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A PRIORITY SETTING FOR URBAN EXCRETA AND/OR WASTEWATER DISPOSAL PROGRAM IN INDONESIA

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A PRIORITY SETTING FOR URBAN EXCRETA AND/OR WASTEWATER DISPOSAL PROGRAM IN INDONESIA

Approved by

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ABSTRACT

The objective of this study was to develop an Indonesia urban excreta/wastewater disposal prioritizing model based on government strategies and conditions, as well as characteristics. A priority model for selecting project localities for the urban excreta/wastewater disposal program is strongly needed to ensure that limited government money will be spent more wisely and that the people believe the program is being implemented fairly.

The linear combination of variable $\sum_{i=1}^{k} W_i \cdot S_{ij}$ is used to determine ranked priorities. The priority model required several parameters which should be relevant to the excreta/wastewater disposal program in Indonesia and also should be suitable to the situation, condition, and feasibility in applying them to the data available. The proposed parameters are health hazards, population density, city potential, water supply condition, and technological alternatives. The Double Delphi Method was used for assigning the weight W_i of the five parameters and for scoring categorization S_{ij} of each parameter. For this approach a panel was formed, consisting of thirty-seven distinguished experts from various countries and international agencies who are devoting their time to the study of the urban excreta/wastewater disposal program.

The priority model was tested by using 80 selected cities and the results were workable, although only four of the five proposed parameters were used. Since the Indonesian urban excreta/wastewater disposal program was just begun on April 1, 1979, one parameter, namely, technological alternatives cannot be validated. At present the government is still conducting several survey feasibility studies for excreta/wastewater purposes. Thus, what kind of disposal is appropriate for every local condition cannot be decided at present.

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CHAPTER I

INTRODUCTION

General

The rapidly accelerating, unplanned urbanization that is occurring in Indonesia has greatly exceeded the ability of most cities concerned to provide adequate excreta/ wastewater disposal services for the vast influx of new inhabitants. As a consequence, widespread and serious water pollution has occurred, causing several diseases. Human excreta are the principal source of the pathogenic organisms carried by water, which constitute the vehicles of transmission to susceptible hosts. Specifically, the enteric diseases, including cholera, typhoid, dysentery, and the diarrhoeal diseases, and others of a viral nature (such as infectious hepatitis) are the leading causes of death and disability in this country. Schistosomiasis, a snail-transmitted disease caused by the pollution of streams, ponds, and irrigation ditches by human excreta, has reached endemic proportions throughout the country. While the disease is seldom fatal, it is severely debilitating and difficult to treat. Filariasis, transmitted by the Culex fatigans mosquito, is a direct consequence of improper excreta/wastewater disposal, since the mosquitc breeds in standing pools of wastewater. Soil contamination by human excreta results in worm infestations, including ascariasis, enterobiasis, and ancylostomiasis.

Recent outbreaks of cholera in 1974 have again called attention to the perils of continued neglect of community excreta/wastewater disposal facilities. Enteric diseases are widely endemic in this country and exact a heavy toll in mortality and morbidity. One of the most serious, if albeit indirect, public health consequences of the inadequate disposal of community excreta/wastewater, in particular, is the breeding of mosquito vectors of disease; it has been found that this breeding most often occurs in the highly polluted liquid wastes standing in roadside earthen drains or in concrete drains that were originally intended for stormwater disposal. Both of these types of open drains, as well as open pit latrines, are, unfortunately, highly suitable larval habitats for Culex pipiens, especially its tropical form, C.p. fatigans, which finds its optimum breeding conditions in water with a high degree of organic pollution (46). Where climatic conditions permit, C.p. fatigans breeds throughout the year and feeds avidly on man. This subspecies is the main vector of Urban's filariasis and is found not only in large urban centers but also in smaller towns.

While there is every reason to collect and treat excreta/wastewater, the financial resources to achieve this goal are not readily available, because in the past, national priorities of investment placed pollution control at a low level. The Housing, Building, and Urban Development Section of the Second Five-Year Development Plan (54) mentions only research surveys and feasibility studies for urban sewerage, and no specific investment programs are outlined. Aware of the consequences of water pollution, the Indonesian government plans to place urban excreta/wastewater disposal in the Third Five-Year Development Plan, which was started on April 1, 1979. The scope of the Indonesian urban excreta/wastewater disposal program is very broad; it covers about 27 million people who live in 2800 urban areas. Since the resources, especially money and manpower, are very limited, it is felt that a priority model is needed, which determines which cities should receive the excreta/wastewater facilities first to ensure that the limited government money is spent more wisely and that the people feel the program is being implemented fairly. Thus, this dissertation deals with a study on a priority model for selecting project localities of the urban excreta/wastewater disposal system.

The topic of this dissertation uses the word excreta as well as wastewater because the choice of the most appropriate method depends on the local conditions in order to choose the simplest and most economical system. When On-Site or Cartage-Options are chosen to be implemented in an urban area, in this case the word excreta is used. However, the choice of the most appropriate method should involve a careful consideration of social, cultural, and institutional factors, as well as technology. Factors of local conditions, such as topography, soil characteristics, level of ground water table, etc., will determine the type of excreta/wastewater treatment facilities to be installed. For example, when a ground gradient is steep and population density is high, the waterborne sewerage is clearly a reasonable alternative, so that in this case the word wastewater is used.

This dissertation consists of five chapters: Chapter I, Introduction, covers existing Indonesian conditions which describe the social, economic, health, as well as technical aspects. Chapter II, Literature Review, examines references on priority setting for the urban excreta/wastewater disposal program from various sources. Chapter III, Methodology, contains an analysis to develop a priority model suitable for the Indonesian urban excreta/wastewater disposal program, taking into consideration the strategy of the program, Indonesian urban conditions and characteristics, and feasibility in applying the model to the data available. Chapter IV, Test of the Model, demonstrates the utilization of the model developed in previous chapters by using available data. This will provide guidelines to the planners who are involved in the Indonesian urban excreta/wastewater disposal program by giving them some examples of practical use. Chapter V, Summary and Conclusions, summarizes and draws conclusions of research findings.

Geography, Topography, and Climate

Indonesia is an archipelago nation, which consists of five main islands and thirty smaller archipelagos containing 6,000 islands, approximately 3,000 of which are inhabited. The islands stretch over 3,000 miles along the equator from the mainland of Southeast Asia to Australia, with a land area of 1,904,345 sqkm (735,270 sq mi). The archipelago forms a natural barrier between the Indian and Pacific Oceans, a formation which has made the straits between the islands strategically important throughout history. The principal island groups are Sumatra, Java, Kalimantan, Sulawesi and Irian Jaya. The large islands have a central mountain range rising from more or less extensive lowlands and coastal plains. Many inactive and scores of active volcanoes dot the islands, accounting for the predominantly rich volcanic soil that is carried down by the rivers to the plains and lowlands. The peaks rise to 12,000 feet in Java and Sumatra. Java, Bali, and Lombok have extensive lowland plains and gently sloping cultivable mountainsides. Extensive swamp forests and unfertile hill country are found in Kalimantan. Sumatra's east coastline is bordered by morasses, flood plains, and alluvial terraces suitable for cultivation farther inland. Mountainous areas predominate in Sulawesi. These mountains are seismically active; on the average there are 300 to 400 earthquakes each year with magnitudes of over 4 on the Richter scale (75).

Straddling the equator, Indonesia has a tropical climate characterized by heavy rainfall, high humidity, high temperatures, and low winds. The wet season is from November to March; the dry season from June to October. The Worldmark Encyclopedia of the Nations on Indonesia (76) described that rainfall in lowland areas averages 70-125 inches annually, increasing with elevation to an average of 240 inches in some mountain areas. In the lowlands of Sumatra and Kalimantan the rainfall range is 120-144 inches; the amount diminishes southward closer to the Australian continent. Average humidity is 82%. Altitude rather than season affects the temperature in Indonesia. At sea level the mean annual temperature is about 25° to 27°C (77° to 81°F). There is slight daily variation in temperature, with the greatest variation at inland points and at higher levels. The mean annual temperature at Jakarta is 25.6°C (78°F); average annual rainfall is 80 inches.

Urban Area Definitions in Indonesia

Since this dissertation deals with urban excreta/ wastewater disposal and is administered by the Directorate of Sanitary Engineering, Ministry of Public Works, whereas rural excreta disposal is conducted by the Directorate of Hygiene and Sanitation, Directorate General of Communicable Diseases, Ministry of Health, it is necessary here to discuss the urban definition in Indonesia.

There are various definitions of an urban area and definitions vary from country to country, from time to time, even within the same country, which raises the difficulty of making comparisons. In order to analyze urban areas in Indonesia, only urban areas designated in the census will be considered. In the history of Indonesian censuses there have been some improvements and modifications of urban area definitions. In the 1971 census conducted by the Central Bureau of Statistics, in order to be considered as urban, an area must satisfy the following conditions (52):

1. Eighty percent or more of the population were not working in agriculture, and

2. Possessing three urban facilities: hospital/ health clinic, school building and electricity supply. Information on urban facilities was collected. This data includes cinema theaters, government offices, factories and asphalt roads. However, for several reasons only three facilities were considered as significantly important in determining urban status. The total number of urban areas in Indonesia is 2,800, whereas the total number of rural areas is 56,000 villages.

The difference between an urban and rural area lies in the relative concentration on distribution of social, political and economic activities. Sound regional development is based on the best allocation of activities between rural and urban areas in such a way as to take advantage of typical characteristics and facilities of each type of area. Urban areas tend to show high physical, social, economic and political density of infrastructures. For those reasons, industries with their up-to-date technological capacities are generally found in urban areas. Such industries are needed to yield high efficiency and productivity in industrial outputs to raise the national output, whereas they may not be able to absorb as much employment as the small and light industries dispersed in the rural areas. Moreover, most unemployed in the rural areas are lowly educated compared to the urban areas. On the contrary, 60% of the urban unemployed are those with primary school education and beyond. Furthermore, the unemployed with vocational secondary school education is much higher in urban than in rural areas. Big industries, which are highly technological, need educated labor or those who have vocational education and their existence in urban areas might absorb such educated unemployment. Small industries are mostly labor intensive and do not need labor with relatively high education. Thus, their presence in the rural areas might absorb the non-educated or low-educated unemployed (14).

