi industrial estate with plastics and rubber, food, manufacturing, metallurgical, pharmaceutical, and chemical companies making up the bulk of industries (see Table 1, Vol. II). Table 6, Vol. II, presents information on the wastes produced by specific companies on the industrial estates. Oil spills and leaks, which occur hundreds of times annually, result in both chronic and acute environmental degradation of surface water and adjacent wetland and mangrove ecosystems. Between 1976 and 1990, 2.1 million barrels of oil were released in 2,796 recorded oil spills (Inter Press Service 1992). Some reports state that frequent spills of kerosene and diesel oil from drilling and rural transport are causing more significant problems than the crude oil spills (Linden 1993, 8). Through road building and site preparation, oil exploration has caused extensive deforestation. The oil refineries have stressed the local environment through both air and water pollution. The petroleum industry, including the refineries, generates most of the 5,500 tons of hazardous waste produced per year in the state (Osae-Addo 1992, 8.4).

1.13 Localized air pollution problems of particular concern in Rivers State are cement kiln dust, SO₂ from the fertilizer plant and multiple pollutants from the NNPC refinery. The flaring of gas during oil production is a highly visible, but only moderately significant source of local air pollution. Gas flaring is a wasteful emission of greenhouse gases that increases global warming. Nigeria presently (June 1993) flares more gas than any other country in the world (Escravos Gas Project, 1993). In 1989, Nigeria flared off 617 billion cubic feet of associated gas, in the process releasing about 30 million tons of CO₂ (Table 2.20)(esma, 46). In addition, such flaring causes
noise, elevated temperatures and atmospheric emissions of sulphur, nitrate compounds and, under certain circumstances, soot. The noise and increased temperatures are local problems in the immediate surroundings of the flares. The release of soot may be a problem in some cases; the toxicity is, however, likely to be very low. There has been speculation that gas flaring may have contributed to acidification of soils and the corrosion of metal roofs. However, no evidence of such damage has been found. A proposed Global Environment Facility project to reduce gas flaring would lessen the environmental stress caused by this widespread practice.

1.14 The palm oil industry, which operates throughout the state, is another major polluter. Linden reports metal pollution from electroplating, textiles, and tanning (Linden 1993, 13). The NAFCON fertilizer plant pollutes the Okrika River with nitrogen compounds. In 1988, an accidental discharge from the plant caused a massive fish kill that damaged the local artisanal fishing industry (FEPA 1991, 71). At least seven major spills of what was reported as urea during 1992 also killed large numbers of fish in the immediate area (Linden 1993, 13).

1.15 According to the Port Harcourt Environmental Sanitation Authority, neither hazardous nor industrial wastes are separated from municipal solid wastes before disposal in the two municipal waste dumps. The Environmental Protection Agency is pressuring the authority to close the largest dump, which is 30 meters wide and borders a creek in Port Harcourt for a kilometer. Although its water quality has not been analyzed, the creek is visibly polluted. The authority does not operate any leachate collection systems in either of its landfills (Massey 1992, 32). With the impending closing of the Port Harcourt site, the authority is excavating a new landfill 20 kilometers outside of the city. It will be far too small to handle Port Harcourt’s solid wastes (100 meters long, 20 meters wide, and 10 meters deep). Although the authority is not planning to install a leachate collection system, the clay soil layer beneath the site will reduce groundwater contamination.

Kano State

1.16 The combination of Kano’s very low rainfall, growing population, advancing desertification, and industrial pollution seriously threatens Kano’s water resources. With 80 tanneries in the city, Kano is the center of Nigeria’s tanning industry. Three industrial estates, Bompai, Challawa, and Sharada together hold 70 percent of Nigeria tanneries. They also contain a large number of rubber and plastics, food, metallurgical, and manufacturing industries (see Table 1, Vol. II) (Osae-Addo 1991, Table 2-1). A list of major companies in the state is presented in Table 7, Vol. II. No functioning waste treatment facilities exist at any of the estates. Decomposition of refuse tips from the food industry (sugar, sweets, and biscuit factories) have contaminated virtually all of the boreholes in Bompai (Egboka and others 1989, 61). Liquid effluent from tanneries is high in the heavy metals chromium and cadmium. The severe pollution caused by tanneries is illustrated by a 1989 study that found the 15 tanneries monitored were almost without exception in gross violation of permissible limits for all effluent measurements except pH and temperature (see Table 8, Vol. II) (Osae-Addo 1992, 5). Downstream fish and crops irrigated by river water are believed to absorb the metals and pose a threat to human health (Osae-Addo 1992, 1). Human health is further impaired because over 60 percent of residents depend on the local rivers and groundwater aquifers for water (Osae-Addo 1992, 5). Solid wastes from the tanneries emit miasmal odors and are an excellent breeding ground for disease vectors. Of the four states surveyed, Kano created the least amount of hazardous waste, 1,700 tons per year (Osae-Addo 1992, 8.4).

Kaduna State

1.17 In comparison with the other industrialized states, Kaduna has a lower population density (0.67 persons per hectare) and fewer industrial
estates. Most of its 100 industries are located on Kaduna South Industrial Estate including textile, food, metallurgy, manufacturing, and pharmaceutical and chemical companies (see Table 1, Vol. II) (Osae-Addo 1991, Table 1). Table 9, Vol. II lists major companies in Kaduna by industry. The government-owned NNPC refinery and superphosphate fertilizer plant are also located in Kaduna. The refinery chronically leaks hydrocarbons and has had several major spills. The most recent spill, in 1989, caused extensive crop damage. Effluent from the Kaduna South Estate flows into Makera, Kakun, Raiin, and Rami creeks, which drain into the Kaduna River. Pollution of the Kaduna River is the most critical water quality issue in the state because it is the principal source of drinking and industrial water, as well as an important fishing area. The extreme seasonal flow variations of the river exacerbate the effect of pollutants. Flow rates drop from 160 cubic meters per second to 3-5 cubic meters per second during the November to March dry season.

1.18 Sampling conducted by the Kaduna State Board found water degradation to be severe as the river passed through the industrial section of the city (see IBRD Map 26091 and Table 10, Vol. II). Dissolved oxygen levels dropped from 6.6 milligrams per liter above the industrial area to an average of 1.1 milligrams per liter immediately below it. Similarly, COD levels climbed from an average of 17 to 667 milligrams per liter for the same monitoring stations. These two parameters illustrate the extreme oxygen demand of the effluent and the lack of secondary treatment. The oxygen demand is high because approximately 165 million liters per day of organic waste is discharged into the river causing anoxic sections during the dry season. Downstream of the estate, the pH level jumps from an average of 6.6 to 9.6. Total solids also increase but not as severely (from 131 milligrams per liter to 302 milligrams per liter). The drastic changes in these basic water quality parameters may have modified the aquatic environment so that species populations and composition bear little resemblance to the unstressed 'natural' situation. The SEPA also estimates that companies add 160 kilograms per day of heavy metals to the river. It is so badly polluted that the federal superphosphate fertilizer plant must clean the river water before using it even as cooling water, the least demanding of all industrial water uses (Magnier and Duer 1991, 49). One report noted that the lower section of the river changes color depending on the dyes being used in the textile factories. Industries produce an estimated 3,400 tons of hazardous wastes annually in the state (Osae-Addo 1992, 8.4). In addition to vehicular sources, the government refinery and fertilizer plant emit large quantities of air pollutants, particularly SO2.

Nigerian Industry

1.19 Industrial companies in Nigeria tend to be small with 85 percent of the over 20,000 firms being sole proprietorships employing between five and 20 people (Federal Office of Statistics 1988, 4). On the other hand, it is estimated that between 550 and 600 firms employ more than 100 people. Of the 7,400 responses received to the 1988 Federal Office of Statistics Industry Survey, 2,800 firms were in the textile industry; 1,600 in wood and wood products; 758 in agro-food; approximately 700 in manufacture of metal products, machinery, or equipment; over 600 in chemical and nonmetallic industries; and around 400 in paper, printing, and publishing.

1.20 Of the engineering industrial subsector comprising casting and forging, machinery component manufacturing, and assembly of final products, only the third category is a major component of the Nigerian economy. Vehicle and construction products (for example, window frames) are the most important part of the engineering industrial subsector (Western Africa Department 1993c, 24). Industries that are currently expanding include textiles, tanneries, timber-based activities, footwear, soft drinks and beer, vehicle repair, oil services, and engineering. Most small-scale industries are growing, whereas public sector industries with few exceptions are stagnant or declining (Western Africa Department 1993b, 4). Private sector industries that are
regressing include cement production, vehicle assembly, and radio and television set production (Western Africa Department 1993c, 5).

1.21 As a group, the engineering industry subsector has been one of the worst performers in the Nigerian economy. MAN estimates industrial capacity utilization averaged 35 percent between 1988 and 1991 (Western Africa Department 1993c, 5). Regardless of criticism that this percentage is an underestimate, capacity utilization remains low and hinders modernization incorporating pollution prevention or control equipment. Most Nigerian industrial facilities were installed between the mid-1970s and early 1980s and have not been substantially upgraded since (Western Africa Department 1993b, 4). Even without adding pollution abatement equipment, the use of modern equipment would improve energy efficiency and reduce waste. It is very difficult to obtain financial and production information on small firms and impossible to find pollution data because government agencies and trade organizations, such as MAN, do not track them (Western Africa Department 1993c, 3). The composition of foreign investment in Nigeria is changing; a number of multinational corporations are deciding that profit levels in Nigeria are relatively low and are selling their facilities. It is expected that investments by smaller foreign companies will become more typical in the short term (Western Africa Department 1993c, 3). Most of the larger companies have foreign ownership of 40 to 60 percent. Lebanese, Indian, and Chinese ownership is very high in the textile industry whereas British shareholders are the largest group of foreign owners. The largest Nigerian firms are listed by market capitalization in Table 11, Vol II. Two of the largest companies are breweries (Nigerian Breweries and Guinness Nigeria) and three are petroleum marketing firms (Africa Petroleum, National Oil and Chemical, and Mobil Oil Nigeria).
CHAPTER 2

SOURCES OF INDUSTRIAL POLLUTION

2.1 The Winvent industrial waste prediction model was used to estimate waste production by industrial subsector from employment levels. The model calculates waste per employee coefficients based on waste generation data from over 7,000 facilities worldwide. Data for the model were primarily obtained from the 1988 census of industry. When better data were available, they were also incorporated into the Winvent model. Limitations of the waste prediction include:

(a) nonavailability of state-level waste generation since the census had only country-level information;

(b) assumption that waste treatment was at higher levels than typically practiced in Nigeria;

(c) possible overstatement of emission levels if Nigerian productivity per employee is lower than the productivity levels used as a basis for the model;

(d) limited data quality of the census (Some industrial subsectors were poorly documented by the census. Although the census includes data on firms with as few as five employees, weak information is particularly a problem for small-scale enterprises);

(e) the grouping together of waste generation data from small- through very large-scale facilities in this initial use of the model (Subsequent studies could classify waste generation by industry size, as well as by subsector); and

(f) no estimation of air emissions.

