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RESEARCH REPORT

INTEGRATED STUDY OF ENVIRONMENTAL PROBLEMS OF METRO MANILA: AIR, WATER AND LAND POLLUTION

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ABSTRACT. Rapid industrialization and urbanization in Metro Manila, the Philippines' primate urban area, has resulted in menacing environmental problems which pose a threat to the health and comfort of residents and commuters. Air pollution in the metropolis comes from motor vehicles, power generating plants, factories and residences, with two-thirds being contributed by the first two sources. Water pollution in the metropolis' six major river systems and in Manila Bay comes from residences and industries, with more being contributed by the former. Land pollution is caused by the dumping on land of solid and liquid wastes by markets, residences and factories. The inefficiency of the present environmental management system may be traced to the failure to integrate efforts among the political units of the metropolis and among the various sectors in it. The deteriorating ecological condition in the metropolis can be stemmed by adopting solutions involving population relocation; industrial dispersal; resource reuse, recycling and reclamation; generation of land use decision maps; and integrative planning and implementation, among others.

INTRODUCTION

This study which was conducted with financial assistance from the National Research Council of the Philippines (now Philippine National Science Society), has the following objectives:

1. To present a reliable data base of the environmental situation in Metro Manila, especially on air, water and land pollution;

2. To identify the principal causes and sources of pollution and pollutants in Metro Manila; and

3. To propose solutions to minimize, with reasonable limits, the effects of pollution in the National Capital Region.

The data on air and water pollution in the study covered only the years from 1979 to 1983 which were furnished by the National Pollution Control Commission (NPCC). Whatever results and conclusions are presented should therefore be seen under this limitation, considering that the full report is coming out a few years later.

In view of the fact that the report contains 218 pages and the appendices of graphs and maps contain about 200 pages also, it is reason-

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able that only the summary, conclusion and recommendations are being given hereunder.

SUMMARY

Metro Manila is geographically defined by the four contiguous cities of Manila, Caloocan, Pasay and Quezon City and by the thirteen municipalities of Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinlupa, Navotas, Parañaque, Pasig, Pateros, San Juan, Taguig and Valenzuela. Its total land area of 636.10 square kilometers constitute about 0.5 percent of the total land area of the Philippines.

Metro Manila is the Philippines' dominant urban center which has continually assumed a pivotal role in practically all the country's affairs. It is the virtual nerve center of the country's administrative, economic, industrial, educational, political and social activities which usually shape up the events in the entire country. The heavy concentration of business establishments and industrial complexes in its limited area further enhances its domineering presence in the trade and industrial sector and its contribution to the growth of the national economy. Its link to the major cities of the world not only through the major airlines and shipping companies plying the route but also through the embassies and consulates makes it the country's gateway to international trade and tourism.

The full-blast industrialization and urbanization of Metro Manila have resulted in a number of menacing environmental problems which pose a growing threat to the health and life of Metro Manila residents. Extreme population pressure on limited space and resources seriously strain and degrade important life support systems. The accumulation of pollutive substances from different sources result in the alteration of the physical, chemical and biological properties of life support systems such as air, land and water system which affect the health and well-being of the inhabitants.

Air Pollution

The sources of air pollution in Metro Manila may be classified into four general categories. The first and major source is the internal combustion engine of motor vehicles, otherwise also known as mobile sources of air pollution. As of 1982, NPCC has estimated that there were operating in Metro Manila some 464,000 vehicles of all types, representing about 60 percent of the total vehicles registered in the country in that year. NPCC has also estimated that all the motor vehicles in the study area contributed the following air pollutants:

(a) 4,113 tons of carbon monoxide

(b) 13 tons of particulates or dusts

(c) 13 tons of sulfur dioxide

or a total of 4,139 tons of pollutants.

A second source of air pollution are the stationary generating plants located in Metro Manila and using bunker or diesel fuel oil. They contribute the following estimated daily pollutants:

(a) 3,952 tons of sulfur dioxide

(b) 103 tons of particulates

(c) 37 tons of carbon monoxide

totalling 4,112 tons of pollutants.