Government Policy on Water Supply and Sanitation

The present government is based on the 1945 constitution, a short, broadly-phrased document drafted when Indonesia proclaimed its independence on August 17, 1945. The constitution provides for a highly centralized state whose principal components are the President, the Parliament, and the People's Consultative Assembly. The highest court in Indonesia's judicial system is the Supreme Court, whose members are appointed by the President. It is essentially a court of review and does not rehear cases or pass on the constitutionality of laws.

Indonesia is divided into 27 provinces which are subdivided into 240 regencies (kabupaten). The governors and regents of these areas are appointed by the central government from nominees submitted by the regional legislature. There are 21 ministers. The central ministries, with responsibility for water supply and sanitation, are shown in Figure 1, whereas central, provincial and local authorities in charge of water

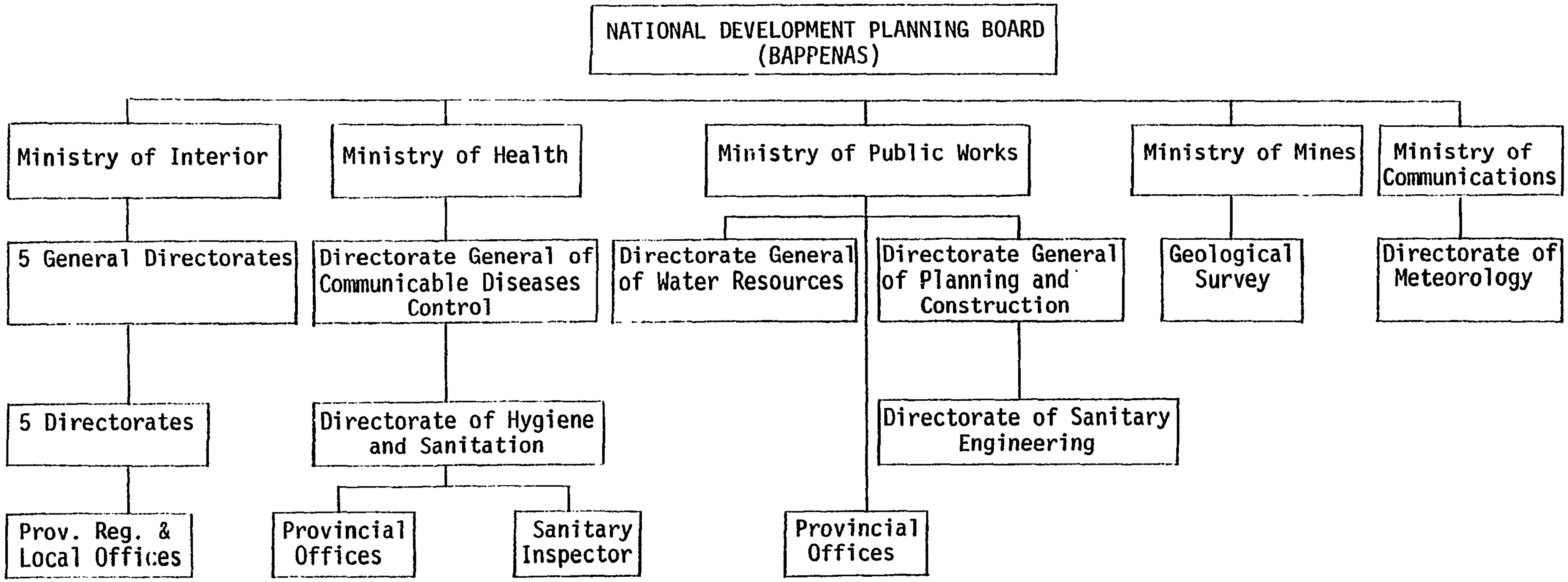
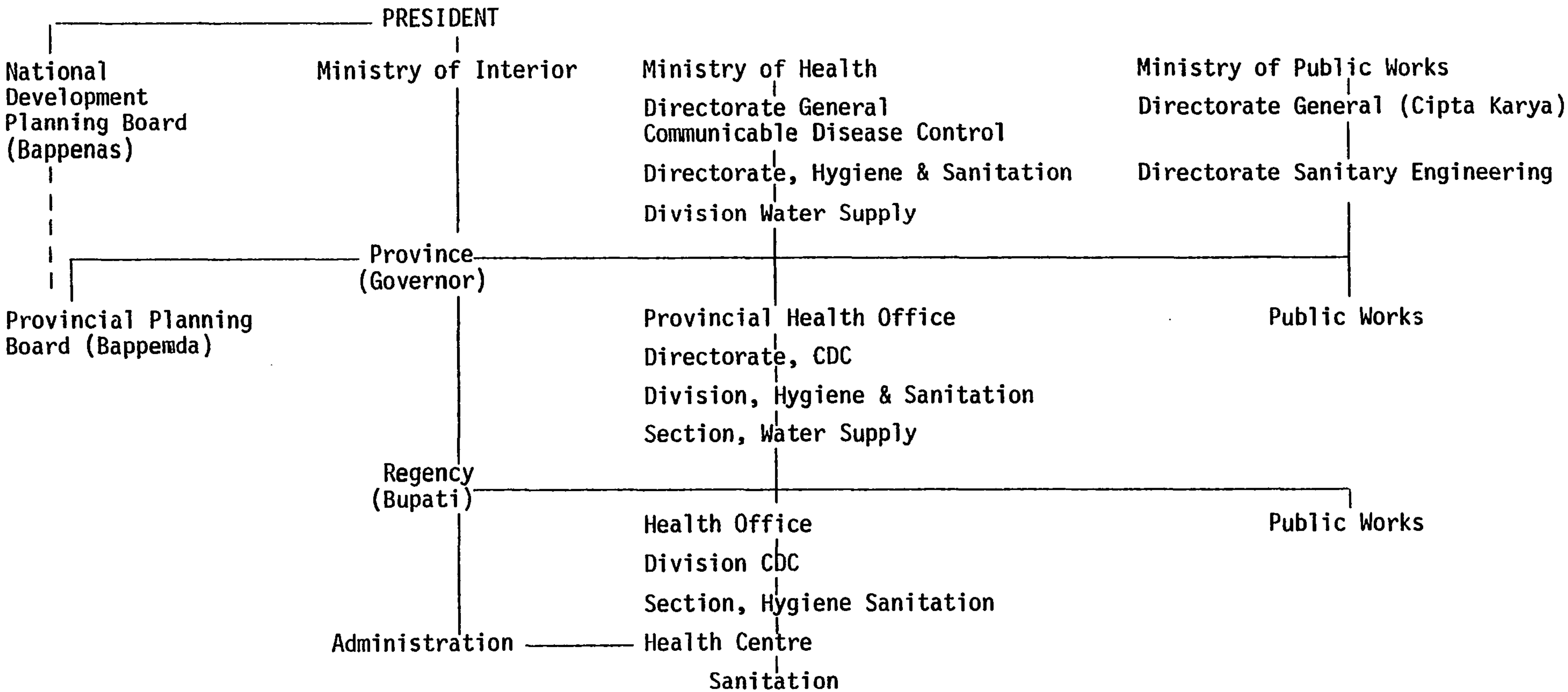


Figure 1: Central Ministries with Responsibility for Water Supply and Sanitation

Source: World Health Organization/World Bank Cooperative Programme: Indonesia Water Supply and Sanitation Sector Study, Pre-Investment Planning Unit, Divison of Environmental Health, WHO, Geneva, Vol. 2, February, 1977, p. 8.



Note: At the primary (Governor, Province) and secondary (Bupati, Regency) regional levels, some functions are carried out autonomously and others, including water/sanitation, are transferred and supervised by the Ministry of Interior (general control) as well as by the functional ministries (technical control).

Figure 2: Central, Provincial and Local Authorities in Charge of Water Supply and Sanitation

Source: World Health Organization/World Bank Cooperative Programme. Indonesia Water Supply and Sanitation Sector Study, Pre-Investment Planning Unit, Division of Environmental Health, WHO, Geneva, Vol. 2, February, 1977, p. 9.

supply and sanitation are depicted in Figure 2. In principle, the Ministry of Public Works is responsible for civil construction throughout Indonesia. Within the Ministry, the Directorate General of Housing, Building, Planning and Urban Development (Cipta Karya), and more particularly the Directorate of Sanitary Engineering, are responsible for water supply and sanitation. However, the Directorate of Sanitary Engineering has not been able to meet its responsibility completely (75). It is in need of a more broadly-based organizational structure, difficult to realize in view of the small number of experienced professional staff overloaded with routine tasks. Therefore, the following distribution of responsibilities has developed.

In urban areas, the Directorate of Sanitary Engineering plans, designs, supervises construction and puts into service urban water supply and sewerage schemes. Financing for source development and treatment works, and sometimes also for storage and distribution networks, has, in the past, been provided by the Central Government of Indonesia as grants and still is today, in the case of emergency assistance. There has been a gradual change to joint loan/equity financing. The Directorate of Sanitary Engineering prepares an annual project list and presents it to the National Development Planning Board (BAPPENAS) for approval. Planning is on an "ad hoc" basis; targets for the current Five-Year Plan consist of proposed increases in total national production of water, not related to people or to service conditions. The municipalities and urban administrations have, in the past, been responsible for financing the construction of distribution networks and operating and maintaining the finished systems. Their performance is often unsatisfactory due to lack of funds and of professional and sub-professional manpower. They find it difficult to obtain technical support and advice.