2.2 Although the absolute numbers predicted by the model are not accurate, the model is an appropriate tool for estimating the relative waste generation of different industrial subsectors. The main purpose of the modelling was to rank industrial polluters. Industries are listed in Table 2.1 by amount of oil and grease and total, solid, and hazardous waste generated. The top ten sources of waste generation are illustrated in Figure 2.1. Seven industries are of particular concern according to total waste and hazardous waste generation: steel works, metal fabrication, food processing, tanneries, textiles, pharmaceuticals, and petroleum refineries; one additional industry, paint, generates high hazardous waste. The discussion in this chapter will focus on the industries identified as major polluters. Annex B outlines the major polluters along with the Winvent waste rank assigned to them through this model.

Steel Works

2.3 Four government-owned steel facilities currently operate in Nigeria: the Delta Steel plant in Aladja and the three inland rolling mills at Jos, Katsina, and Oshogbo. A fifth plant at Ajaokuta has been under construction for years. In addition, 16 private companies operate both crude steel-making facilities and rolling mills (Federal Ministry of Mines, Power, and Steel 1991, ii). The census included data from five iron and steel establishments, which, combined, produced $885 million worth of output in 1988. On average the plants employed 368 people, and three of five plants were large-scale enterprises. Steel output data for the parastatal plants are presented in Table 12, Vol. II. Iron and steel producers in Nigeria have problems complying with limits for suspended solids, phenols, ammonia, and cyanide. Heavy metal and organic pollutants also contaminate receiving water bodies.

2.4 Particulate matter and SO₂ levels are the steel industry’s principal air emission problems.
Other air pollutants of concern are fume and alkaline oxide emissions from blast furnace and by-product coke oven operations (Environment Department 1988, 129).

Steel rolling and finishing processes generally do not produce significant amounts of air emissions if industry-standard control equipment is in place. It is not known whether these practices are used in Nigeria. If not, common emissions would include sulfur gases and iron oxide, acidic, salt flux, and solvent fumes (Environment Department 1988, 149). Wastewaters tend to be high in suspended solids, oil and greases, and dissolved iron. Discharge of spent pickle liquors and rolling mill oils also pose a potential health and environmental hazard. They typically contain high levels of metals and acids, which drop pH levels of the effluent to very low levels. Pollutants in wastewater from steel-plating operations include metals and anions, such as phosphates, chlorides, and metal-complexing agents. The major solid wastes from steel rolling and finishing are steel scrap, scarfing residues, and refractory materials, most of which can be recycled back into the manufacturing process (Environment Department 1988, 152).

Although not mentioned as a major aspect of air pollution from steel works, the Delta Steel facility is depositing metals in downwind areas. Soil levels 250mm from the pellet plant for cadmium, chromium and lead were all about 7.5 times background levels. Nickel concentrations were measured as 140ppm; over 30 times background levels. The mean metal concentrations of nearby cultivated crops were also found to be elevated. Epidemiological studies on the surrounding communities would have to be conducted to determine the health effects from ingestion, inhalation, and dermal exposure of metals from the facility. Air emissions, including metals, from the Delta plant may represent a case where air pollution imposes a significant health risk on local communities (Ezihe and Ndiokwere 1990).

### Food Processing

Of the 759 food-processing plants recorded in the industry census, only 21 employ more than 500 workers. The food-processing subsector average of 48 employees means that most facilities are small-scale enterprises. The value of processed food in 1988 was N2.5 billion (Federal Office of Statistics 1988). This subsector is defined as including the processing of fish, dairy products, grain mill products, bakery products, sugar products, cocoa and confectioneries, beverages (nonalcoholic), and edible oils.

Although this group of industries is very diverse, all dispose of large amounts of organic wastes creating $\text{BOD}_5$, suspended solid, and pH problems. Dairy industry wastes are largely biodegradable liquid organic matter. As a result, they decrease dissolved oxygen and increase suspended solids. In the sugar industry, processing wastes contain large quantities of oxygen-depleting molasses and bagasse. The vegetable oil industries discharge kernels and cottonseed cake, as well as other bagasse. Mills dispose of grain bran, husks, and chips. In addition to high organic loading, sampling of diluted food-processing effluent gave chlorine levels in excess of 5,000 milligrams per liter (Olawuni in Industrial Control Unit 1986, 195–6). A study of the effect of a fruit canning industry and a bottling industry discharging wastes at one point along a stream in Ibadan found that oxygen demand, temperature, and dissolved solids (measured as conductivity) levels were so high that the water was no longer usable for irrigation (Table 15, Vol. II). Ajayi and Osibanjo analyzed the effluent from two Ibadan bottling plants and found the Pepsi-Cola factory to be much closer to or even within FEPA standards whereas the Coca-Cola plant was usually noncompliant (see Table 15, Vol. II).

### Tanneries

The limited utility of the census of industries is shown by its inclusion of only three tanneries,
Table 2.1 Nigeria: Sources of Industrial and Hazardous Waste Pollution (tons/year)

<table>
<thead>
<tr>
<th>INDUSTRY</th>
<th>TOTAL WASTES</th>
<th>INDUSTRY</th>
<th>HAZARDOUS WASTES</th>
<th>INDUSTRY</th>
<th>SOLID WASTES</th>
<th>INDUSTRY</th>
<th>OIL AND GREASE</th>
</tr>
</thead>
</table>

Source: Mission estimates.

Note: The wastes generated are estimates calculated by the use of the Winvent Waste Estimation methodology. The amounts of waste generated by each sub-sector may not be accurate. The model is, however, an appropriate tool for estimating relative waste generation of different industrial subsectors.
whereas Kano State alone has 80 (Federal Office of Statistics 1988). Tanneries are notorious for polluting water with the heavy metal chromium, but some tanneries use vegetable rather than chrome processes. They also greatly elevate total dissolved solid levels; in Mexico, tannery effluent commonly exceeds 2,000 milligrams per liter (Benavides 1992, 12). Other principal constituents of tannery pollution include oxygen demand, suspended solids, acids, nitrogen compounds, sulfides, vegetable tannins, and oil and grease (Environment Department 1988, 184). Typical wastewater quality values are given by tannery category in Table 16a, Vol. II. Although the typical values are virtually all above FEPA standards, they are considerably lower than the values for tannery wastewater discharged into the Ogun River given in Table 17, Vol. II (Oluwande 1983, 962). This discrepancy probably means that individual tannery pollution is much higher in Nigeria than the international average. The potential water quality degradation of the Ogun River is graphically illustrated by the very high solids, phosphorus, nitrogen, and chromium levels and exceptionally low pH. Specific noncompliance with federal standards includes a pH measurement of 3 and BOD, levels that were over six times the standard. In addition, the COD limit was exceeded by a factor of four. Suspended solids were 130 times more concentrated than the acceptable standard (Dissolved solids were not measured but are expected to be equally high).
Box 1: Canplas

Canplas is developing an integrated foundry and machine shop operation in Ikeja, Lagos. The foundry will produce 2,000 tons of iron per year. As is common in the metalworking industry, the plant will use iron scrap for 55 percent of its raw material requirements. As part of its loan conditions with the International Finance Corporation (IFC), the project will incorporate fume and dust collection and filtering equipment. The company will also train workers in environmental and safety management. Coolant water will be recycled through the plant rather than immediately discharged. The company has also agreed to maintain Nigerian and IBRD environmental and health standards. Although not an innovative pollution prevention program, the inclusion of training, pollution control, and water recycling as part of the foundry is a good example of how pollution management practices can be made an integral part of the metalworking process.

Source: IFC Project Summary

Metal Fabrication and Finishing

2.10 According to the industry census, there are 620 metal fabricating facilities in Nigeria (excluding machine and equipment manufacturers). Two-thirds of the facilities are very small-scale (employing fewer than ten workers) and only 15 had more than 200 workers giving an average of 24 people per plant. The total work force for the 620 establishments was 14,960 and their total output was N623 million (Federal Office of Statistics 1988). The Federal Ministry of Industry reported that there were 36 foundries in Nigeria. For the heavily industrialized states, nine foundries were located in Lagos, two in Kaduna, one in Kano, and none in Rivers (Western Africa Department, April 1991, 36). Only two electroplating and galvanizing companies are known to operate in Nigeria: General Metal Products (Lagos) and Vincent Standard Steel (Onitsha) (IFC Project Summary 1991).

2.11 The metal-working and metal-finishing industries dispose of potentially harmful levels of cyanide, toxic metals, oils, caustic soda, and acids. Table 13, Vol. II is provided to give a sense of the wide variety and concentration ranges for pollutants in the plating and electroplating industry. It is likely that sludges and liquid wastes from spent-baths and rinse waters are disposed untreated as they are in Peru (Benavides 1992, 15). Their solid wastes are also frequently contaminated with metals. Some solid wastes, especially discarded metal pieces, are bought or sold as scrap for recycling. Metal wastes are extensively recycled. Auchi reported the second highest partial and complete reprocessing of wastes in this industry, 50 percent and 19 percent respectively (Achi in Math and Robinson 1991, 483). Fumes can create local air pollution hazards (FEPA 1991, 37).

Textiles

2.12 The textile industry employs approximately 180,000 people and contributed N8.5 billion or 30 percent of non-oil GDP in 1991, making it Nigeria’s second largest industry (Western Africa Department 1993b, iv–1). There is substantial foreign investment in the industry and almost no government ownership. In contrast to the generally low capacity utilization in Nigerian industry, textile plants are operating at 80–85 percent of capacity. Investment in the industry is high and future prospects are promising. In the industry, 90–95 major companies own 200 plants. Most of the industry is located in Lagos, Kano, and Kaduna. The largest textile firm, United Nigeria Textile, had a turnover of more than N1.5 billion in 1991 and employed 10,000 people. In 1988, Nigeria produced 564 million meters of fabric (cotton: 332 million, synthetic: 197 million, and knitted: 35 million) (Western Africa Department, April 1991, 5). The synthetic fiber industry is
comprised of five plants producing polyester filament yarn out of imported polypropylene chips. Domestic synthetic material will be available when the gas-based Eleme petrochemical plant goes online in late 1993. There are no acrylic, rayon, nylon, or acetate production facilities. The garment industry in Nigeria is also large, but the informal nature of the industry means that data are unavailable. Dyestuffs are either directly imported or manufactured by multinationals from imported raw materials (Western Africa Department 1993c, iv). Textile plants typically have both a grey mill where cloth is woven and a finishing mill where the cloth is dyed, printed, or embroidered.

2.13 The textile industry produces large quantities of fabric and fiber solid wastes. Much of the waste from large manufacturers is recycled by smaller firms, but the rest is sent to landfills, burned, or buried in shallow ditches on site (Sridhar and Arinola 1991, 65). Except for fibers, dust, and volatized synthetic fibers, air pollution is not an important consideration for the regulation of textile mills (Environment Department 1988, 453). Fiber residues make textile wastewater high in BOD and suspended solids. It also contains a wide variety of chemicals including dyes, surfactants, oxidizing and bleaching agents, reducing agents, and silicates and inorganic salts (Ibidapo in Industrial Control Unit 1986, 140). Effluent from textile factories often contaminate water with oils, greases, and waxes (Akintunde in Industrial Control Unit 1986, 90). The dyeing process usually contributes chromium, lead, zinc, and copper to wastewater (Benavides 1992, 9). The effect of high oxygen demand decreasing dissolved oxygen and the large number of different chemicals used in textile processes greatly stress aquatic environments.