The third main source are the more than 1,150 industrial firms operating in Metro Manila, particularly metal fabrication, foundries, ceramics, textile mills, etc. and their total daily contribution is estimated by NPCC as follows:

(a) 2,961 tons of particulates

(b) 280 tons of sulfur dioxide

(c) 114 tons of carbon monoxide

or a total of 3,355 tons of pollutants.

Lastly, domestic residences in the metro area which do not make use of electric energy also contribute to pollution through their use of firewood and/or cooking gas either of which results in the release of incomplete combustion products. A rough estimate of the contribution from this source is shown below:

(a) 270 tons of particulates

(b) 120 tons of carbon monoxide

(c) 4 tons of sulfur dioxide

or a total of 394 tons of pollutants.

The above estimates of air pollutants in tons per day over Metro Manila show that motor vehicles contribute 34.9 percent, stationary plants 34.26 percent, industrial firms 27.96 percent, and domestic residences 3.28 percent. On overall basis, motor vehicles and stationary power plants contribute about two-thirds of the total air pollutants. Industries contribute about a fourth and domestic sources account for the remainder.

The principal effects of air pollution are health-related. Inhalation of particulates, carbon monoxide, sulfur dioxide and unburned hydrocarbons which are well-known health hazards predispose susceptible individuals to upper respiratory ailments. Gasoline engines produce great amounts of carbon monoxide while improperly maintained diesel engines release a great deal of smoky and ill-smelling emissions. Indus-

tries contribute a great deal of particulates, with domestic residences a distant second. Air pollution also results in damage to crops and property in the form of hastened corrosion in the case of the latter and stunted growth or untimely death in the case of the former. This condition is exacerbated by the presence of sulfur dioxide, which on contact with moisture in the air results in the formation of sulfuric acid.

To assess the quality of air in Metro Manila, NPCC has set up several monitoring stations equipped with continuous recording analyzers for three important parameters, namely: particulates, carbon monoxide and sulfur dioxide. The present study was fortunate to secure original data from five monitoring stations located in the following places: (a) Cubao (Elementary School), (b) Ermita (NPCC Office), (c) Malacañang, (d) Pasay (Elementary School), and (e) Quiapo (Plaza Miranda).

Monitoring data appear to show that, except at the Pasay station, there was an increasing trend of particulates from January, 1979 to December, 1983. Combining all the data, the particulate concentration was about 74 micrograms per cubic meter at the beginning and about 101 micrograms per cubic meter at the end of the 5-year period. In Pasay, however, the particulates measured about 100 micrograms per cubic meter at the start and dropped to only 62 micrograms per cubic meter at the end of the monitoring period.

For carbon monoxide, the compiled data showed that the concentration levels were decreasing, except for the Ermita station. The average of the four other stations was about 3.8 ppm in January, 1979 and decreased to about 1.6 ppm in December, 1983. For Ermita, the carbon monoxide level measured at 3.3 ppm at the start and increased to 9.0 ppm at the end of the period.

The concentration levels of sulfur dioxide showed a very slightly increasing trend, except in Ermita. Three stations averaged 0.026 ppm at the start of the period and about 0.030 ppm at the end. Records for the Quiapo station were so erratic and did not merit inclusion in the discussion.

The monitoring data given above indicate the overall picture of air pollution in Metro Manila and may be considered as the integrated result of all sources of pollution present. It must also be noted that all air pollutants, when not carried by the prevailing winds far away from the study area, are brought down by precipitation during the rainy days of the wet season and thus contribute directly to the water pollution problem.

Based on the five-year period (1979-83) data, the average hourly concentration of pollutants in Metro Manila were: 89 micrograms per cubic meter for particulates; 2.7 ppm for carbon monoxide; and 0.027 ppm

for sulfur dioxide which was fairly constant. These figures are below the standards of 250 micrograms per cubic meter for particulates, 30 ppm for carbon dioxide and 0.30 ppm for sulfur dioxide.

Water Pollution

Water pollution was determined from the analysis of monitoring data obtained from specific sampling points in particular rivers or waterways present in the area. There were a total of some 33 monitoring stations or sampling points which were located at the following rivers: (a) Malabon-Navotas River, (b) Tinajeros-Tullahan River, (c) Pasig River, (d) San Juan River, (e) Marikina River, and (f) Zapote-Parañaque River.