In rural areas, since 1969, The Ministry of Health, through its Directorate of Hygiene and Sanitation (DHS), has taken over from the Directorate of Sanitary Engineering responsibility for rural water supply and sanitation. DHS supervises design and construction, and also assists in installing hand pumps and latrines, and in operation and maintenance. Lack of an adequate organizational structure and of enough trained technical manpower has negatively influenced DHS's performance. The Regency Public Works Departments (RPW), in conjunction with the Regency Health Departments, which are directly responsible to the regency heads (bupati) and not to the Central Ministries, conduct physical planning and construction of all public works, including rural water supplies. These departments are inadequately staffed; most of RPW's work is directed to the construction of roads, bridges, buildings and irrigation schemes. The village authorities, and sometimes the office of the lower ward, are responsible for operation and maintenance of the finished water supply installations. They should assist construction by supplying labor, and also be responsible for financing those parts of a scheme not provided for by the central, provincial or regency authorities. Contributions are very limited due to shortage of local funds, materials and manpower, and the lack of supervision negatively influences performance. The flexible policy tool of presidential instructions (INPRES) has given momentum to programs concerned with rural areas. However, since 1974 the largely augmented INPRES program has been handicapped as far as piped supplies are concerned because they need the greatest engineering input.

Other government agencies, such as the Ministry of the Interior, have only more recently expanded their roles, starting from marginally-related activities; for example, community development and promotion of village self-help. BUTSI volunteers--a group of university and high school graduates--provide manpower and technical support to the villages in many fields of everyday life, including public health.

The Ministry of Mining also has a Research Institute which has been equipped with a complete laboratory to detect, among other things, marine pollution due to oil spill or accidents involving tankers (59).

Economy and Foreign Assistance

Indonesia's size, soil, and natural resources give it the potential for self-sustaining economic development. The islands contain vast timber resources and rich deposits of petroleum, gas, tin, bauxite, nickel, copper, and iron ore. Extraordinarily rich volcanic soils, though concentrated in already densely populated Java, Bali, and South Sumatra, are capable, with modern techniques, of greatly expanded production. Indonesia's relatively slow economic progress, to date, has resulted from complex social, historical, and geographical factors. Perhaps the most important of these has been lack of education and training and the mismanagement and neglect which, under the previous government, plunged the country into economic chaos and financial bankruptcy. High population growth has eroded the benefits of development. Grosset and Dunlap on "Indonesia," The World Almanac and Book of Facts (22) described that Indonesian gross domestic product (GDP) is estimated at U.S. $46 billion in 1978, while average per capita income was U.S. $300, which is among the lowest in the world.

In April 1969 Indonesia initiated its first 5-year development plan (PELITA 1) which dealt mainly with economic infrastructure and agricultural production under conditions of acute scarcity of resources. PELITA 2 (1974-1979) gives more emphasis to social development by stressing the creation of employment, more widespread income distribution, and investment in community services, such as education and health. INPRES has been most prominent in channelling more funds than originally planned to help the urban and rural poor. Central government development expenditures for PELITA 1 amounted to over U.S. $2.5 billion, of which almost 50 percent was allocated and spent during fiscal 1973-1974 (75). The outlay for public housing (which includes urban water supply and sanitation), health, family planning, social welfare (which includes rural water supply and sanitation), regional, village and urban development, and education increased to 20 percent of the total by the end of PELITA 1. It was planned to increase this share further to

33 percent during PELITA 2, with estimated expenditure totalling U.S. $12.4 billion in 1973-1974 prices, of which about 12 percent or U.S. $1.5 billion was earmarked for the initial 1974-1975. Actual expenditures, however, amounted to U.S. $2.2 billion or 50 percent more than planned. The foregoing amounts include grants from central to provincial and local governments, but not the development expenditures of the latter, for which no data are yet available. On the average, the total volume of their cash contribution can be estimated at about one-third of the central government's effort. Investments in urban sub-sector, almost exclusively for water supply, did not increase in real terms between 1972 and 1975 and even decreased as a portion of total plan expenditures, from 1.0 to 0.6 percent (i.e., U.S. $13 million) over the period. Only recently have they picked up substantially as a result of external projects assistance. In both 1975-1976 and the current year, more than U.S. $19 million have been allocated from the central development budget, to which have to be added for the current year almost U.S. $25 million equivalent of authorized bilateral import credits for complete installations and various equipment.[1]

In improving economic stabilization and development

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[1]This compares with a budgetary request by Directorate of Sanitary Engineering for 1976-1977 of U.S. $63 million. For lack of overall development budget data for 1976-1977, it was not possible to ascertain the sector's share in total public investment.

objectives, some donor nations are cooperating in providing assistance to this country. The International Monetary Fund (IMF), the International Bank for Reconstruction and Development (IBRD), the Asian Development Bank (ADB), the U.N. Development Program (UNDP), the Inter-governmental Group on Indonesia (IGGI), and other international organizations are lending their expertise and financial resources to Indonesia's efforts. The Central Government Officials of the Ministry of Public Works and the Ministry of Health described that in implementing the water supply and sanitation program, the Indonesian government is receiving assistance from the World Health Organization (WHO) in terms of experts in planning and supervision; from United Nations Children's Fund (UNICEF) in terms of materials and equipment, such as pipes, water pumps, survey and drilling tools; from UNDP and United States Agency for International Development (USAID) in terms of manpower development.

Population

The Central Bureau of Statistics on Demography of the Indonesian Population (50) stated that the population of Indonesia by the end of 1978 was estimated at 141.6 million, consisting of 26.9 million who live in urban areas and 114.7 million who live in rural areas, showing that more than 80 percent of the total population reside in rural areas where agricultural and various small industrial activities are conducted. About 75 percent of the population live in Java, Madura and Bali, mostly in villages of an average size of 2,000 people. Estimates of the urban and rural population by province, number of municipalities and regencies are shown in Table 1.

There were population censuses in 1920, 1930, 1961 and 1971. In general, during the period of 1961-1971 the rate of urbanization was slow, with the rapid growth of some politically or economically important cities which had an average annual rate of growth of 3 percent or more. The average annual rate of growth for the urban areas was 4.6 percent and for the rural areas 1.97 percent during the sixties (52). Like many other cities in so-called developing countries, Jakarta has experienced an enormous increase in its population in recent years, partly because of heavy migration from rural areas of Java and from outlying islands in the Republic. This has put a heavy burden on the city's resources, such as housing, education, employment and the provision of public facilities, including water supplies and waste removal. As part of an organized effort to overcome these problems, the government is sponsoring a transmigration policy to help lessen the ill effects of urban over-population. Meanwhile, the inadequacy of public services tends to perpetuate the health problems of the poorer sections of the community.

Dayan (14) in Rural Economic Development and Urbanization stated that the rapid rate of population growth, together with the limited arable agricultural land, has caused a continuous redistribution of land and a declining land-man ratio with the consequence of low average productivity and low income per capita in the rural areas. More than two-thirds of the farm families in Java are dependent in part on income from on-farm

Table 1

THE PROVINCES, THE NUMBER OF MUNICIPAL, REGENCIES TOGETHER WITH URBAN AND RURAL POPULATION[1], AT THE END OF 1978

Province	Municipal	Regencies	Population in thousands		
			Urban	Rural	Total
1 D.I. Aceh	2	8	216	2,267	2,483
2 North Sumatra	6	11	1,507	6,679	8,186
3 West Sumatra	6	8	616	2,836	3,452
4 Riau	1	5	268	1,761	2,029
5 Jambi	1	5	347	896	1,243
6 South Sumatra	1	9	1,163	3,094	4,257
7 Bengkulu	1	3	69	572	641
8 Lampung	1	3	342	3,000	3,432
9 D.K.I. Jakarta	5	-	6,805	-	6,805
10 West Java	4	20	3,450	21,380	24,830
11 Central Java	6	29	3,067	22,043	25,110
12 D.I. Yogyakarta	1	4	498	2,360	2,858
13 East Java	8	29	4,687	24,613	29,300
14 Bali	-	8	257	2,292	2,549
15 West Nusa Tenggara	-	6	224	2,424	2,648
16 East Nusa Tenggara	-	12	167	2,593	2,760
17 West Kalimantan	1	6	275	2,172	2,447
18 Central Kalimantan	1	9	83	765	848
19 South Kalimantan	2	9	547	1,511	2,058
20 East Kalimantan	2	4	327	561	888
21 North Sulawesi	2	4	405	1,675	2,080
22 Central Sulawesi	-	4	63	1,044	1,107
23 South Sulawesi	2	21	1,176	5,107	6,283
24 South-East Sulwesi	-	4	51	813	864
25 Maluku	1	4	161	1,148	1,309
26 Irian Jaya	-	9	131	980	1,111
27 Timor Timur	Data not available				
Total	54	234	26,902	114,677	141,579

[1]Excluded the province of Timor Timur.

Source: Republic of Indonesia, Central Bureau of Statistics, Indonesian Population Projection; 1976-2001, Jakarta, June 1978, p. 11.

activities and they have to compete for the limited employment opportunities available for the large number of rural workers who have no farm land to operate either as owners or tenants. The labor surplus in agriculture pushed down labor income in other rural activities as well.

It has been generally believed that the most important factor underlying rural to urban migration is economic motivation. Such motivation can be caused either by push factors, such as serious socio-economic conditions in the rural areas or by pull factors, such as the expectation for employment opportunities as well as advancement in the urban areas (14). Which of these two is more important varies from region to region, as well as from migrant to migrant in Indonesia. The rural to urban migration has never been distributed evenly among existing urban settlements. The stream of urbanization tends to concentrate toward cities with geo-political and socio-economic significance where the so-called urban pull really exists. Even in the case of rural migrants with push-oriented motivation they must also have pull-oriented motivation, such as the expectation of better employment, better educational opportunities, higher income levels, upward social and economic mobility, and the like, which can be provided by such city centers.

Dayan (14) presented two different estimates based on rapid urban growth with regard to the distribution of population between urban and rural areas. The first estimate is based on the assumption that population results from a constant fertility schedule, together with a slowly declining death rate, so that at the end of this century the female life expectancy at birth will be 60 years. The second estimate is based on the assumption that population would result from a successful family planning program, so that after 1976 the fertility rate would decline linearly and reach NRR = 1 in the year 2001, while mortality follows the same course as in the first estimate. The resulting distribution of population between urban and rural areas according to those two estimates is presented in Table 2 and Table 3.