2.14 Historically, the industry has done little to treat its wastewater and contributes heavily to waste pollution. A study on industrial pollution of the Kaduna River found that four of the seven largest polluters were textile facilities (Osuide 1990, 6); however, this situation may be gradually changing as firms begin to comply with environmental regulations. A World Bank private sector assessment report noted that FEPA effluent guidelines are beginning to have an impact because several firms stated that they need to invest to improve their effluent quality (Western Africa Department 1993b, iv–7). The General Cotton Mill facility in Onitsha, which employs 1,500 workers, currently discharges its untreated effluent into a settling pond that overflows into the Niger River, but the facility is developing treatment options to comply with guidelines of the International Bank for Reconstruction and Development (IBRD) as part of an approved International Finance Corporation (IFC) loan (IFC 1992, 3).

Box 2: Afprint Nigeria PLC

Located in Lagos, Afprint is one of the largest integrated textile mills in Nigeria. In 1990, the company manufactured 724 tons of yarn and 24,990,000 meters of fabric on 46,080 spindles and 902 looms. Seventy-five percent of its production is African prints, most of which are sold domestically. The company discharges untreated wastewater directly into open trenches that empty into the ocean. Under an IFC proposed project, Afprint would install treatment equipment to meet the World Bank’s environmental guidelines and provide annual monitoring reports to the IFC.


Pharmaceuticals

2.15 The census of industry recorded 22 manufacturing plants that produced N484 million worth of drugs and medicines in 1988. The majority of factories were medium-scale with an average work force of 184 and total employment of 4,000. Four large facilities employing between 500 and 1,000 workers also operated in the subsector. No information on the environmental impact of the Nigerian pharmaceutical industry has been located; however, the small-scale industry in
India probably closely approximates the Nigerian situation. In India, wastewater volumes are small and depend on the drugs being prepared at each plant. No Indian companies in Bombay pretreat their wastes, and it is unlikely that their Nigerian counterparts are more diligent. Solid wastes, most of which are cartons and plastic bags, are sold for reuse (Benavides 1992, 10).

**Petroleum Refineries and Petrochemical Facilities**

2.16 The four Nigerian refineries, all government-owned, are located in Kaduna, Warri (Delta State), and Port Harcourt, which has two. The newest refinery, sited in Port Harcourt, was commissioned in 1989 and is capable of producing 120,000 barrels per day. The other refineries combined currently produce 180,000 barrels per day. The Warri and Kaduna refineries are very inefficient compared with refineries in developed countries. For example, the operating costs for the Warri refinery were US$22 per ton whereas a typical Western European refinery costs US$13 per ton to operate. The high energy consumption of the Nigerian plants cause most of the inefficiency. Specifically, the Warri refinery uses up 11 percent and the Kaduna refinery 16 percent of crude throughput just to operate (Western Africa Department, June 1989, 17). Marginal pollution output would decline dramatically simply by operating more energy-efficient refineries; however, since the refineries do not pay the full price of their oil inputs and do not have to maximize profits, they have little incentive to stop wasting energy.

2.17 The government also operates two petrochemical plants sited at the Kaduna and Warri refineries. They produce linear alkyl benzene, solvents, carbon black, and polypropylene. Production began in 1987, but capacity utilization has been low because of a shortage of inputs from the refineries (Economist Intelligence Unit 1993/4, 30). A gas-based petrochemical plant at Eleme is expected to open in early 1995 (Western Africa Department 1993b, iv–5). Since state ownership is prevalent throughout the industry and oil companies operate under federal jurisdiction with the Department of Petroleum Resources in charge of oil pollution issues, the regulatory power of FEPA and the Rivers SEPA is not well defined.

2.18 The major air pollutants emitted by refineries and petrochemical facilities are sulfur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons. Of lesser concern are particulates, aldehydes, ammonia, and organic acids (Environment Department 1988, 339). The exact emissions depend on the specific characteristics of the individual refinery. Similarly, wastewater outflows depend on the type and size of the refinery. Table 19, Vol. II, lists median effluent characteristics for different refining operations. From the descriptions of operating conditions below, Nigerian refineries probably have much higher liquid waste levels than the averages presented for plants internationally.

2.19 Oil pollution from wells, pipelines, ships, and refineries is endemic in the Niger Delta and a hazard around the Kaduna refinery. Oil equipment frequently leaks and accidental spills occur daily. The environmental impact of the contamination includes both surface and groundwater pollution. Petroleum discharges also stress terrestrial and wetland ecosystems. Marine organisms, including plankton, benthos, and nekton species, can be severely affected by spills. In some cases, fish population declines caused by a combination of pollution and, especially, overfishing, have been so severe that fishing communities have lost much of their principal source of protein and income. Water supplies are also often contaminated. Spills also occasionally damage agricultural crops. Two of the largest oil spills in recent years occurred in the Ohio Akpor and Bonny Local Government Areas of Rivers State. In both cases, pipeline ruptures caused the spills. The Bonny spill contaminated the major drinking water sources in the area and caused crop and animal damages estimated at N5 million. The Ohio Akpor spill covered 25 hectares and caused similar environmental and drinking water damage (National Concord, Sept. 22 1989). Local communities, angry about pollution and lack of
direct benefits from the oil industry, have disrupted production at numerous oil facilities. A recent protest involved thousands of people and shut down production at Shell's Forcados facility for two days in April 1993 (Reuters 1993). To mitigate the environmental impact of its operations, Mobile Producing Nigeria stated in 1992 that it was developing a company-wide waste management plan (Inter Press 1992).

2.20 In contrast to the general paucity of pollution information, oil industry environmental data cover many ecological zones and include both oil spills and routinely monitored effluent data. Information from oil producers goes back to the early years of the industry, but much of it has not been standardized and the accuracy of pre-1980 data is not uniformly high. Spill data are more comprehensive than effluent information. Air monitoring is still not conducted by most companies and only spot measurements are taken. Both the Kaduna and Warri refineries analyze water quality along many parameters, but have yet to measure air emissions (Hassan 1991, 15). The Department of Petroleum Resources is setting up a computerized data base of oil pollution statistics that should be incorporated into an industrial pollution data base (Adegbulugbe 1990, 55).

2.21 As part of the World Bank Refineries Rehabilitation Project, wastewater treatment systems were supposed to be upgraded at the Warri and Kaduna facilities to reduce pollution to normal industry standards by July 1991; however, the project closed on June 30, 1993, without full disbursal of the loan. Before the anticipated improvements, the Warri refinery did not have the capacity to treat all of its wastewater and some of the pollution control equipment did not function. The project was expected to rehabilitate the broken equipment, enhance working wastewater equipment, and build facilities to separate storm- and oil-contaminated water (Western Africa Department, June 1989, 19). The wastewater modifications proposed for the Kaduna refinery were even more substantial because its condition was worse. The current first-stage oil-separation equipment cannot handle the quantity of wastewater and has resulted in the complete shutdown of biological treatment processes. Design deficiencies in the flocculation section and overloading throughout the treatment facilities have made oil leaks common throughout the system. Oil from the refinery has migrated into wells in the Chidimu, Rido, and Romi residential areas. Oil wastes are thought to be one of the major contributors to pollution of the Romi River. Pollution has depleted fish populations in the river to such an extent that fishing was abandoned in 1988 (Osuide 1990, 7). It is not surprising that an Ahmadu Bello University study cited the refinery as one of the seven largest contributors to the poor quality of the Kaduna River (Osuide 1990, 6). Improvements through the rehabilitation project would have included an activated sludge system to reduce phenol content and oxygen demand, a new oil separator, and a new flocculation-flotation system to treat oily sewer water. In addition, the rehabilitation work was designed to improve the energy efficiency of both refineries and to install monitoring equipment. Before loan closure, only some wastewater treatment improvements were carried out at the Warri refinery and none were completed at the Kaduna refinery (Nayar 1993).

2.22 A study of metal concentrations near the Warri refinery found elevated levels in both soils and plants. Concentrations ranged from three times background for chromium (44 ppm), 4 times for lead (30 ppm), 4 times for zinc (119 ppm), 6 times for copper (43 ppm), and 7 times for nickel (7 ppm) and for cadmium (44 ppm). Plant levels were similarly elevated. The combination of metals and other air pollutants from the refinery complex may mean air pollution, as well as wastewater, is affecting human and ecosystem health (Ezihe and Ndikwere 1990).

Small and Very Small-Scale Industries

2.23 Using the U.N. Development Programme's (UNDP's) Urban Management Programme (UMP) criteria for industry size, 59 percent of Nigeria's industries are very small-scale (fewer than ten employees) and virtually all of them, 92 percent, are small-scale (fewer than 50 employees) (Western
Financial and production data for small firms, let alone environmental information, are not collected in Nigeria. As a result, this section relies primarily on studies in other developing countries; specifically case studies from Peru, Mexico, Zimbabwe, and India developed through the UMP, World Bank, and the U.N. Centre for Human Settlements (UNCHS). UMP has determined that the following small- and very small-scale industries produce significant amounts of hazardous wastes in developing countries: (a) tanneries, (b) textile plants (especially dye processes), (c) metalworking and electroplating shops, (d) foundries, (e) vehicle repair shops and petrol stations, (f) paint shops, (g) printers, and (h) battery production and recycling. Many of these industries in Nigeria also include medium- and large-scale companies.

2.24 Small industries are the most difficult subsector to regulate because of their small size, shorter life span, endless variety of processes, and paucity of information. In addition, operators usually have no training in pollution management. They also frequently operate on the margin of business survival and cannot afford the opportunity cost of concentrating on nonproductive activities (Benavides 1992, 26). For example, in Nigeria, very small-scale service industries such as garages, mechanic workshops, and petrol stations are regulated for oil and grease discharges, but the ability of the government to monitor the discharges from thousands of small industries is almost nonexistent (FEPA 1991, 20). Their sheer number makes pollution control particularly important and laborious.

2.25 Many very small-scale companies in Nigeria operate in the informal sector and employ fewer than five people. The companies are run by individuals, families, extended families, and cooperatives. In addition to all types of artisans, informal industries are important suppliers of services such as auto repair and maintenance, welding, wiring, and carpentry. Since their establishment, most small- and very small-scale industries have grown and 43 percent have doubled their staff. The informal sector activities of vehicle repair and maintenance, tailoring, and garment making have led small-scale industry growth (Western Africa Department 1993b, 5). With half of all small enterprises having no outside financing and collateral demands being too high, financing of pollution abatement equipment or even more modern equipment of any kind is very difficult.

2.26 In general, small companies produce more waste per unit output than larger firms. They tend to use even more inefficient and antiquated processes, which generate more wastes than the processes used at larger companies. This is not always the case. In Peru, large-scale industries create 45 times as much bleaching effluent and 12 times as much dyeing effluent as the small plants (see Table 27, Vol. II). Small-scale Peruvian producers only create slightly more solid waste fuzz than the large firms (Benavides 1992, 23). In general, the small scale of production also makes marginal pollution abatement practices more expensive. In the electroplating industry, treatment costs per unit are three to four times higher than for large-scale firms. On the other hand, waste generation by small-scale operations may be relatively small because of extensive recycling, since small- and very small-scale industries often recycle their own wastes and those from larger corporations. For example, in Nigeria, small textile firms use the fabric scraps of the large producers as raw material. The need to prolong equipment and materials life may also reduce waste.