In general, all Metro Manila rivers and waterways are polluted in varying degrees. Industrial establishments operating on the banks of these waterways contribute to the total pollution load, but a significant, most probably greater, fraction is contributed by the greater population not served by the public sewerage system which covers less than about 15 percent of the metropolitan area.

Color and turbidity, as expected, increased significantly during the months of April to August, with the highest readings in June and August. Dissolved oxygen in the river, the single most important parameter, varied considerably but appeared to improve (i.e., to increase its level) greatly in the months of June to August in 1981 and 1982. This corresponds to the rainy months. In November of 1980, however, various rivers gave almost zero readings. Significantly constant was the pH value in all the waterways, which varied from 6.7 to 8.3. Water temperature closely followed that of ambient air values.

Biochemical oxygen demand (BOD) values varied considerably from a low of 2.8 ppm in July, 1982 to a high of 130 ppm in April, 1980. Total dissolved solids increased during the dry months of February to May since there was as yet no dilution from the rains. Chlorides and sulfates both decreased, the former from a value of 4,800 ppm in February, 1979 to 670 ppm in March of the same year; and the latter from 79 ppm in February, 1979 to 27 ppm in May, 1979. The presence of methylene blue active substances (MBAS), a parameter for measuring the levels of detergents, was recorded at a value of 2.9 ppm in February, 1979 but decreased to a value of 0.2 ppm in 1980-1981, then slowly increased to 0.8 at the end of 1983.

Heavy metals such as Fe, Mn and Ni were also found in significant concentrations which varied with the months. The highest value recorded for Fe was 17.5 ppm in April, 1983; for Mn, the highest value detected was 0.5 ppm in June, 1983; and for Ni it was 0.5 ppm in May, 1983.

Mercury was also detected with a high value of only 0.5 ppm in October, 1982, which is way below the standard (0.05 ppm) set by WHO for drinking water. Ag and Zn were also found but their values were all below the WHO standards.

The polluted river waters may be contaminated with some types of pathogenic bacteria and viruses coming from infected sewage discharges which sometimes lead to epidemic outbreaks of contagious diseases. The deplorable state of these rivers is briefly discussed below.

The Pasig River, the main navigable river in Metro Manila, exemplifies an "overused" river in an urban center. It is now seriously degraded, carrying an estimated population of 1,390,600 living in unsewered districts within the river basin. Although the installation of water pollution control devices by the water-pollutive firms have reduced industrial contribution to Pasig River pollution, there is still a considerable amount of effluent which is diverted to the river.

Marikina River, on the other hand, is partially polluted, with its upper reach receiving a Class A rating from NPCC, while its lower reach which is affected by industrial waste is classified as C. Industrial pollution is about 33 percent while load coming from domestic sources is estimated at 67 percent.

The Tinajeros River System is considered the most polluted river system in the country today. The latest NPCC estimate showed that 37 percent of its pollution load comes from industry and 63 percent from domestic sources. Despite the installation of wastewater treatment facilities by most of the industrial polluters there has been no noticeable improvement in the water quality due to the continuous discharge of domestic sewage which leads to siltation by organic and inorganic pollutants in the river bed.

The Zapote-Parañaque River is not as seriously polluted as the other major rivers in Metro Manila. Although its classification is also Class C, it has a higher DO content which averages 6.9 mg/1 and a lower BOD averaging 19.0 mg/1 — showing that it can support fish life.

The Manila Bay is likewise being seriously degraded due to the various types of solid and liquid wastes discharged into it. It receives huge amounts of waste materials, including grit and solid particles due to the run-down condition and overloaded capacity of present sewers and pumping stations in Metro Manila. A substantial volume of domestic, agricultural and industrial wastes are also being discharged into the Bay from the adjoining provinces of Bataan, Cavite, Bulacan and Pampanga. Garbage washings, oil and grease are also constantly being discharged by ships berthed at the piers of the North and South Harbors of Manila Bay.