With a rapid growth of urban population and high fertility, the total population in 2001 will be about evenly distributed among the urban and rural areas, which are 134 million in the urban and 139 million in the rural areas. On the other hand, with successful economic development and successful family planning programs that will cut the fertility rate in half by the end of this century, the growth of both urban and rural populations by identical amounts will be reduced, which is 29 million, respectively, around the year 2001.

The problem with population in Indonesia is its uneven distribution among various provinces and also among urban and rural areas. There are some rural areas, especially in Outer Java, with small populations which are isolated due to backward infrastructure. As mentioned earlier, more than 80 percent of

Table 2

ESTIMATED URBAN AND RURAL POPULATION IN INDONESIA FROM 1971-2001 UNDER THE ASSUMPTION OF HIGH POPULATION PROJECTION AND RAPID GROWTH OF URBAN POPULATION

Year	High Projection Total Population	Percentage Urban to Total Population	Urban Population	Rural Population
1971	118,459	22.3	26,416	92,043
1976	133,836	25.2	33,727	100,109
1981	151,963	27.6	41,942	110,021
1986	174,419	32.3	56,337	174,096
1991	201,566	37.9	76,394	125,172
1996	233,882	43.0	100,569	133,313
2001	272,543	49.0	133,546	138,997

Source: Dayan, Rural Economic Development and Urbanization, Economic Department, University of Indonesia, December 1976, p. 49.

Table 3

ESTIMATED URBAN AND RURAL POPULATION IN INDONESIA FROM 1971-2001 UNDER THE ASSUMPTION OF LOW POPULATION PROJECTION AND RAPID GROWTH OF THE URBAN POPULATION

Year	Low Projection Total Population	Percentage Urban to Total Population	Urban Population	Rural Population
1971	118,459	22.3	26,416	92,043
1976	133,836	25.2	33,727	100,109
1981	149,446	27.6	41,247	108,199
1986	166,161	32.3	53,670	112,491
1991	183,377	37.9	69,500	113,877
1996	200,104	43.0	86,045	114,059
2001	215,296	49.0	105,495	109,801

Source: Dayan, Rural Economic Development and Urbanization, Economic Department, University of Indonesia, December 1976, p. 49.

the Indonesian population live in rural areas and less than 20 percent live in urban areas. This means that Indonesians depend upon agriculture for a living; the low-income bracket is dominant; industry is not yet developed; there is a high unemployment rate; and the national economic growth is low. The gap between the rich and the poor is too wide and, unfortunately, the greater portion of the Indonesian population belongs to the low-income bracket (60). The location of urban population in Indonesia is depicted in Figure 3.

Public Health Profile

The Ministry of Health places emphasis on preventive work. Private initiative is encouraged in the curative field. The central government bears the major part of the expense of health facilities but expects autonomous local units to assume a greater financial share. Foreign enterprises have long spent considerable sums on medical care for their workers.

The campaign against malaria has been successful; yaws and trachoma are being successfully combated. Overcrowded cities, poor sanitation, impure water supplies, sub-standard urban housing, and dietary deficiencies are contributing factors in the poor health situation.

In 1977 life expectancy at birth was approximately 48 years; the crude birth rate was 48/1,000; the crude death rate was 19/1,000; and infant mortality was 125/1,000 live births. Cholera, which is a sensitive indicator of hygiene and

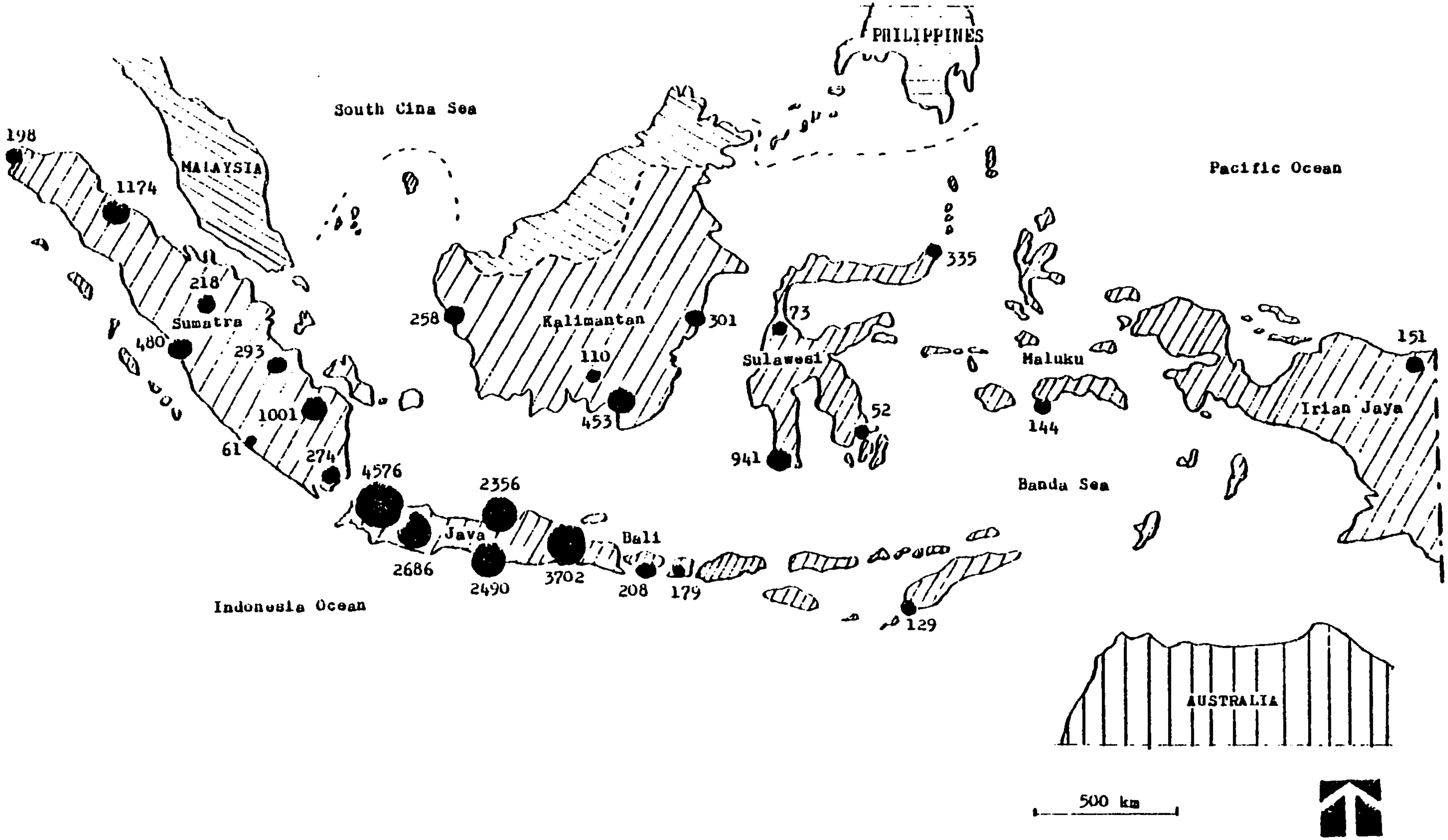

Figure 3 Indonesia Urban Population (X 1,000 inhabitants)

Source: World Health Organization/World Bank Cooperative Programme. Indonesia Water Supply and Sanitation Sector Study, Vol. 2, 1977, Annex, p. 105.

sanitary conditions, is endemic in the whole of Indonesia. In 1974, the country had the highest number of cases (51,016) and deaths (4,012) of any country in the world that reported such data, the two figures quoted being 42 percent and 51 percent respectively of the corresponding global figures (75).

A household survey conducted in 1972 by the Ministry of Health (MH) showed that in the six provinces covered, waterborne, water-related and parasitic diseases had the highest incidence and were a primary cause of the high rate of infant mortality. Other studies showed that 60 percent of the population in some areas were affected by three different types of parasites; 80 percent by at least two; and 100 percent by one. It is generally accepted by health authorities that diseases related to lack of proper water supply and sanitation constitute the principal causes of morbidity and mortality. An additional contributory factor is the general contamination of water courses used for bathing and washing clothes.

Data concerning existing health facilities are presented in Table 4. Additionally, the ratios of population per physician, per nurse and per hospital bed were respectively, 27,650, 8,000 and 1.720. There are, however, great differences between the regions and provinces and also between urban and rural centers.

In May 1975 MH promulgated national standards of drinking water quality. The considerable increase in recent years of new and improved water supplies, especially in the

Table 4

NUMBER OF HOSPITALS (GOVERNMENT AND PRIVATE), BEDS AVAILABLE AND NUMBER OF PHYSICIANS PER 10,000 POPULATION IN INDONESIA, BY PROVINCE, 1977

Province	Government Hos.	Government Beds	Private Hos.	Private Beds	Total Hos.	Total Beds	Number of Physicians Per 1,000 Population
D. I. Aceh	22	700	1	-	23	700	0.38
North Sumatara	66	7,022	81	1,907	147	8,929	0.73
West Sumatara	17	1,198	20	221	37	1,419	0.65
Riau	13	551	11	175	24	729	0.44
Jambi	6	268	2	24	8	292	0.59
South Sumatara	29	2,141	5	344	34	2,485	0.78
Bengkulu	4	188	-	-	4	188	0.75
Lampung	6	538	10	215	16	753	0.22
D. K. I. Jakarta	33	4,122	112	2,961	145	7,083	3.18
West Java	54	6,094	24	1,370	78	7,464	0.32
Central Java	84	7,955	97	1,384	181	9,339	0.30
D. I. Yogyakarta	8	1,131	6	1,259	14	2,390	1.50
East Java	75	8,412	62	2,458	137	10,870	0.36
West Kalimantan	24	1,050	4	147	28	1,197	0.40
Central Kalimantan	8	222	-	-	8	222	0.41
South Kalimantan	13	582	2	86	15	668	0.40
East Kalimantan	13	970	3	82	16	1,052	0.96
North Sulawesi	12	1,141	13	984	25	2,125	0.80
Central Sulawesi	8	450	1	11	9	461	0.46
South Sulawesi	46	2,607	25	993	71	3,600	0.45
South-East Sulawesi	10	272	1	55	11	327	0.31
Maluku	6	422	5	440	11	862	0.55
Irian Jaya	19	849	7	54	26	903	0.73
Timor Timur	Data not available						
Total	613	51,258	504	15,829	1,117	67,067	0.55

Source: Republic of Indonesia, Central Bureau of Statistics, Statistical Pocketbook of Indonesia, Annual Statistics, Jakarta, 1977, p. 107.

rural areas, has outstripped the ability of MH to maintain surveillance and control of the quality of all water supplies, effectively and continuously. Technical capacity at provincial and regional levels has yet to be developed to perform this function. Training of personnel and the introduction of systematic inspection services, including laboratories, will be required to enable MH to fulfill this role.