2.27 Another problem is that government pollution control programs tend to ignore small waste producers. None of the countries in the UMP case studies (Mexico, Peru, Zimbabwe, or India) has developed environmental legislation designed for small-scale industry. Officials in these countries also have an ingrained belief that small-scale industries are not worth regulating because they produce insignificant amounts of waste (Benavides 1992, 23). Although official perception of the relative importance of small-scale polluters is not known, Nigeria has not determined when or how
it will foster small industry compliance with environmental regulations. Small enterprises are usually located in poor residential areas, where they pose additional health risks to populations already coping with deficient sanitation and high environmental degradation (Benavides 1992, 25).

Similar to their Peruvian counterparts, who view any risks as a normal part of doing business, Nigerians probably lack an understanding of the health concerns associated with exposure to contaminants from neighboring small industries (Benavides 1992, 16).
CHAPTER 3

CONSTRAINTS FOR POLLUTION CONTROL

The following sections outline key constraints in Nigeria to the development of an effective strategy for redressing pollution. Chapter 4 presents strategic options designed to overcome these constraints.

Institutional Constraints

3.1 Institutional constraints are one of the critical limits to efficacious pollution management in Nigeria. Industrial pollution control is fragmented over at least two federal agencies and three government levels with no clear designation of responsibilities. Coordination among the various agencies and levels is weak. Division of federal and state responsibilities is also a source of disagreement, with FEPA preferring a more centralized pollution management process and at least the Lagos SEPA emphasizing more state control (Aarrestad 1991, 3).

Capacity Constraints

3.2 Federal. Financial, personnel, and technical constraints at all government levels severely limit industrial pollution management capabilities. With an average of five employees per heavily polluted state and a similar number in the nascent zonal offices, FEPA is too understaffed to monitor adequately or enforce pollution regulations. Furthermore, the staff is largely untrained in industrial pollution control. FEPA offices also lack pollution-monitoring equipment and laboratories as well as sufficient vehicles and adequately equipped offices. For example, the zonal offices have only one vehicle each (Massey 1992, 37). Furthermore, neither the FEPA office nor the Rivers SEPA has a laboratory in that state. As a result, after oil contamination incidents, the authorities must ask the responsible companies to provide soil and water analyses, which is a clear conflict of interest (Massey 1992, 33). Not surprisingly, the World Bank's 1991 industrial pollution control mission found that enforcement of environmental legislation is ineffective overall and called for institutional strengthening as a prerequisite to program implementation (Osae-Addo 1991, 7, 10).

3.3 State. Of the five major polluting states, only Rivers has a pollution control and management strategy that targets specific cleanup actions (Osae-Addo 1991, 7). Like their federal counterpart, the state agencies are understaffed. In a typical SEPA the staff comprises: one engineer, one scientist, two enforcement officers, two drivers, and one laboratory technician (Osae-Addo 1992, 10). In contrast, Brazil’s most industrialized states, São Paulo and Rio de Janeiro, have very strong SEPAs. The São Paulo environmental agency had a budget of US$250 million and employed 2,350 people in 1990. Rio de Janeiro’s SEPA was smaller, with a budget of US$100 million and 1,100 employees but still vast compared with its Nigerian counterparts (Energy and Industry Division 1992, 6). To compound the effect of small staffs, SEPAs have completely insufficient monitoring and laboratory equipment and even basic needs such as office equipment and vehicles are unmet. One of the principal reasons for the poor resources is the dependence on funding from state budgets (Osae-Addo 1991, 10). Osibanjo, a FEPA resident consultant, summarized the state-level institutional setting as follows: the majority of the states that have vital roles to play in the implementation of the Standards have no institutional framework in place, or well-articulated Environmental Action Plans or competent manpower (Osibanjo in Aina and Adedipe 1992, 99).

3.4 Only Lagos State, through its Pollution Discharge Charge, has been able to generate substantial revenue from pollution charges. With these funds, the state has built a laboratory (the
Wastewater Laboratory Complex) but has yet to equip it. To enhance pollution monitoring in the state, the Lagos Drainage and Sanitation Project, supported by the Overseas Development Administration, will provide basic equipment for a water pollution laboratory, which presumably would be housed in the state's currently unequipped laboratory building (Environmental Resources 1993, 26). The Lagos SEPA is considered the strongest of the state-level environmental agencies and was the only state considered ready in 1991 by the National Council on the Environment to enforce the national guidelines developed by FEPA (Osae-Addo 1991, 10; Lagos State Government 1991, i). Lagos State was also one of the first states to implement regulations requiring environmental impact assessments to be completed on all new projects (Lagos State Government 1991, iii). Lagos has created working groups to further environmental management in the following industries: textiles, paints, ceramics and glass, cement, food-processing, wood-processing, pharmaceuticals, iron and steel, and plastics (Lagos State Government 1991, iv).

3.5 Municipal. Of the three tiers of government, municipal agencies are the least prepared to deal with industrial pollution. They are usually responsible for providing solid waste disposal and water services; however, they have completely inadequate financial resources to supply the services because the income from user charges does not cover costs. As a result, they rely heavily on federal and state funding. The weak financial base has kept the quality of services they provide at very low levels. For example, in 1990 about 80 percent of solid waste disposal trucks were inoperable in the five most polluted states. In comparison, the Port Harcourt Environmental Sanitation Authority, which is supposed to collect the city's municipal and industrial solid waste, was in the relatively good position of having 28 of its 42 vehicles functioning in 1991 (Massey 1992, 32). Municipal government staffs tend to be the weakest of all government levels in terms of number, level of education, and quality of personnel (Osae-Addo 1992, 12).

3.6 FEPA has adopted a direct-regulation pollution-control approach that requires industry adoption of emission standards promulgated by FEPA in 1991 and the licensing of all industries in the country backed up by a progressive incentive process of warnings, penalties, fines, and shutdowns for noncompliance (Environment Department 1990, 3). To enhance enforcement activities, FEPA recently created the Inspectorate and Enforcement Department (Osibanjo in Aina and Adedipe 1992, 99). FEPA and the SEPAs can seek court-levied fines to a maximum of N500,000 and prison sentences up to ten years (Magner and Duer 1991, 27). All fines must be determined in court; no automatic administrative fines exist; and there is no predetermined basis for the size of the fine, which could be based on the volume, toxicity, damage, or polluting history of the corporation. Except for the Lagos pollution charge fund, all revenues from fines go to general government revenues and not directly to FEPA or a SEPA. Without direct gain from enforcement through increased agency revenue there is little incentive to pursue enforcement aggressively.

3.7 Since FEPA and the state agencies do not have the resources to monitor industrial pollution, they are far from able to enforce regulations adequately. WASTEC found that enforcement is generally limited to accidents that cause visible pollution (Massey 1992, 24). In fact, FEPA has yet to impose any penalties for noncompliance. Rather than immediately enforce the regulations, it is allowing a short moratorium for polluters in which it advertises that pollution compliance is now the law. After this 'sensitization' period ends, FEPA officials state that they will act quickly to close down several polluting industries to send a message to industry that they are serious about enforcement.

3.8 Until FEPA ends its moratorium on enforcement, companies have little incentive to improve their pollution records. It is not surprising that in a World Bank review of regulatory constraints on Nigerian business, FEPA was not
Box 3: Monitoring and Enforcement Powers granted to FEPA under the FEPA Decree of 1988 (Sections 25, 26(1))

25. For the purpose of enforcing this Decree, any authorized officer may without a warrant:
   (a) require to be produced, examine, and take copies of any license, permit, certificate, or other document required under this Decree or any regulations made thereunder;
   (b) require to be produced and examine any appliance, device, or other item used in relation to environmental protection.

26.(1) Any authorized officer, where he has reasonable grounds for believing that the Decree or any regulations made thereunder [is being violated], may without a warrant:
   (a) enter and search any vehicle, land, building, or other premises . . . in which he has reason to believe that an offense against the Decree or any regulations made thereunder has been committed;
   (b) perform tests and take samples of any substances relating to the offense;
   (c) cause to be arrested any person who he has reason to believe has committed such offense; and
   (d) seize any item or substance that he has reason to believe has been used in the commission of such offense or in respect of which the offense has been committed.

mentioned as being among the most important and burdensome regulatory bodies in the country (Western Africa Department 1993c, 22). In contrast, the U.S. Environmental Protection Agency (EPA) is one of the most prominent regulatory agencies in the United States. The major difference does not lie in weak Nigerian regulations, since most of them are similar to those adopted by developed countries, but rather in the nonexistent enforcement of the regulations.

3.9 One problem is the poor zoning and enforcement of industrial estate areas, where landowners in the estates continue to sell land to people wanting to develop residential properties because few new manufacturing facilities are being established (Ogbeide in Industrial Control Unit 1986, 220). Although FEPA is planning to improve zoning regulations, housing encroachment on industrial estates throughout the country will continue unabated without enforcement.

3.10 State enforcement strategies are equally ineffective. For example, Rivers State has fines that escalate from ₦500 to ₦5,000 depending on the offender and the degree of pollution. Fines of such small size are clearly ineffective in modifying corporate pollution practices. Lagos State has a more sophisticated and demanding enforcement system. The maximum fine for illegal waste disposal is ₦1,000,000. Fines range up to ₦500,000 for noncompliance with state standards and rules and for not paying the Pollution Discharge Charge. The state can also imprison managers and directors of firms for not more than ten years if they consent to the environmental offenses. Finally, courts can order a facility closed until the guilty party restores the polluted area. As an incentive for aggressive enforcement, the fines are incorporated into the Pollution Discharge Charge Fund administered by the SEPA (Magner and Duer 1991, 27).

3.11 With virtually all facilities polluting at levels far above FEPA limits, Nigerian industry is unprepared for strict enforcement of pollution regulations in the immediate future. Most firms do not have the capital, information, or technical expertise to install the necessary equipment, so
many of them would be forced to keep paying fines or close down. (Osae-Addo 1991, annex B).

3.12 Also, enforcement will very likely be constrained by corruption, with payoffs to inspectors and judges reducing the efficacy of a pollution management strategy. Enforcement through court action is inhibited by the severe limitations of the Nigerian legal system. Penalties are very difficult to enforce because of long processing times and other ways of circumventing the system to keep from paying penalties; thus, reliance on legal fines may not significantly induce corporate compliance, and, since shutting down numerous chronic polluters is politically difficult, threats of doing so are hollow.

**Monitoring Constraints**

3.13 In addition to the existence of data and management, monitoring—the ability to generate more specific information about environmental conditions on an ongoing basis—is fundamental to pollution management in Nigeria. In the FEPA decree, environmental agencies are granted very powerful-monitoring rights (see box 4). For instance, authorities are able to conduct both announced and surprise inspections (Environment Department 1990, 6); thus, lack of legal authority is not a reason for the poor monitoring record of the agency. The problem is that neither FEPA nor the state environmental agencies have the resources to monitor industries in their jurisdictions systematically. Under the National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations of 1991, industries are supposed to have a pollution monitoring unit at each site and analyze all discharges for monthly reporting to FEPA. Accidental or unusual discharges must be reported to FEPA within 24 hours. To monitor chemical use and storage, the regulations also demand that firms give them a list of chemicals used in manufacturing; details of stored chemicals; where chemicals are bought, sold, or obtained; and names of secondary buyers (National Environmental Protection Regulation 29). Such information is obviously an essential basis for any monitoring program, but no evidence has been found to show that any of these monitoring activities have been implemented by states or firms.