Land Pollution

Easily discernible to the public is the problem caused by solid waste dumping on land or land pollution, particularly when collection of garbage and refuse is insufficient or inefficient and the materials begin to pile up on the sidewalks. Land pollution results from the introduction into the soil or land surface of solid waste materials such as organic wastes from the municipalities (markets), domestic and industrial solid wastes, environmentally persistent products (plastics), and inorganic wastes. Garbage and refuse dumps are not only unsightly but also attract and harbor insects, pests and disease-carrying vermin. Agricultural chemicals, such as fertilizers and pesticides, also cause land pollution and, together with surface runoff, ultimately contribute to water pollution.

Results of the 1981 "Metro Manila Solid Waste Management Study" which was partially financed by the World Bank, show that the estimated 1.2 million households contributed directly to the daily generation or production of almost 2,650 tons of solid wastes in the study area. The breakdown of the estimate is as follows:

Residential areas	1,300 tons
Markets	340 tons
Commercial firms	144 tons
Industrial firms	154 tons
Construction/Demolition	29 tons
Street Sweepings	486 tons
Institutions	136 tons
Others	60 tons
Total	2,649 tons

An analysis of refuse generation shows that the high-income families generated about three times as much as the low-income families as shown in the table below:

Sector	Population (mil)	Total Tons	Kilo/Capita
Low Income	4.196	704.9	0.168
Medium	1.531	304.4	0.202
High Income	0.566	270.1	0.477

The two major problems in solid waste management are the lack of sufficient number of trucks for collection and hauling as well as the absence of suitable dump sites within the metropolitan area. These two problems are the main worries of the management staff of the agency concerned with this service.

The inefficiency of the present system lies in the evident failure to integrate environmental efforts and thus secure a unified approach. There are quite a number of agencies assigned to deal with specified

aspects which are, of course, characteristically sectoral. Thus, there is a tendency to focus on the agencies' own respective areas of responsibilities and not to consider the intricate relationships of the various kinds of pollution. A unified approach is the holistic way of approaching environmental problems through comprehensive planning, assessment, control and decision-making. Projects and activities should be integrated considering functional linkages, resource utilization, access to basic services, and people participation in the planning and implementation processes. A number of strategies being recommended for adoption will now be considered.

Recommendations

1. Decongestion/decentralization of Metro Manila through an aggressive, feasible and implementable countryside development program. This will insure the gradual removal of squatters and the improvement of marginal communities in Metro Manila which all contribute to a significant level of environmental pollution.

2. Dispersal of industries outside of Metro Manila. This will complement the first recommendation and help remove the attraction the area offers to rural inhabitants who generally feel that all the opportunities are found only in Metro Manila with its principal industries.

3. Maximized utilization of resources through innovative processes of reuse, recycling and reclamation. These three terms are better understood by taking bottles as an example. If a glass of soft drink is used again in the original intent, the process is reuse; if the glasses or bottles are broken and grounded and manufactured again into similar bottles, the process is recycling; and if the ground pieces are made part of another product, say in the manufacture of tiles, then the process is reclamation.

4. Use of ecological mapping for generating land-use decision maps. This will help identify land areas which are to be developed into housing, refuse dumps or industrial estates and thus minimize and reduce expected pollution levels.

5. Integration of environmental consideration in project planning and implementation through the use of more recent methodologies, such as extended cost-benefit analysis, social costs analysis, and economic valuation of environmental degradation.

6. Translation of environmental research results into more usable technology or guidelines in the implementation of economic and other development projects.

7. Effective implementation of environmental policies and regulation through a workable and integrated management information system.

8. Participation of citizens' groups, including non-governmental organizations (NGOs), in project planning and implementation.

9. Intensified environmental information dissemination to arouse public awareness and commitment. Subjects in environmental studies should be incorporated in the elementary, secondary and tertiary levels of education.

10. Institutional reorganization of the major environmental agencies to effect the desired integrated management approach to the solution of Metro Manila's environmental pollution problems.

AUTHORS' NOTE

As this report was being written, several environmental agencies such as the NEPC, NPCC, ECP and certain offices under the Department of Natural Resources were being reorganized under a new Department of Environment and Natural Resources.

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