Indonesia has received much help from the United Nations, particularly through WHO and UNICEF, in solving health problems. The Ministry of Health is seeking to build up a health service starting in the village with a hygiene officer, who is an official of the village, and working up through groups of villages with more facilities and better-trained personnel for the regional doctor, who is head of curative-preventive work. So far, this program has been confined to only parts of Java. In 1971 there were 4,561 doctors, 547 dentists, 311 pharmacists, 15,008 nurses, and 6,997 trained midwives. The ratio of one doctor to every 27,650 persons, among the lowest in all of Asia (76), gives, moreover, an inflated picture in view of their uneven distribution. More than one-third of the country's doctors practice in Jakarta and other big cities, and many rural districts have no doctors at all.

Urban Water Supply Situation

Indonesia has a total of over 200 urban water supply systems. Many operate intermittently because of some inadequacy in parts of the system, mostly in treatment, storage or distribution networks and in fewer cases due to source deficiency or a high percentage of water lost in the system. World Health Organization/World Bank Corperative Program on Indonesia Water Supply and Sanitation Sector Study (75) reported that hours of operation vary from 4 to 8 per day, although eight urban systems are reported to have 24-hour supplies. With few exceptions, operation of treatment plants is not up to standards, leading to an excessive use of chemicals and the distribution of water of poor quality. Control of quality by the Ministry of Health is hampered by lack of laboratory facilities, skilled manpower resources, and limitations to a few large cities. It was further stated that from 1969 to 1974 (i.e., during PELITA 1) the capacity increase is estimated at 63 percent, from 0.8 to 1.3 million m^3/day, but only a small part of the increase benefitted consumers. The municipalities, which were supposed to increase the capacities of their distribution network as the corresponding sources were developed, could not do so due to lack of funds. It was firm government policy until 1971 to provide financing only for source development and treatment works, all other parts of the systems being financed by the municipalities. Subsequently, funds were also made available for the other parts as emergency assistance, with a shift of policy away from grants to loans.

The Government Officials of the Ministry of Public Works described that compared to the 1971 census, the increase in urban population from 1971 to 1978 is 5.7 million, while a much smaller additional number of urban dwellers benefitted from the delivery of safe water. Furthermore, service by house connections remained relatively stagnant and often systems expanded mostly through public standposts and/or water vendors. These comparisons are hard to substantiate or to refute, especially if people obtain their water through neighbors or arrange for ad hoc community schemes by pooling the costs and obtaining the quiet approval of the authorities. The point remains that service through the public system has not progressed but more likely has fallen back. Two-thirds of the urban population, which is growing at an average rate of 4 percent, are yet to be supplied (75). They now rely on tube and dug wells, springs and rainwater collections. Others take water from the numerous rivers and water courses that are usually heavily polluted. With the possible exception of springs, these sources are unsafe and contribute to the unsanitary conditions marking the life of many urban people.

As far as the present state of existing water supply systems is concerned, some of their oldest elements, mainly source and network facilities, date back as far as 1903, occasionally augmented or extended during subsequent decades. Many of these old installations, though in bad condition, are still in use today. Discharge capacities of pipes have decreased due to incrustation as well as leaks, and increased waste discharges into rivers have deteriorated water quality at the source. Thus, a higher standard of treatment is required. The improper functioning of old equipment, lack of materials, such as chemicals, ineffective management and administration and an acute shortage of skilled personnel, give rise to unsatisfactory operation of treatment plants.

Distribution networks installed during previous years generally do not serve the whole of any urban area and the practice of intermittent supply is widespread in urban systems. In the absence of proper records registering the hours of pumping and maintaining of pressure, it appears that only those systems recently constructed or augmented operate on a 24-hour basis. Intermittent supply goes along with deficiencies in pressure maintained in the network. A number of cities provide drinking water timewise to two or more pressure zones, using a sliding time schedule. Pressures prevailing in the zones may vary, and as a result, some water works keep pressure at a minimum, just sufficient to avoid backsuction and backsyphonage. This, in turn, has the effect in inadequate supply conditions at the consumers' taps in the houses and, even more evident, at public hydrants, where pressure sometimes is so low that the tapping points are installed in a basin 1 to 2 meters below street level, i.e., at about the level of the distribution main.

Another result of the old age of networks is the frequency of leaks and the excessive water losses accruing. With no appropriate metering or recording practiced by the majority of urban water works, rough estimates[1] have been made

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[1]Based on data compilation of several feasibility studies and masterplan of Urban Water Supply in Indonesia.

indicating maximum losses on the order to 60 percent of total production; only a few networks constructed more recently report lower figures of 20-30 percent losses.

It is not possible to obtain a breakdown of overall loss figures into losses by leakage, illicit connections, water consumption not billed (public fountains, army, certain government institutions) and other wastage of piped water. Thus, the figures above represent the portion of accounted-for water produced. Different methods of charging consumers for the consumption of water drawn from public hydrants are in use, although most medium- and small-sized cities do not raise charges. Jakarta has a rather elaborate system based on licenses issued to concessionaires.

The replacement of old pipes and other parts of networks is not done in an appropriate manner, and only a few urban water undertakings have been able to carry out some renewal within their systems; e.g., in Surabaya (2.3 million population) an annual length of 5,000 to 10,000 meters of pipework, mostly replacement, are being laid. In Malang (population 470,000) 10,000 meters of small diameter, 2" to 4", pipes are being replaced annually (75). In other cities programs for rehabilitation have been drafted, but their implementation is lagging behind schedule due to a lack of funds or because additional water is not available at the sourse. The latter fact is responsible for restrictions which water works have imposed for the installation of new house connections, public hydrants, bathing houses and connections to industrial estates (e.g., Surabaya and Malang).

The deficient state of many urban systems is also reflected by the small number of water meters used. There are no master meters which would permit a continuous record of daily production quantities released into the distribution system. As to metering of individual connections, again experience shows that the major cities and those with recently completed systems have a reasonable portion of consumers with meters. Water undertakings claiming 90 to 100 percent metering are Jakarta, Surabaya, Menado, Bogor and Padang. In other cities, as far as there are any figures on record, this percentage decreases to 50, 20 or nil.

Urban Excreta/Wastewater Disposal Situation

At present only four cities (Bandung, Solo, Jogjakarta and Surabaya) have sewerage. Only one (Bandung) has some sewage treatment. The sewerage systems cover only parts of the towns and their capacities are not adequate due to age and under-design. The method of sewage treatment in Bandung is the Imhoff Tank which was constructed in 1920 and was designed to serve 50,000 people at that time. The city has grown and the number of people increased--at present numbering about 1.4 million--but the waste treatment facilities were never expanded, thus at present the system is obviously overloaded.

As the total urban population by census in 1971 was 21 million, roughly 5 million people had no facilities whatsoever, and they discharged excreta directly into rivers, storm drainage or irrigation canals, consequently creating serious water pollution problems due to untreated waste. Since direct use of surface waters for drinking purposes is still common, this results in endemic levels of incidence of communicable diseases, such as cholera and typhoid. The 1971 census stated only the total number of households with some kind of excreta disposal; it is not clear how many can be considered to be sanitary. The assumption was made, therefore, that only houses in the best category have sanitary excreta disposal (i.e., some sewerage, septic tanks and water-sealed latrines). The population living in these conditions is approximately 4.3 million, about 16 percent of the present urban population. The 1971 census data on urban sanitation are presented in Table 5

Table 5

URBAN SANITATION SITUATION AS OF CENSUS 1971

	Urban Population Served by				
	Flush Toilets		Dry Latrines		Total
Category	000's	Percentage	000's	Percentage	000'0
Private	6,260	30	1,710	8	7,970
Joint	2,830	13	2,080	10	4,910
Public	940	4	1,930	9	2,870
Total	10,030	47	5,720	27	15,770

Many cities, for example Jakarta, Surabaya, Medan, etc., are traversed by drainage channels provided to evacuate rainwater and prevent flooding. All kinds of rubbish, sullage waters and excreta, as well as commercial and industrial effluents, are discharged into them, thus converting them into open sewers or anaerobic ponds when dammed by solids during the dry season. When the rains start, water cannot flow freely and large parts of the cities become flooded. Flood waters sweep raw sewage and rubbish out of the channels back into the kampungs (high population density, low-income areas called kampungs). When the dry season returns and there is insufficient flow to drain off wastes, they decay and pose a serious health hazard.

Most kampungs in many cities lack basic sanitary facilities. Rubbish is dumped into the channels or in open spaces. The kampungs are foci for all kinds of waterborne, water-related and parasitic diseases, prevalence of the latter often reaching 100 percent.

One important and indisputable difference between communities in the developing countries and those of the developed countries is the existence of the open drains in the former. In the developed countries, normally all the different components of sewage are eliminated from the human premises through sewers (33). Unfortunately, in most of the communities in Indonesia at least one component of sewage finds itself in the open drains where mosquitoes breed. Other pathogens could be present, depending on the source of the component of sewage present in the open drains.