3.14 Inadequate analytical equipment and laboratories also hamper monitoring; however, in addition to the public sector laboratories planned by FEPA and the SEPA s, a private medical diagnostic and environmental analysis laboratory is being proposed for Abuja. It would test industrial effluents, concentrating on the oil industry (IFC 1993). Interest in developing a privately owned and operated environmental laboratory illustrates that some companies take the government's commitment to managing industrial pollution seriously and view it not as a hindrance but rather as a new industry. Initial steps for private sector involvement in environmental management such as this one are critical for making environmental management a normal part of business.

**Regulatory Constraints**

3.15 In general, the federal legislative framework for controlling industrial pollution is sound, since it enables the federal and state governments to establish the necessary environmental agencies and industrial discharge standards. It also creates an appropriate monitoring, enforcement, and legal prosecution process for polluters; however, the division of responsibilities between FEPA and the SEPA s is not well defined. FEPA policy is that "State governments with the appropriate infrastructure and capability approved by FEPA will implement FEPA policies, guidelines, and standards in the states. Otherwise, FEPA will implement its own programs and enforce regulations in states without the necessary infrastructure and capability" (FEPA 1991, 22). In theory, this statement may be acceptable, but it does not correspond to the reality that FEPA itself is grossly understaffed and poorly equipped to manage industrial pollution. The guidelines also state that "each State should adopt FEPA's standards as the minimum standards." All four of the industrialized states have developed their own
One alternative for multinational environmental management in the face of incomplete regulations and uncertain enforcement is to abide by standards in the corporation's developed country headquarters. For example, Dunlop Nigeria Industries has since at least the mid-1980s strived to maintain environmental and health standards as regulated under British Health and Safety Regulations and Factories Acts. The company's major shareholder, BTR Group (UK), has a corporate environmental policy that requires all its subsidiaries to follow European standards.

Source: IFC Project Files.

Box 4: Dunlop Nigeria Industries

standards, which tend to be stricter than FEPA's limits. The regulations are contained in disparate regulations for health, drainage, and sanitation, which inhibit a coordinated approach to industrial pollution abatement.

3.16 Industry complaints that the effluent standards established by FEPA and the SEPAs are not appropriate for Nigerian conditions may be well founded. Although FEPA purported to draw on experiences in nine developed and developing countries, most of the standards are based on regulations effective in the United States (Hewawasam 1993). Obvious problems emerge from such a transfer, such as the applicability of water regulations based on rivers, such as the Hudson and Chesapeake, to Nigerian rivers, such as the Niger and the Kaduna. To amend this problem, FEPA plans eventually to revise the regulations to make them more compatible with Nigerian conditions; however, the promise of future relaxed standards reduces the incentive of industries to comply with the current limits. The diversity of ecosystems in the country makes the development of intra-Nigerian standards that take into account the ecology and climate of different regions an important future step.

3.17 A major limit to the effectiveness of current regulations to reduce pollution is the absence of economic incentives. Except for the Lagos and Kano pollution charge programs, market-based incentives for pollution control do not exist. The lack of incentives is exacerbated by the excessively low energy, water, and waste disposal charges. Furthermore, there are no subsidy programs, such as tax credits, grants, or lines of credit, to provide positive incentives for industry to abate pollution.

3.18 Although FEPA has established general land-zoning regulations, including division of industry and housing by buffer zones, specific regulations for industrial land use have not been promulgated. Without more precise regulations coupled with active enforcement, industry compliance remains improbable. In response to comments on the draft guidelines, FEPA stated it will issue more comprehensive zoning standards based on the ecology of the industrial site, but they have not yet been written (FEPA 1991, 23).

Information Constraints

3.19 The amount and quality of information on industrial pollution in Nigeria is very poor. Information on effluent characteristics and ambient pollution levels is sparse and uncoordinated, and virtually no continuous monitoring programs exist. Data on the ecological and human health effects of pollutants in Nigeria are equally unavailable. A WASTEC report concluded in 1992 that little national-level information on waste generation was available. Except for general descriptions of wastes in the Lagos State Industry Directory, the state-level situation was found to be even worse, with essentially no information in existence (Massey 1992, 23). Furthermore, WASTEC found that with the exception of some multinational corporations, effluent data are not communicated from companies to government authorities. Industrial data as compiled by MAN are also not useful because they do not include information on plant capacities, production rates, or energy use.
3.20 The lack of pollution information is a severe hindrance to pollution management directly but also has several indirect effects. Without adequate data, some government authorities remain unconvinced that industrial pollution abatement is an environmental priority (Osae-Addo 1992, 11). The information available on the benefits of improved human health and ecosystem productivity is not sufficient for monetary estimations. Consequently, it is difficult to convince industry or government skeptics that the tangible and immediate private costs of pollution prevention or control equipment is more than offset by the social gains.

3.21 The information constraints will be reduced by several studies to be conducted under the Nigeria Environmental Management Project (EMP). The accumulation of specific information on sources and volumes of industrial wastes in the main industrial areas will be very helpful in providing sound baseline data on which to develop pollution control programs. The project will also assess the effects of current pollution on human health, which will help determine priorities for abatement actions. The EMP's evaluation of current industrial pollution management and development of a strategy for industrial waste disposal will expand the information contained in this report. The environmental impact assessment guidelines study of the EMP could also strengthen government control of pollution from new and existing facilities by improving assessment procedures.

Data Quality

3.22 The environmental data presented in this report have serious limitations for assessing the impact of industrial pollution. In almost all cases, no baseline or time series data for comparison exist. Consequently, the modification of ecosystems over time by industrial pollution cannot be quantified. Without baseline data, the pollution thresholds and assimilative capacities of the stressed systems are also impossible to delineate. The quality of the instruments used and training of personnel may not be uniformly high, and bias results. Much of the data involves single sampling that cannot depict the effects of seasonal water flow fluctuations or effluent quantity and quality changes. Basic data required to put the measurements in context, such as date, time, and flow rates, are often missing. In addition, no descriptions of ecological changes from pollution in, for example, river bank vegetation, river species composition, or evidence of air pollution stress have been found. Bioassays in effluent and downstream areas have not been conducted.

3.23 In spite of these limitations, the countrywide waste estimations for industrial subsectors and site-specific scientific studies together provide a good indication of the magnitude of the problem. The information is sufficiently sound to point out which industries are the most significant polluters and to initiate a pollution management strategy. Also, although the data taken individually are not especially valuable in describing environmental stress from industrial pollution, as a whole they present a picture of decades of excessive contaminant loading that must have a grave impact on local ecosystem and human health. The pollution is so widespread in Lagos and Rivers States that it has now expanded beyond being a local issue and is threatening to become a regional problem.

Financial Constraints

3.24 Credit and exchange rate policies affect the cost of capital and indirectly the magnitude of industrial pollution. A variety of factors limiting competition among banks for industrial business further increase the financing costs of industry (Western Africa Department 1993b, ii). In Nigeria, only 10 percent of commercial loans
mature in ten years or more and 70 percent have a maturity of six or fewer months. Furthermore, while the government sets the interest rate spread at 5% above funding costs, which has kept average commercial lending rates to 25.7% in 1992 and 32.8% in 1993, liberal interpretations of the regulations, such as requiring borrowers to pay interest charges up front, considerably increase the actual rate businesses have to pay. The short terms and high interest rates of most loans mean that companies will borrow only to finance the most attractive or critical investments. Except for some cost-reducing pollution prevention processes, the majority of pollution abatement investments are not in this category. Firms have enough trouble financing traditional plant expansion without having to worry about attempting to secure loans for pollution abatement equipment.

Industry Constraints

3.25 A variety of industrial plant handicaps diminishes the ability of individual firms to abate pollution. For example, many older or smaller facilities have spatial limits and cannot accommodate large pollution control equipment (Osae-Addo 1992, 2). It may not make economic sense to add modern pollution control equipment to old factories. Financially strapped industries may not be able to afford to put significant employee time toward environmental management. Even if they have the financial resources, most companies do not have the technical expertise to implement a pollution control strategy. These problems are even more severe for the thousands of very small-scale industries in Nigeria.

3.26 Lack of information can also play a critical role in perpetuating even uneconomic pollution practices. Without information on pollution prevention or control alternatives, companies cannot make appropriate and efficient decisions. In one case, the NAFCON fertilizer plant allowed sulfur to escape as SO₂ rather than recover it as useful sulfuric acid. Without a price or additional charge that forces the company to internalize the social cost of the SO₂, the private benefits of capturing the sulfur are exceeded by the private costs, and so the firm decides to emit the pollutant. Fortunately, in this case, the world price of sulfuric acid was higher than the costs of recovering the sulfur, and so the firm eventually decided to build a sulfur-capturing process into its fertilizer manufacturing process (Magner and Duer 1991, 21).

3.27 Since FEPA's environmental regulations were promulgated only three years ago, industries have historically paid little attention to the environmental consequences of their actions. In fact, industry awareness of the recent environmental regulations is limited, supporting the need for FEPA's sensitization period. For example, Magner and Duer (1991, 24) found in 1991 that many industrialists did not even realize that the government had issued interim emissions standards. Industries have been hit with a combination of declining government support for manufacturing since the mid-1980s and a very difficult economic environment. They perceive environmental regulations and fines as another government-imposed burden that further reduces their profitability. Pollution reduction efforts are still viewed outside the scope of routine industry practices (Environment Department 1990, 4).

3.28 Industrialists' views on pollution management cut across a broad spectrum from outright hostility and lack of knowledge of pollution issues to cooperation with government initiatives. The gradual trend is toward a more enlightened corporate appreciation of environmental issues. A World Bank aide memoir summarizing mission findings stated that most industries recognized the need to control industrial pollution and were aware of the importance of pollution prevention practices. During the mission, MAN stated its support for the World Bank's pollution management program (Western Africa Department, December 1991a, 7).

3.29 WASTEC found that multinationals such as Peugeot, Air Liquide, Lever Brothers, and Michelin tend to adopt parent company waste management practices and have access to superior pollution control equipment (Massey 1992, 20,
25). Some other firms, which are also typically run by foreigners, have established pollution control practices. Specific instances of more sophisticated treatment processes include a paint factory that filters its wastes through a sand column and an automobile company that has reduced its hexavalent chromium effluent concentration.

3.30 On the other hand, most companies remain unwilling to share waste production data with government environmental agencies. Only 10–15 percent of companies surveyed for their hazardous wastes in the four most industrialized states by FEPA returned the questionnaires; a lot of the information given was probably inaccurate. Industries showed as little interest in cooperating with the fledgling state agencies as they did with the FEPA survey. For example, the five most industrialized states sent out questionnaires to industries on waste emissions, but only 10 percent of the companies surveyed bothered to complete the survey and much of the data provided were inaccurate (Osae-Addo 1991, 7). With such reluctance, monitoring of firms is going to be difficult and self-monitoring as practiced in many developed country programs may not be suitable. Even getting monthly discharge reports from companies, as required under the National Environmental Protection Regulations, will be difficult.

Parastatal Constraints

3.31 State-owned corporations dominate or remain important players in several major polluting industries. Parastatals include all five major steel facilities, both fertilizer companies, the aluminum company, several cement firms, three sugar companies, two pulp and paper corporations, and a number of hydrocarbon-based plants owned by NNPC. Some of the companies have been commercialized in name and others are supposed to be privatized, but have yet to move in that direction (Western Africa Department 1993c, 22). Although parastatals are not exempt from environmental regulations, in practice the environmental agencies have very limited enforcement power over state industries. Energy facilities are difficult to regulate because the energy sector has considerable political power in Nigeria (Osae-Addo 1992, 12).

3.32 The difficulty in getting parastatal compliance is a near universal problem. Parastatals are more difficult to deal with than private companies because, unlike profit-focused private companies, parastatals have general, ambiguous, and inconsistent goals that thwart agreement (Banfield in Thia-Eng and Scura 1992, 98). Nigerian environmental agencies do not have open communication, mechanisms for dispute resolution, or effective oversight of the parastatals, characteristics that are critical to ensuring compliance with environmental regulations (Fenno in Thia-Eng and Scura 1992, 98). Evidence from other countries shows that cooperation with other government institutions, particularly parastatals, for compliance with regulations can only be achieved through bargaining and negotiation (Thia-Eng and Scura 1992, 98). In Brazil, state environmental agencies have very limited enforcement power over parastatals; only strong state agencies are able to convince parastatals to reduce pollution. As in Nigeria, Brazilian parastatals' high employment levels and essential products make severe penalties unlikely. Some parastatals, such as Petrobras, ignore state laws in favor of companywide regulations (Energy and Industry Division 1992, 3). Indian parastatals are under a lot of pressure to comply, and some have applied for funding under the Industrial Pollution Control Project. Currently, only one parastatal has received project funding (Vergara 1993). Parastatals that are not economically viable should be considered for closure; the remaining facilities should be required to meet pollution standards and receive pollution management assistance at the same level as private sector firms.

Economic and Policy Constraints

3.33 Industrial and economic development policies often have unintended and detrimental environmental impacts. Fiscal (taxes and subsidies), monetary (interest and exchange rates),
and commodity- and waste-pricing policies explicitly designed to foster industrial growth help to determine the extent of industrial pollution in Nigeria. Industrial policy influences industrial pollution in three ways. First, it affects the speed and type of industrial expansion. Second, policies can distort decision making as to whether industrial by-products are treated as wastes or recycled and reused. Third, subsidies cause excessive use of whatever is being subsidized. Policy shortcomings such as these are widespread in Nigeria. Industrial and economic development policies need to take into account their environmental implications to ensure the efficient allocation of resources and to reduce pollution to optimal levels. Energy and input subsidies need to be reconsidered in light of their indirect environmental and human health costs. Ideally, prices need to reflect the social costs of production and consumption, not just the financial costs.

Trade Policy

3.34 Tariffs and other trade barriers, which remain too high in Nigeria, contribute to increased pollution. Protectionism reduces competition, allowing firms to be less efficient and less cost conscious. Companies are less concerned about minimizing input costs and tend to use nonoptimal amounts of resources. Pollution abatement is directly affected by duties on pollution control equipment, which are in the range of 30-40 percent and put the cost of compliance with environmental regulations further out of reach (Magner and Duer 1991, 32).

Energy Subsidies

3.35 The federal government policy of energy subsidies creates numerous environmental costs. Energy prices, particularly petroleum product prices, have been set well below world market levels. In 1992, domestic petroleum prices were only 4 cents per liter compared with the European average of 30 cents per liter. The October 1994 energy price increases have put them much closer in line with world prices. Since industries do not pay the full cost of consuming the energy, the incentive for them to conserve it is dissipated. The excessive energy use creates greater environmental pollution than if energy prices at least matched world prices. In addition to the accelerated depletion of a nonrenewable resource, pollution results from direct oil contamination and increased air pollution from excessive use of petroleum for transportation and energy production. Aarrestad reported that electricity seems also to be priced below production and transmission costs. The environmental costs of the electricity subsidy depends on whether electricity in Nigeria is a substitute for fossil fuels or a consumer of them (Africa Technical Department 1991, 2). Despite the low cost of electricity, its uncertain supply has forced many industries to operate their own generators. For example, in the textile industry, continuous process plants use power supplied by the National Electric Power Authority (NEPA) only for administrative and other nonessential purposes (Western Africa Department 1993b, iv-5). Power cuts and trippings cause an estimated 10 percent of capacity utilization losses in the textile industry (Western Africa Department, April 1991, 14). Private-generating capacity in the country is estimated at 1,500-2,000 megawatts. NEPA’s unreliability costs Nigeria approximately US$900 million every year (Western Africa Department 1993b, 13).

State and Municipal Service Charges

3.36 Water prices that are much lower than the costs of purification and wastewater treatment act as de facto subsidies and lead to equally wasteful practices. This problem is exacerbated in Lagos State where many industries pay a flat rate regardless of water use. In contrast, Kaduna meters and charges all industries according to their water consumption. Without adequate incentives, industries have little reason to limit their water intake or recycle water within facilities. In 1990 1,000 liters of industrial water cost N0.80 in Kano, N2.2 in Lagos, and a maximum of N4.34 in Kaduna. Kaduna has instituted progressive user charges depending on water use, but the revenue covers only 65-70 percent of total costs including capital recovery (Magner and Duer 1991, 36). Not
only is water supply subsidized, but the charges that are mandated are often not collected. The revenue from charges for water and other municipal services has declined from 75 percent to 40 percent of the Lagos State Government's revenue. To reverse this decrease, the state government has established a Revenue Generation Bureau that will be driven by recommendations made by a Billing and Collection System Study as part of the Lagos Drainage and Sanitation Project Department (1993d, 37).

3.37 Overall, the poor quality of infrastructure, from electricity to water supply, has made companies install private equipment that is far less efficient and creates more pollution than sound, publicly supplied infrastructure. Firms employing fewer than 50 people place about 25 percent of total investments toward providing their own infrastructure equipment and operations (Western Africa Department 1993b, 12).

3.38 All municipalities are required to collect solid wastes. In 1990, the Lagos Waste Management Authority collected or contracted collection of waste from 720 firms for over $6 million (Lagos State Government 1991, 3). This figure represents only a fraction of the full cost of solid waste disposal. In Nigeria, the weak enforcement of waste disposal laws and disposal prices that do not include the social costs of unregulated dumping allows firms to treat waste disposal costs as externalities. When a firm's waste disposal costs do not incorporate the social costs of disposal, it has no economic incentive to dispose of the wastes in an acceptable manner or to reduce the amount of waste it generates. Consequently, companies typically discharge wastes into unlined pits or the nearest water body. For example, the $5 charge to dump a truckload of waste at Iddo Getty into Lagos Lagoon clearly does not include the environmental costs of human health impairment from reduced water quality, a degraded aesthetic experience, fish population declines, or multifarious other losses (Osae-Addo 1991, 9). Waste contractors, which are hired by many industries, can charge very low rates because they usually dump wastes illegally. In Port Harcourt, solid waste fees charged to industries cover only the cost of waste containers, not the collection and disposal costs.

3.39 Municipalities and states are beginning to increase fees for services and charge for previously free services. To increase its waste disposal revenue, Kano has instituted a registration fee for waste collection contractors of N2,000 annually. Rivers State is proposing a N300 annual fee for its waste haulers. Rivers has also established an N800 annual fee for water analysis from industries. A similar fee for emissions analysis would help defray the cost of water and air emissions monitoring. To enhance its industrial revenue and land zoning process, Kano State Government has developed licensing fees for industrial facility siting (Magner and Duer 1991, 36). Three separate licenses are required. In addition to direct financial benefits, the zoning licenses give state environmental agencies greater control of industrial development.

3.40 Municipal or private user charges on wastewater transportation and treatment have not been discovered; however, some industrial estates do finance wastewater systems indirectly through rent charges (Magner and Duer 1991, 36). User charges for services and inputs are important steps toward incorporating the social and environmental costs of providing the services into the cost accounting of firms. Inclusion of the full costs of providing services leads to more efficient use of water, energy, and disposal services, and consequently less pollution. Until full social costs are included in industrial firm costs, inputs and services will continue to be subsidized by current and future members of society in terms of wasted resources and environmental degradation. On a more immediate level, appropriate user costs are a means for paying for capital and operating expenditures of the government agencies. Without such user charges, maintenance of current facilities and future expansion of pollution control infrastructure, such as wastewater treatment and solid waste systems, may not be financially possible.
CHAPTER 4
STRATEGIC APPROACH FOR INDUSTRIAL POLLUTION MANAGEMENT

Based on the existing institutional and regulatory framework and taking into consideration the constraints discussed in the preceding chapter, the following sections outline a strategy to control and manage industrial pollution in Nigeria.

Objectives

4.1 Nigeria has made substantial progress in setting the stage for effectively addressing the country’s serious industrial pollution problems. It is now at a juncture where critical decisions need to be made regarding what strategy to adopt as a basis for future action and the allocation of responsibilities to be carried out by the various institutions that have been created to address industrial pollution issues. This chapter will enumerate the issues requiring decisions, outline the principles most likely to lead to effective choices, and describe some of the possible options. The Government’s effectiveness in reducing industrial pollution will depend on the choices that it makes in the coming months.

Summary of the Current Situation

4.2 A summary of the accomplishments made to date, which form the basis for future progress, includes the following:

(a) FEPA has been established as a knowledgeable and effective public environmental agency with the technical capacity to set environmental policy and establish environmental standards at the national level; however, its staff is limited in size and technical expertise and its laboratories are not yet effective or sufficiently numerous to serve the entire country.

(b) SEPAs have been established in most states, but most of them have even more serious staffing and facility limitations than FEPA.

(c) Nigeria has put in place a reasonably good legislative and regulatory framework for controlling industrial pollution.

(d) FEPA has established and promulgated industrial pollution standards, which some states have modified to even more rigorous levels.

4.3 Very little enforcement has actually taken place, however, and industrial pollution continues to occur at high levels, especially in the four most heavily industrialized states. Penalties for violating the industrial standards are either very low or nonexistent. Responsibility for enforcement is not clearly defined and both the national and state governments have constrained financial resources for expanding enforcement staffs to effective levels. Also, manufacturers argue that the standards put in place are too strict for Nigerian conditions, and many polluting enterprises lack the incentive and/or financial means to install effective pollution control equipment.

Conceptual Policy Framework

4.4 Before enumerating the policy issues that need to be addressed, it might be useful to outline the general principles that have proved the most effective means of dealing with environmental degradation around the world. These principles can then be considered in light of Nigerian conditions and in the context of specific issues. They are as follows:

(a) Any pollution management strategy should adhere to a pollution management hierarchy
that emphasizes waste prevention and reduction over recovery and recycling, with treatment and burial the least desirable level of management. This principle is based on the observation that it is almost always less expensive and more effective to prevent pollution in the first place rather than to deal with pollution after it occurs.

(b) Strategic options should use the "worst first" principle of tackling the worst areas and worst polluting industrial subsectors first, modified as appropriate by further detailed economic analysis to determine the optimum return from alternative investment choices to obtain maximum efficiency of resource use.

c) The options should be based on the "polluter pays" principle, whereby firms are required to pay all—or at least a substantial part of the social costs of their activities.

4.5 These principles are widely accepted as sensible concepts on which to base environmental policy choices. Their application, of course, raises difficult choices that have to be made given the realities of each situation. Nevertheless, if choices stray too far from them, the result is an ineffective environmental program or an unacceptably high cost of implementation.

Policy Choices Requiring Decisions

4.6 The areas that require policy choices, based on the information contained in the earlier portion of this report, include:

(a) To what extent is improved industrial pollution legislation needed?

(b) How should industrial environmental efforts be concentrated geographically and/or by subsector?