The wastewater in urban areas is commonly discharged into open drains. There are different types of open drains. Some are constructed and well-lined while many are neither constructed nor lined. Those which are not constructed are often formed by the wastewater, especially the rain run-off. In some areas the lined surface drains are well-maintained, including regular spraying with insecticides, while in many areas the drains are very unsightly, with refuse and foul-smelling septic sewage. Those areas which employ properly-designed, well-constructed and regularly-maintained septic tanks have open drains for only the surface run-off from rain, waste water from car-washing or other wastewater without much pollution. While those areas with faulty septic tank systems or those without any ready access to any form of excreta disposal facility have open drains which serve as open sewers. Poor refuse collection programs worsen the characteristics of the open drains in all areas. Such refuse is often deposited at places where they have access to the open drains where it obstructs flow and causes flooding during rain. The regular flooding of many areas in the city is due mainly to the blocking of the main drainage channels and streams with refuse. From these characteristics of the open drains, it is not difficult to imagine that all types of organisms, both pathogenic and otherwise, will at one time or the other have access to the drains. The important point is the persistence or the latency of the pathogens in the drains.

Some studies and reports have been undertaken and are being carried out on the physical, chemical and biological characteristics of domestic wastewater in open drains as well as in another surface water. Soesanto (59) reported that several surveys on the quality of water in rivers and storm water canals in Jakarta showed that the BOD ranged between 100-200 ppm and the D.O. many times dropped to 0 ppm. The bacteriological quality of raw water taken from the storm water canal for Jakarta Water Treatment Plants was very bad, showing MPN of 500,000-2,000,000/100 ml. The condition is often worse during dry seasons where dilution is lacking. The number of pathogenic organisms, such as Salmonella and viruses, are expected to be very high also, since the main sources of pollution are human waste and refuse.

Gracey (20) found that large numbers of Enterobacter-iaciae were recovered from samples of surface waters from widely scattered parts of the city of Jakarta when examined in the early part of a recent monsoon season. This confirmed Gracey's suspicions about the polluted condition of these waters and strengthened his suspicions about the importance of this environmental factor in causing a high rate of infectious diarrhoeal disease. Further, he stated that it must be understood that the Ciliwung River and its tributaries and interlacing canals make an integral part of the life of the city of Jakarta and particularly for the poorer sections of its population, many of whom live in inadequate squatter settlements and who use the river for washing, laundering, washing food and for the removal of human and domestic waste. The waters are also used by the children for swimming, playing and cooling off from the tropic heat.

During the First Five-Year Development Plan, the government started a kampung improvement program--constructing roads and footpaths, installing public hydrants and even some house connections and latrines, sometimes public, with septic tanks. I.B.R.D. has provided two loans to accelerate this program in Jakarta and Surabaya. The government recognizes that it is important to maintain standards for the quality of river water, and in August 1977 a new set of regulations was introduced. The English translation of the law is presented in Appendix A.

Indonesian Urban Excreta/Wastewater Disposal Program

The Indonesian urban excreta/wastewater disposal program began in the fourth year of the Second Five-Year Development Plan (1974-1979), but mentions only research surveys and feasibility studies for urban sewerage, and no specific investment programs are outlined. The largest single project underway, for which first-stage construction is to start in 1977, is the WHO/UNDP-assisted Jakarta sewerage project. Cost estimates by the consultants are in the U.S. $100-150 million range, if any definite impact is to be made on improving sanitary conditions in the capital. The order of magnitude of the likely funds required is such that major decisions on domestic/foreign financing, municipal participation in funding and on a policy of charges for property owners/users are imminent at central government level, in view of potential projects in other big cities, such as Surabaya, Medan, Bandung and Semarang.

Learning from past experience, the government is aware that the best way to control excreted infectious diseases is to provide adequate excreta/wastewater disposal, so that in the Third Five-Year Development Plan, which started on April 1, 1979, the excreta/wastewater disposal will be implemented more extensively. Other plans are:

a. To introduce sewerage in those cities where conditions are critical and compounded by the expansion of water supply. The term critical is used to denote the areas which often have high incidence of infectious disease.

b. Additional attention and funds are devoted to kampung improvement programs, and the collection and disposal of excreta which forms an important part of it.

c. The latrine program will be extended to serve many more of the poor urban areas. It is mentioned that 1,750,000 latrines will be constructed during the Third Five-Year Development Plan.

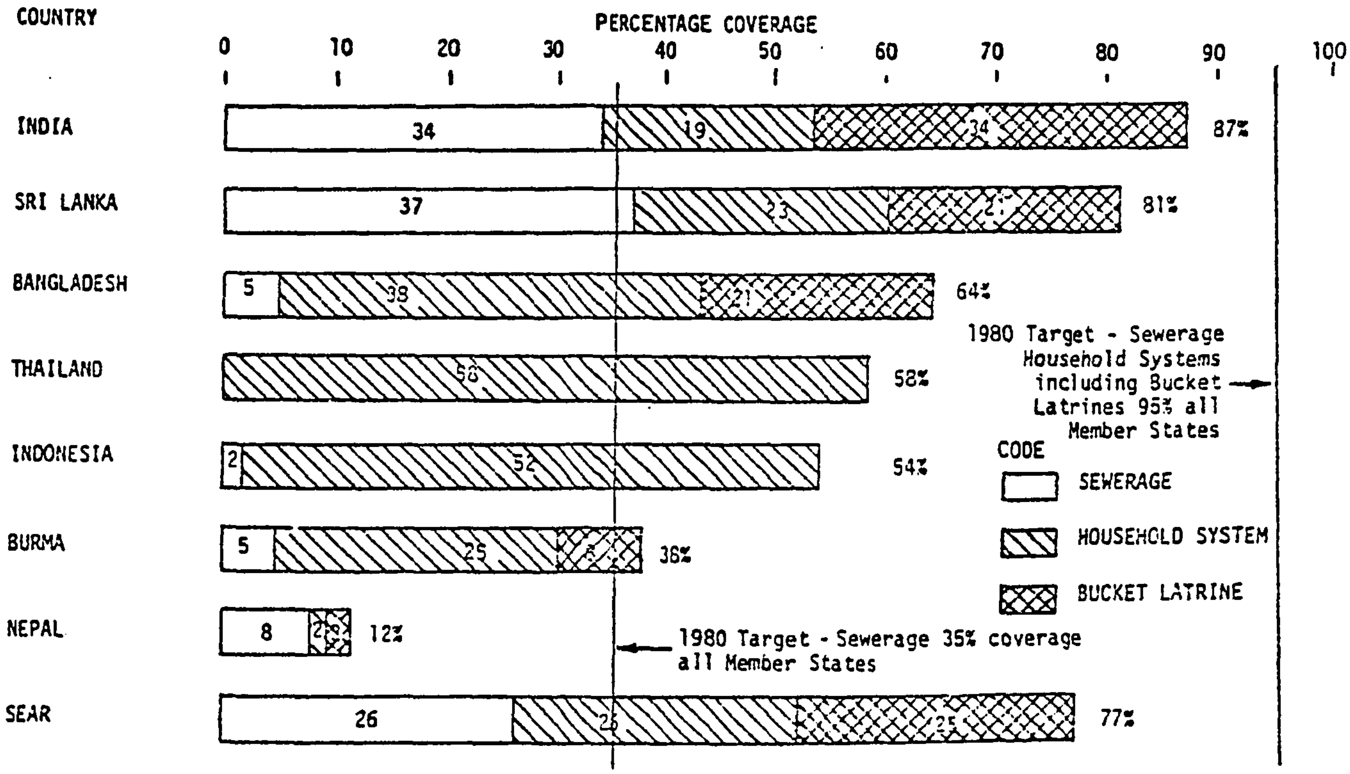

Figure 4 Percentage coverage, urban sewage and excreta disposal in SEAR countries, 1975.

Source: WHO Regional Publications, Community Water Supply and Excreta Disposal in South East Asia, South East Asia Series No. 4, New Delhi, 1977.

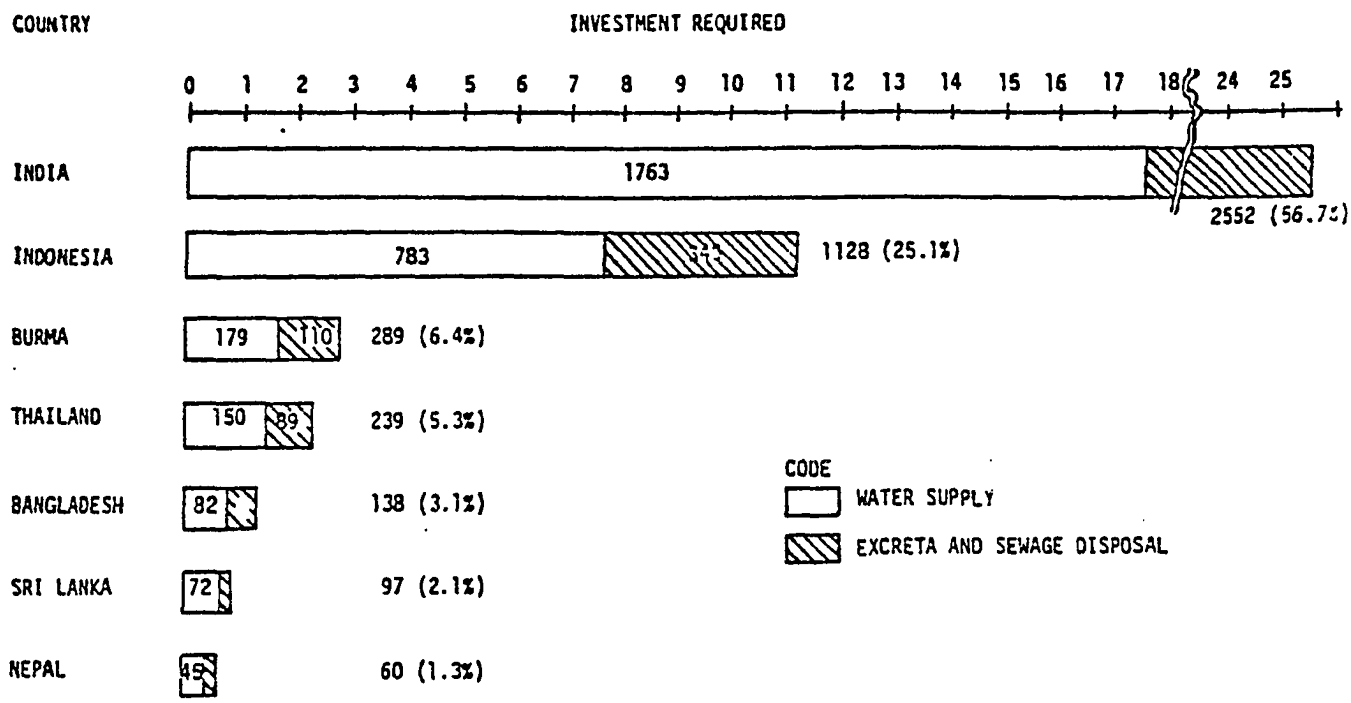

Figure 5 Investment required SEAR member countries to meet 1980 targets for water supply and excreta and sewage disposal.