(c) Are the present industrial standards appropriate? Should state standards different from federal standards be continued?

(d) How can subsidies of potential pollutant inputs (for example, water, power, and petroleum products) be reduced?

(e) How and at what level should pollution charges and penalties be established?

(f) How should FEPA and the SEPA's divide responsibility for monitoring and enforcement? How should their laboratory operations interrelate?

(g) What waste treatment facilities are needed? How should they be operated?

(h) How can necessary pollution control equipment and facilities be financed?

(i) Should public education about industrial pollution be expanded, and if so, how?

Policies and program initiatives for addressing industrial pollution in other developing countries, including Brazil, India, and Indonesia are described in Table 4.2.

Legal and Regulatory Framework

4.7 With the FEPA Decree of 1988 and subsequent environmental regulations, Nigeria has established a sound legislative foundation for pollution management. To address emerging problems such as strict effluent concentration limits and weak land use zoning, refinements are planned; however, major overhauls of the regulatory framework appear to be unnecessary and would slow implementation of pollution management in Nigeria. The only significant changes might be a community right-to-know regulation and the integration of market-based incentives into current regulations.

4.8 The community right-to-know law in the United States has motivated many American companies to improve their pollution record. Under the law, the public and nongovernmental organizations have access to the Toxic Releases Inventory that documents discharges from 10,000
### Table 4.1: Industrial Pollution Control Programs and Projects in Other Developing Countries

<table>
<thead>
<tr>
<th>COUNTRY/PROJECT/PROGRAM</th>
<th>DESCRIPTION</th>
<th>IMPLEMENTING AGENCIES/BENEFICIARIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BRAZIL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Industrial Pollution Control Project</td>
<td>Finances investments in pollution control in industries located in critically polluted areas. Also provides capacity-building assistance to SEPA's to implement State Pollution Control Strategies.</td>
<td>Implementing Agencies: State Environmental Protection Agencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Borrower: Banco Nacional de Desenvolvimento Economico e Social (BNDES)</td>
</tr>
<tr>
<td>IBRD</td>
<td>US$50 million</td>
<td>Intermediaries: Eligible commercial, investment, and development banks</td>
</tr>
<tr>
<td>BNDES</td>
<td>US$25 million</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>US$25 million</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>US$100 million</td>
<td></td>
</tr>
<tr>
<td><strong>INDIA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Pollution Control Project</td>
<td>Finances investments to set up common treatment facilities, assistance to industry to comply with industrial pollution regulations, and technical assistance to the central government and state government pollution control boards.</td>
<td>Implementing Agencies: Ministry of Environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Borrower: Government of India</td>
</tr>
<tr>
<td>IBRD</td>
<td>US$124 million</td>
<td>Beneficiaries: Industrial Credit and Investment Corporation of India (ICICI) and Industrial Development Bank of India (IDBI)</td>
</tr>
<tr>
<td>IDA</td>
<td>US$31.6 million</td>
<td></td>
</tr>
<tr>
<td><strong>INDONESIA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third Jabotabek Urban Development Project</td>
<td>Finances basic infrastructure and community services and solid waste management, and technical assistance for pollution control, including monitoring equipment and studies to develop joint waste treatment facilities for highly polluting, small-scale industries.</td>
<td>Borrower: Republic of Indonesia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implementing Agencies: Jakarta Provincial Government and local governments of Bogor, Tangerang, and Bekasi.</td>
</tr>
<tr>
<td>IBRD</td>
<td>US$61 million</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>US$0.6 million</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>US$6.5 million</td>
<td></td>
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</tbody>
</table>
corporations. Once monitoring and the industrial pollution data base are in place, a similar law could provide an incentive for Nigerian companies to reduce wastes as they respond to community action. The right-to-know law should be buttressed with the ability of citizens to bring companies to court for degrading their property or health under environmental legislation (Olokesusi 1988, 34).

4.9 It would seem appropriate to promulgate a waste reduction law to focus national policy explicitly on pollution prevention. The only mention of pollution prevention found in current Nigerian legislation is section 13 of the National Environmental Protection Regulations 1991, which states that new facilities "shall adopt in-plant waste reduction and pollution prevention strategies." New regulations could expand this unelaborated statement along the lines of the United States Pollution Prevention Act of 1990.

4.10 The roles of FEPA and the SEPAs should at some point be explicitly described in amendments to the environmental laws; however, as long as the division of power and responsibility is operationally discrete, there is no rush to amend the laws. Finally, in subsequent legislation, groundwater effluent standards could be developed from the current guidelines or be explicitly tied to the surface water effluent standards.

Concentration of Environmental Resources

4.11 Application of the "worst first" principle is essential if Nigeria wants to make a measurable impact on its industrial environmental problems, since both financing and administrative resources are limited and should be applied in a manner that maximizes their use. It will be crucial to concentrate those resources on the most severe problems, as has been done in India and China with impressive results.

4.12 That concentration can be accomplished either geographically, by industrial subsector, or by a combination of both. Geographically, it is obvious that the areas of greatest industrial pollution are Lagos, Rivers, Kaduna, and Kano States, as indicated in the preceding sections. Although this can be measured in a number of ways, one rough indicator is the estimated level of hazardous waste emissions (Figure 4.1).

4.13 In Table 2.1 industrial subsectors are ranked by estimated emission of various kinds of waste products. Concentrating on the worst polluting subsectors first would have the earliest favorable impact on Nigeria's environment. Obviously, each highly polluting state has its own priority ranking of polluting industrial subsectors; therefore, once choices are made as to the geographic areas of concentration, the targeted states should assess their individual priorities based on the industries in their area, so long as the principle of concentrating on the highest polluters first is adhered to.

Adequacy of Industrial Standards

4.14 Nigeria's industrial pollution standards have now been in place long enough to have generated some response from the industrial companies affected by them. As the Government of Nigeria prepares to take action toward more vigorous enforcement, it would be appropriate to review the complaints received and other evidence that suggests the standards may not be appropriate for Nigerian conditions. Also, there are obvious questions on: whether it is in Nigeria's interest to have different standards for each state—which can lead to confusion and uncertainty on the part of investors—and what useful function this diversity of standards serves; thus, it would be useful, based on experience to date, to decide whether the existing standards should be reviewed for possible modification and whether the dual standard system should continue or be modified.

Subsidies

4.15 Input prices for resources used in industrial production, such as water, power, and petroleum products, that reflect their actual cost of production give companies a greater incentive to conserve these resources compared to subsidized prices. Their conservation in turn reduces the
environmental impact of residual waste disposal. When companies have a continuous cost incentive to conserve, they will consistently do so without the need for regulations or external enforcement by extensive bureaucracies. Also, since price increases are inevitable, firms cannot reduce their effect by illegally evading controls; thus, full cost pricing of inputs ranks highest in priority within the pollution management hierarchy.

4.16 Although the efficacy of full pricing as an efficient means of reducing pollution is obvious, in practice there are many obstacles to achieving it. Indeed, other compelling reasons for full costing of inputs, such as the viability of the entity providing the inputs, have not always been sufficient to achieve this result. Nevertheless, greater awareness of the desirable environmental impact of full pricing on the part of government officials responsible for these decisions would add another compelling argument for doing so. The practical problem for Nigeria's environmental agencies is to decide what actions would move the government closer to full pricing of inputs, which would in turn lead to substantial reduction in pollution levels, reducing the need for waste disposal facilities.

Pollution Charges and Penalties

4.17 Higher charges for the disposal of solid waste and wastewater treatment would produce a similar incentive for companies to reduce generation of waste products. As the constraints section makes clear, user charges at present do not cover the social costs of inadequate treatment and disposal. An additional advantage of full cost pricing is that it will make the service institution financially viable and hence better able to provide effective disposal services. User charges that reflect the full capital and operating costs of solid and hazardous waste disposal, as well as wastewater treatment, are probably a more appropriate objective than charges that reflect the full marginal social and environmental costs since determining these costs and the economic hardship that could ensue can be difficult.

4.18 It is now time to establish effective but realistic penalties that can be enforced with charges indexed to reflect increases in the price level so that inflation does not erode their impact. Charges should be progressively higher as discharges rise above the established standard, and lower as pollutants fall below the standard. Levying fines in this manner has the advantage of efficiency—the firms with the lowest abatement costs would reduce pollutants the most—and also generates revenues that can finance the operation of the environmental agencies. To be effective, the system must be designed to levy fines at a level that makes compliance less expensive than paying fines, at least for most companies.

4.19 Before implementing the new regulatory system, it should be clearly presented to industry. The function for calculating the fees and fines and the parameters on which the charges are based should be straightforward so that firms themselves can predict how much they will be charged (Magner and Duer 1991, 40). The charge system could begin as a wastewater discharge program based on only a few parameters (for example, BOD, COD, pH, oil and grease, suspended solids, and some hazardous substances). The system could later be expanded to include air emissions, which are more difficult to monitor. Again, the number of air emission parameters liable for charges and fees should initially be small until the program is operating efficiently.

4.20 The pollution charges and fines should be increased over a period of time until they reach approximately the marginal social costs of pollution. The gradual increase will provide an incentive for abatement without the extreme economic stress created by immediate enforcement of very high charges and fines. Regardless of the specifics of the regulatory framework, however, new regulations will not provide any incentive for corporate behavior modification without stringent enforcement.

4.21 As presently practiced in Nigeria, the setting of fines is a state function, and presumably would continue to be so; however, FEPA could
play a role in assisting the states in this process so that all states can benefit from each other's experience and so that a common set of principles can be applied. Decisions now need to be taken as to how to proceed with the establishment of an appropriate set of charges and penalties in the areas most affected by industrial pollution.

**Monitoring and Enforcement**

4.22 The most important aspect of any pollution management strategy is aggressive enforcement of regulations. Companies will abate air and water pollution and properly dispose of wastes only if they clearly see that the costs of penalties are higher than complying with the regulations.

4.23 Regardless of the systems used to incorporate industrial waste information into the environmental information network, being set up under the Nigeria EMP, monitoring of facilities in the worst polluting industries should begin with a rapid assessment. This will establish the degree of noncompliance, get industries accustomed to being monitored, and improve the data collection and analysis capabilities of the SEPA.s. The programs should concentrate initially on monitoring the plants in the target industries. An innovative and simple method of monitoring would be to empower local environment or sanitation board officials with the responsibility to inspect sites visually for gross violations such as discolored, direct discharge into water systems.
4.24 Having the SEPs administer the fines and charges, as is now the case, serves two purposes. First, administrative charges and fees can be collected by the SEPs and used to strengthen their programs, which gives them a strong incentive to enforce aggressively. Second, it eliminates litigation, which can be evaded or drag on indefinitely.

4.25 Penalties for exceeding the environmental standards in Turkey have been ineffective because they are too low and are imposed by an ineffective court system. These are two problems that Nigerian administrators must avoid to create an effective enforcement environment. The threat of closure and the actual closure of several tanneries for six months has been the strongest incentive for compliance in Turkey. It should be available as a final resort in Nigeria also. The first enforcement actions will set the tone for industry compliance and pollution management in general. Realistic timetables for compliance should be developed in consultation with the targeted industries. To be taken seriously, FEPA and the SEPs should stick to the deadlines and document the violations meticulously.