Note: Figure in brackets is percentage of total SEAR investment. Scale for "Investment Required" in 100 million U.S. dollars; numbers in the Chart represent investment required in million U.S. dollars.

Source: WHO Regional Publications, Community Water Supply and Excreta Disposal in South East Asia, South East Asia Series No. 4, New Delhi, 1977.

Table 6

URBAN EXCRETA AND SEWAGE DISPOSAL--COMPARISON OF SERVICES, 1970 AND 1975, AND PROJECTIONS FOR 1976-1980

Country	Population Connected To Public Sewer System				Population Served by Household Systems: Pit Privy, Septic Tank				Population Served by Household Systems: Bucket				Total Urban Population Served				Projections for 1976-1980: To be Served by Sewerage		Projections for 1976-1980: To be Served by Household Systems		Projections for 1976-1980: Total Population to be Served N'1000	Projections for 1976-1980: Total Investment[2] US$ Million	
	1970		1975		1970		1975		1970		1975		1970		1975								
	N'1000	%	N'1000	%	N'1000	%	N'1000	%	N'1000	%	N'1000	%	N'1000	%	N'1000	%	Proposed 1980 Target %	Additional Population to be Served N'1000	Proposed 1980 Target %	Additional Population to be Served N'1000		Needed	Proposed
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bangladesh	500	12	505	5	2 000	45	2 100	38	1 200	27	1 200	21	3 700	87	3 805	64	35	1 797	60	647	2 444	46.44	
Burma	321	6	346	5	1 600	28	1 804	25	600	11	570	8	2 521	45	2 720	38	35	2 801	60	3 021	5 822	110.62	
India	40 000	36	45 500	34	14 000	13	25 000	19	40 000	36	46 000	34	94 000	85	116 500	87	35	11 598	60	26 882	38 480	731.12	
Indonesia	460	2	460	2	10 000	48	13 969	52					10 460	50	14 429	54	35	11 353	60	6 281	17 634	335.05	
Nepal	40	8	50	8	5	1	15	2	10	2	10	2	55	12	75	12	35	237	60	467	704	13.37	
Sri Lanka	1 100	39	1 300	37	500	18	783	23	551	20	654	19	2 151	76	2 737	78	35	183	60	1 104	1 287	24.45	
Thailand					3 600	65	4 150	58					3 600	65	4 150	58	35	3 250	60	1 421	4 671	88.75	
TOTAL	42 421	28	48 161	26	31 705	21	47 821	26	42 361	28	48 434	26	116 487	77	144 416	78	35	31 219	60	39 823	71 042	1350.	

[1]Source: Community Water Supply and Waste Water Disposal (Mid-Decade Progress Report). Report by the Director-General, Twenty-Ninth World Health Assembly. Document No. A/29/12 Rev.1, 1976, WHO, Geneva. Also World Health Statistics Report, Vol.29, No.10, 1976, WHO/Geneva. (Note: Some corrections by SEARO, 1977).

[2]Estimated investment per capita $19.- per capita.

Current accomplishments and the above plans are far short of the WHO goals for South East Asia Region (SEAR) member countries for 1980. Figure 4 shows percentage coverage for urban sewage and excreta disposal in SEAR countries in 1975, whereas Figure 5 shows investment required of SEAR member countries to meet 1980 targets for water supply and excreta/ sewage disposal. Table 6 shows urban excreta and sewage disposal comparison of services, 1970 and 1975, and projections for 1976-1980. In order to meet the WHO goals the Indonesian government should spend U.S. $34.5 billion for the period 1976-1980 based on per capita investment cost U.S. $19, in which 35 percent will be served by sewerage and 60 percent by household systems. However, this figure is difficult to achieve, since urban excreta/wastewater construction has just begun in the Third Five-Year Development Plan on April 1, 1979.

Constraints

Environmental pollution control programs, as any other programs concerned with the delivery of services to the public, are subject to a large number of constraints. A serious limitation on the effectiveness of water pollution control programs is the present rate of urbanization and the concurrent growth of population. Pollution problems grow more rapidly than do the resources available to control them, and programs planned today may already be inadequate before they can be implemented.

The main categories of constraints in implementing of the urban excreta/wastewater disposal program in Indonesia are money, manpower, and social and political factors. With respect to money, in 1975 WHO Regional Publications (74) in Community Water Supply and Excreta Disposal in South-East Asia estimated that the Indonesian government should spend U.S. $7.5 billion a year to achieve the 1980 target, which is a substantial amount of money for the Indonesian government at present because many other projects are being implemented simultaneously under the Third Five-Year Development Plan.

With respect to manpower, there are about 60 sanitary engineers who work for the Directorate of Sanitary Engineers, Ministry of Public Works, to serve 27 million urban people. Some of them are located at the provincial capital as project officers. These personnel figures are far below the needs of the urban water supply and excreta/wastewater disposal, especially as their work is overloaded with routine functions at the present time.

In terms of social factors, lack of social awareness and of understanding the problem by the public may be an important reason for the low priority accorded to environmental health, in general, and environmental pollution control, in particular. The relatively small financial resources allocated for water pollution control are, to some extent, a reflection of the comparatively low value the community attaches to environmental quality or the lack of awareness of the importance of environmental quality.

In terms of political constraints, water pollution control programs may be politically desirable or inopportune, because of the restrictions they may place on economic development, hence the need to integrate the excreta/wastewater disposal program with other elements of economic development programs. Also, there is often a tendency to support other programs in which quick results can be seen rather than to invest in long-term pollution control programs with less demonstrable beneficial effects.

Objective and Justification

As mentioned earlier, the Indonesian government plans to place urban excreta/wastewater disposal facilities in the Third Five-Year Development Plan started on April 1, 1979. Feasibility studies, master plans, and detail design for cities in Indonesia are being implemented by the Directorate of Sanitary Engineering, Ministry of Public Works. But there is the question of which one should be constructed first to ensure that limited government money will be spent most wisely, and whether the program is being implemented fairly. Thus, it is necessary to develop a priority model for selecting project localities of urban excreta/wastewater disposal systems. Thus, it is felt that there is a need of criteria for selecting which cities should receive an excreta/wastewater disposal system first. Therefore, the objective of this dissertation is to develop a municipal excreta/wastewater disposal priority rating model suitable to Indonesian conditions, characteristics, and strategies.

CHAPTER II

LITERATURE REVIEW

Introduction

Much of the literature on priority setting for the urban excreta and/or wastewater disposal program is of a "fugitive" nature; that is, it is in the form of short reports reproduced in small numbers or in the form of articles in journals with varying degrees of accessibility. A great deal of work has been done under the auspices of the World Health Organization, some of which has been published.

Efforts have been made to obtain the priority model both from developing countries and developed countries for comparative study. However, most developing countries do not have such a model because in the past there was little attention from the government on pollution control due to a lack of funds and manpower. Some developed countries do not have such a model, such as the Netherlands, Switzerland, New Zealand, etc. This is so because the first efforts to control water pollution started early, so nearly all urban communities are sewered. Second, the standard of sewage treatment and disposal is generally adequate and third, financial resources are sufficient to fund sewage disposal projects without the need for a priority rating.

Although priorities may be greatly influenced by political considerations, nevertheless such factors as public health conditions, population concentration, availability of local resources, and ability to sustain the services are among the major factors in the decision making on priority settings (46).

Four different approaches for assigning priority of urban excreta/wastewater disposal projects followed by priority model will be presented in this chapter. These four approaches are under the following headings: Basic Considerations in Establishing Priorities; Public or Government Policy; Technical Considerations; and Priority Models.

Basic Considerations in Establishing Priorities

A report of a WHO Scientific Group on Environmental Health Criteria (49) discussed basic considerations in establishing priorities. It was stated that each country must interpret environmental health problems, including excreta disposal, in terms of its own national situation. Where people lack adequate housing and basic sanitary facilities, the health hazards attributable to natural environmental stresses and communicable diseases often demand more urgent attention than does, for example, chemical pollution, which is of great concern to industrialized countries. The provision of basic sanitation often requires the development of low-cost or intermediate technology, the use of local materials, the strengthening of manpower resources, and the creation of appropriate institutional arrangements--problems that are outside the scope of this report. The WHO program of assistance for the provision of safe community water supplies and sanitary disposal of human wastes, for instance, deals with such aspects.

It is expected that environmental health hazards from a lack of basic sanitation will be gradually overcome by economic development. However, these processes introduce new pollution problems, for example, to the use of agriculture chemicals, to the discharge of industrial wastes, and to increased energy production. A sound principle is therefore to incorporate pollution control elements in all economic and industrial development schemes at the outset. It was also stated by the WHO Scientific Group that the scientific knowledge of disposal is fragmentary and not always readily accessible or comparable, despite efforts at national and international levels. The resulting regulatory control decisions directed towards correcting existing or preventing potential adverse effects of environmental pollutants are, therefore, often controversial. An international program on environmental health criteria can significantly enhance national efforts to improve human health and to harmonize man's relationship with his total environment by stimulating the improvement of the scientific information available.