4.26 Decisions are needed to confirm that monitoring and enforcement will remain primarily state responsibilities; however, further consideration is also needed of the roles of municipalities, the Department of Water Resources and their equivalents in the states, river basin authorities, local voluntary organizations, and industrial associations, since these bodies have both monitoring capabilities and a significant stake in seeing that enforcement is effectively implemented. These institutions can expand the capacity of the SEPs to gather data on the degree of compliance taking place and in locating areas of noncompliance. Cooperative relationships need to be established between these various bodies and systems of reporting need to be agreed on to provide the most comprehensive coverage, while avoiding duplication of effort. Also, the role of FEPA, the states, and other institutions interested in the monitoring of company operations and of the surrounding atmosphere needs to be clarified; special attention needs to be given to the issue of enforcement of environmental regulations, charges, and fines imposed on the large parastatal enterprises.

4.27 Another important decision area relates to the need for and operation of laboratories capable of evaluating environmental conditions. FEPA has several laboratories now in operation, as have some of the states, and all of them aspire to expand their laboratory facilities; however, careful review is required to avoid an overlap of facilities and responsibilities. Also, in many countries these functions are less expensive when obtained from privately operated facilities on a for-hire basis. A careful review of the effectiveness and cost of operating FEPA's existing laboratory facilities would be a good starting point for this review. These issues should be thoroughly explored and alternatives, including the use of private laboratories, carefully considered before any further laboratory facilities are added.

Joint Treatment Facilities and Hazardous Waste Disposal

4.28 The economic efficiency of common treatment plants is well recognized. Nigerian companies are generally willing to pay for collection and treatment of effluent at a common treatment facility if they are charged on the basis of volume or quality of their effluent. Many treatment plants in Nigeria are, however, poorly maintained and are constantly breaking down. Also, there are no secure landfills in which to place dewatered sludge from treatment plants.

4.29 State ownership or operation of joint treatment plants is not recommended because of conflict of interest with state regulation. Either joint ownership by the member users or commercial operation by a commercial firm combined with strict enforcement of standards by the state authorities is probably the best option. Technical and operational standards covering storage, transfer, collection, disposal, and operation of solid waste facilities should be the
responsibility of FEPA to ensure uniformity. The states, through their enforcement units, should enforce the FEPA standards.

4.30 The key to operating sound solid waste systems is a well-developed system of user and disposal charges. If private firms collect wastes, they should pay disposal charges—based on the volume and type of waste—that cover the cost of treatment and disposal of industrial solid waste. By covering the costs of waste management, the user charges will also provide an incentive for waste reduction, recycling, and illegal dumping. Illegal dumping must carry severe penalties to counter the low probability of being apprehended.

4.31 Essentially two options exist for disposal of hazardous wastes: incineration or landfilling. In most cases, landfilling is the most appropriate choice since incineration requires high operation and maintenance skill levels to avoid emissions of hazardous air pollutants. Incinerators are also expensive to construct and operate. Also, incineration does not totally eliminate the need for landfills because ash disposal still requires a secure landfill. Land is usually available for landfills in Nigeria, but siting must be carefully performed to prevent leachate contamination of groundwater; however, incineration, particularly in cement kilns, should not be totally ruled out as a complementary disposal method since high water tables limit the amount of available land in some ecological areas. Solidification is another important option that should be evaluated for a hazardous waste strategy.

4.32 In the absence of hazardous waste treatment facilities, strategically located hazardous waste storage systems and secure landfills can be utilized. Solidification techniques using cement, fly ash, lime, and cement kiln dust can be utilized to render some industrial and hazardous wastes harmless. The solidified waste can then be disposed of in a less secure landfill fairly safely and at reasonable cost.

4.33 Decisions are needed on how FEPA and the SEPA can encourage the creation and successful operation of an adequate number of joint treatment facilities and secure landfill sites for hazardous waste disposal. The hazardous waste disposal study to be carried out under the Environmental Management Project should be a helpful input into this decision-making process.

Financing Requirements

4.34 The establishment of an adequate system of charges and fines combined with strict enforcement will necessitate investments by companies in improved processing equipment and/or treatment facilities so that they will comply with standards. Some of them will be able to finance this with their own resources; however, others will lack the needed financing and may be forced to close down. Although compliance may lead to closures in some cases, it is obviously desirable to avoid excessive closures because of the adverse social impact associated with them. The gradual imposition of the standards will help in this regard, but may not in itself be an adequate means of cushioning the shock. A reduction in the level of tariffs for pollution abatement equipment would also make the installation of such equipment more manageable, with socially desirable consequences.

4.35 An obvious additional solution would be to provide lines of credit from government sources for pollution control investments, processed either through government or private banks. This is a type of investment that is frequently attractive to aid agencies providing concessional financing. A related decision is the degree of commercialization that should apply to financing of this kind. Although new facilities should usually be able to meet the full unsubsidized cost of installation, a persuasive argument can be made that a subsidized loan is justified to an ongoing operation that is required to add to its investment to meet a regulation that did not exist when the original investment decision was made. Similar issues exist regarding investments for common treatment facilities operated on a commercial basis.
4.36 Thus, decisions are needed on tariff reductions on pollution abatement equipment, whether the government is to provide a lending resource for pollution abatement investments, how funds would be administered, and under what terms and conditions they would be made available.

Public Education

4.37 Public participation in industrial pollution management through individual and community action is an important aspect of any pollution control strategy. Increased information can lead to pollution reduction through public pressure or judicial action. A decision is needed on whether the present level of public education, as supported by the EMP, is adequate or whether an expanded program with emphasis directed at industrial pollution is needed.

Institutional Issues

4.38 The respective roles and appropriate size of each of the government institutions with responsibility for industrial pollution control needs to be thought through and clarified, based on the experience to date. A suggested statement of roles is given below, although specific decisions regarding each of the issues discussed previously is also required.

Role of FEPA

4.39 FEPA’s role should be to coordinate and assist the state programs. It would be responsible for pollution control policymaking and legislative modifications. To keep regulations consistent and simple, federal standards should be uniformly enforced in all states. It would be the federal agency’s responsibility to ensure that the standards are reasonable and regionally relevant. Through the creation of a pollution management resource center, FEPA would facilitate information exchange and provide technical assistance. An expanded industrial pollution component of the environmental information network, being set up under the Nigeria EMP will also vastly improve information flow. FEPA should take the leadership role in integrating public participation into policymaking and standard setting.

4.40 FEPA’s monitoring and enforcement capabilities will have to be upgraded to implement the strategy at major pollution facilities outside of the four states, such as the steel facilities. As the strategy is expanded to additional polluted states, FEPA might be required to enforce regulations until state institutions are sufficiently strong. Parastatal enforcement may also require FEPA assistance.

4.41 FEPA should also consider setting up an information clearinghouse, either operated by an educational or nonprofit institution or by FEPA itself, to provide Nigeria with information on cleaner production processes, pollution prevention techniques, waste minimization, waste recovery, recycling techniques, and reuse of discarded materials pertaining to Nigerian industries. In this regard, the World Bank’s Industrial Pollution Prevention and Abatement Guidelines could be used as a starting point. Considerable information of this kind is also available from the U.N. Environment Programme’s ICPIG data base and EPA’s PIES data base.

Role of SEPAs

4.42 SEPAs should have full responsibility to carry out all aspects of pollution management within their respective states. To orchestrate pollution management in the four target states, Pollution Management Units (PMUs) should be established. They would be in charge of monitoring, enforcement, discharge fees, and technical assistance. According to Osae-Addo, a monitoring and enforcement unit in a SEPA for an industrialized state would have to include at least 20 staff each making a minimum 24 field visits per year. Compared with this level, the current SEPAs could complete at most 30 percent of the required enforcement in Lagos State, 20 percent in Rivers State, and 15 percent in both Kaduna and Kano (Osae-Addo 1992, 12). In addition to requiring 20 monitoring and enforcement officers, the PMUs
should have another ten staff for technical assistance and administration of the effluent fee system. Studies of the structure and function of the state environmental agencies must be conducted to determine how best to develop the PMUs.

4.43 Revenue from the discharge fees will assist in improving finances and reduce reliance on state allocations, allowing the SEPAs to become self-sufficient regulatory agencies.

Role of Municipal Agencies

4.44 Municipal agencies should be strengthened so that they can enforce and operate higher user charges for the services they provide (water supply, sewage, sewerage, and solid waste disposal). The revenues from the higher user fees should cover the operating and capital costs of the agencies. For solid waste disposal, municipalities would concentrate on vehicle maintenance and development of secure landfills to improve collection and disposal. Technical and financial assistance would be needed to construct and manage solid waste disposal systems. Although sewage and municipal wastewater treatment plants is required, it is not part of the strategy since it goes beyond the purview of environmental issues per se. Municipal firms that are privatized would need to be regulated for environmental compliance by the municipal agencies.

4.45 The ability to operate and enforce local land-zoning permit systems for new developments requires additional municipal institutional capacity; however, this responsibility may become less important as environmental impact assessments become common.

Conclusions

4.46 A renewed program of action is needed to stimulate the efforts of the national and state environmental agencies to take steps that result in physical changes in Nigeria's environment. The first phase in organizing such a program is to reach decisions relating to the issues raised above, followed by agreement on how to implement those decisions.
ENDNOTES

1. In a typical SEPA in Nigeria, the staff consists of one engineer, one scientist, two enforcement officers, two drivers, and one laboratory technician. In contrast, Brazil's most industrialized state, São Paulo, had a budget of US$250 million and employed 2,350 people in 1990 (see p. x).

2. This figure was determined by a study that surveyed 200 randomly chosen industries in Nigeria (Achi 1991, 480) (see p. 1).

3. Hospitals and other biomedical facilities also create large quantities of hazardous wastes (see p. 2).

4. Over 50 percent of the solid waste is residual from recovery of foundry earth (see p. 2).

5. Other effluent sources before the downstream sampling point or an effluent pulse of metals and other chemicals may explain the higher downstream effluent levels for lead, manganese, iron, magnesium, calcium, and potassium (see p. 4).

6. The large parastatal facilities contribute substantial amounts of air and water contaminants, whereas the textile firms pollute mainly the Kaduna River. The state industries are particularly difficult to regulate because of their political power and the environmental agencies' limited influence over them (see p. 6).

7. The 1988 industry census and the 1990 update are not complete surveys of industry in Nigeria and give only a rough estimation of industrial information. The Federal Office of Statistics sent questionnaires to only 13,621 of the 20,106 industrial establishments listed in the Register of Business. To compound the limited coverage of the census, many of the surveys returned were deficient, giving a 37 percent usable response rate for all industrial companies (see p. 6).

8. If garment makers are included, employment levels probably double (see p. 12).

9. The small- and very small-scale percentages would be even higher if industries employing fewer than five people were included in the industry survey (see p. 16).
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NATIONAL CAPITAL
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INTRODUCTION

The sources of industrial pollution by major industrial facilities outside of industrial states are as follows:

- **Steel**
- **Textile Mill**
- **Petrochemical and Petroleum Refinery**
- **Cement**
- **Food Processing**
- **Breweries**
- **Palm Oil Mill**

**Sources of Industrial Pollution**

**Industrialized States and Other Major Facilities**

**Major Industrial Facilities Outside of Industrial States**

- Steel
- Textile Mill
- Petrochemical and Petroleum Refinery
- Cement
- Food Processing
- Breweries
- Palm Oil Mill

**Highly Industrialized States**

**Propport of Industry by State**

- Kaduna
- Benin
- Lagos
- Other