Ideally, an environmental health criteria document should describe, for each pollutant or agent, its relevant physical and chemical properties, recommend appropriate sampling and analytical techniques, compile relevant national and international production and consumption data, discuss environmental transport and deposition, and provide information on environmental and biological transformation on biological effects of the agent and its interactions with other environmental factors. Exposures and other relevant biological and environmental data should be expressed in an internationally comparable manner. It was further stated that armed with such information the scientific community could effectively coordinate an interlocking series of experimental, epidemiological, and clinical investigations that would elucidate dose-response relationships, linking exposures to alterations in human health and well-being. In reality, however, limited scientific knowledge and resources are coupled with a complex array of rapidly changing environmental problems and it will be a long and arduous task to achieve an adequate information base for dealing with these problems. Any feasible international environmental health program should therefore establish priorities for the preparation of criteria documents and for the research effort necessary to define emerging problems. When establishing priorities, the scientific community should be guided by the following considerations in each specific problem:

1. Severity and frequency of observed or suspected adverse effects on human health.

2. Ubiquity and abundance of the agent in man's environment. Of concern are inadvertently produced agents, the levels of which may be expected to increase rapidly, and agents that add to a natural hazard.

3. Persistence in the environment. Pollutants that resist environmental degradation and accumulate, in man, in the environment or in food chains deserve attention.

4. Environmental transformations or metabolic alterations. Since these alterations may lead to the production of chemicals that have greater toxic potential, it may be more important to ascertain the distribution of the derivatives than that of the original pollutant.

5. Size, type and demographic characteristics of population exposed, the frequency and magnitude of exposure, and selected exposure of highly vulnerable groups of the population.

Other considerations may also influence the establishment of priorities. Priority setting may be facilitated by analog to a known problem or frustrated by the paucity of knowledge, or by conflicting or contradictory conclusions from existing research. Proven or suspected interactions with other environmental factors may alter priorities. The availability and feasibility of control measures and means of prevention may also prove to be a determining factor. Control technology includes replacement by new products, use of different raw materials, alteration of industrial processes, treatment of effluents, and changes in consumption or disposal practices. Other factors of major importance include the general awareness of the problem, the ability to educate the public regarding the hazard, the likelihood of social acceptability of contemplated control measures, and the availability of national resources, including manpower.

The WHO Environmental Health Criteria Program (72) describes the scope of the program and priorities. It was stated that the knowledge of disposal is fragmentary and not readily available for decision-making with regard to environmental regulatory control, despite past and present efforts at national and international levels. The program suggests aims at correcting these deficiencies. In order to take into account the urgent needs and yet make the program feasible, it is necessary to establish priorities for each component. These priorities may differ from one country to another, depending on local circumstances. For example, microbiological pollutants are still much more important for many countries than chemical contaminants. This is clearly reflected in the high priority given to basic sanitation in the WHO environmental pollution program. The major objective of the program is the preparation of criteria documents, i.e., critical reviews of the existing knowledge ready for application and expressed, if possible, in quantitative terms, on identifiable, immediate and long-term effects on man's health and welfare which may be expected from the presence (singly or in combination) of various environmental factors. An additional objective is the provision of guidance regarding levels or conditions of exposure which would be consistent with the protection of the health and well-being of exposed populations. In the preparation of national legislation, governments should be able to use the criteria and recommendations in a manner most appropriate to the specific requirements and conditions prevailing in the countries in question. Responsibility for this aspect of the work must rest entirely with individual governments. It was further stated that chemicals and biological agents are part of the scope of the program that should be considered. Huge numbers of potentially toxic chemicals have been introduced into the environment. Health effects studies may be concerned with specific elements or compounds, or classes of compounds, but also may be specific for the type of toxicity that may be observed. Based upon the principles for allocation of priorities, Table 7 has been drawn up to indicate those chemicals and some biological agents which have been evaluated but need constant review; those of first priority which should be evaluated in the near future, and those of second priority. The chemicals listed in the table should be periodically reviewed, at which time priorities will be reconsidered and appropriately altered, if necessary, taking into account the specific needs of governments, progress in knowledge, and information on new hazards. Reviews and research already under-way should continue. While these lists reflect a global need

Table 7

SOME CHEMICAL AND BIOLOGICAL AGENTS
A TENTATIVE LIST FOR USE IN FORMULATING CRITERIA

	To be kept under review (partial documentation exists)	National and international review required	
		First priority	Second priority
Pollutants that may occur in air, water and food*	F, Cd, Hg, Pb DDT, dieldrin, aldrin, BHC Selected polycyclic aromatic hydro-carbons Radio-isotopes	As, Be, Cr, Mn, Ni, Se, V, Polychlorinated biphenyls (PCBs) and certain other organo-chlorine compounds Asbestos	Co, Sn, Ba, Cu, La, Mo, Zn, Sb, Tl, Ge, Organic F and Br compounds, Carbamates
Pollutants and agents more likely to occur in water and/or food		Nitrates, nitrites and nitrosamines Aflatoxins and other fungal toxins Waterborne viruses Li	Phytotoxins of higher plants like some alkaloids, some amino acids and polypeptides, naturally occurring goitrogens and estrogens Marine biotoxins (ciguatoxin, etc.) Growth promotants

*including compounds of elements listed

Source: World Health Organization; The WHO Environmental Health Criteria Programme, Geneva, Unpublished document EP/73.1.

for information, some countries will in addition wish to pursue programs relating to their special national requirements. A report of a WHO Scientific Group on Evaluation of Environmental Health Programs (48) presents an approach to priority setting which is based on two assumptions:

1. That the health sector can be viewed as an integrated system through which various health programs are delivered to maintain a reasonable standard of health for man in his environment.

2. That the health system can be viewed as an integral part of the whole socioeconomic system concerned with more comprehensive development goals.

If the above assumptions are accepted, then two statements follow as logical consequences, namely:

1. Environmental pollution programs can best be evaluated by comparing their contribution to the health status of man with the contributions of other health programs.

2. The contribution of the health system to the development of man can best be evaluated by comparing it with the contributions of other systems to his overall development.

It was stated that an approach to priority setting may be conceived as a two-stage evaluation process: macro-evaluation, followed by micro-evaluation. In the macro-evaluation stage the environmental pollution program is evaluated for (a) appropriateness, (b) adequacy, and (c) side effects, each of these being assessed at the three levels discussed above. If two or more of several alternative programs are judged capable of producing equivalent effects on the basis of the macro-evaluation results, each of them is subjected to micro-evaluation for effectiveness and efficiency. In assessing programs at the macro-evaluation level, relative ratings may be used. A minimum score is established below for which a program would be rejected. Then, each program being evaluated is given a rank for each of the 9 tests. The rank could be set up on a 1-10 or 100-500 basis, for example, and the total number of points (i.e., the sum of the rank assigned for each of the 9 tests) would be the final program score. Regardless of the scoring system used, macro-evaluation will depend more on expert judgement than on precise measurements, while on the micro-evaluation plane the use of actual figures may be more feasible.

A report of a WHO Expert Committee on National Health Planning in Developing Countries (44) described that in high-income countries with large stocks of trained manpower and large economic resources which can be spent on pollution services, the problem of choice is much easier to resolve than in low-income countries, where economic and manpower resources are extremely limited. Thus, it is possible for high-income countries to adjust both the total allocation to pollution sector and its distribution among the various parts in accordance with the need for pollution services, as indicated by data on morbidity and by the possibility of preventing disability and death in early life. Mortality and morbidity data and other factors may be used in many different ways in selecting priorities; on close analysis, however, these methods are often found to contain many common features. Thus, there are many similarities between the principles underlying the different formal methodologies of health planning used. It was further stated that though the means used to establish priorities are often difficult to interpret, owing to the different meanings attached to the terms used in different countries, there are, in fact, common features that underlie many systems of health planning. Many countries, consciously or unconsciously, use what may be broadly called economic principles to establish priorities. The emphasis on prevention rather than cure is one such principle. The cost of curative services for a disease can be saved if the incidence of that disease can be reduced or if it can be totally eradicated. Secondly, the common emphasis on saving the lives of younger people in whom there has been considerable social investment and who still have major contributions to make to production represents another choice. The choice of diseases that can be prevented only at high cost is a third type of decision with an underlying economic motive. The decision to provide somewhat better health services in areas or for occupations where the loss of skilled manpower or of working hours is of greater value to the economy is a fourth example.

Many countries apply criteria of this kind, although expressing them as principles of public health rather than principles of economics, whereas others have been trying to introduce them by the conscious use of formal economic tools. Although it is not always appropriate to use the same formal systems of establishing priorities for all countries or cultures, the Committee considers that the different systems need further study in order to identify the common features and the differences in emphasis. Public health administrators should learn to use more of the basic concepts and techniques of economics, but health services should not be exclusively aimed at increasing production. They contribute to other aspects of human welfare that are very real, however difficult they may be to measure.

Public or Government Policy

Environmental pollution presents a large number of problems covering every aspect of public health. The resources for solving these problems are limited in all parts of the world, particularly in developing countries. On the other hand, environmental pollution programs must compete within the national development policy with other programs, such as those for industrial development, agricultural expansion and improvement, education, and social services. It commonly happens therefore that, in a given area of environmental pollution, a limited number of programs must be selected on the basis of priority.

A report of a WHO Expert Committee on National Environmental Health Programmes: Their Planning, Organization, and Administration (45) described that often very little effort is needed to persuade politicians to recognize prevailing needs and lend their support. Decisions may be strongly influenced by inquiries addressed to the government by the elected representatives of the people or by public opinion expressed through mass media. Psychosocial tensions may also influence priority decisions. In general, environmental pollution programs such as excreta disposal are preventative in nature, the character and effects of environmental factors being subtle and long-term. Crisis or emergency situations in which immediate decisions must be taken are exceptional. It has also been noted that a drop in the value of capital assets due to poor environmental conditions sometimes results in substantial economic losses for specific population groups, and these groups are then spurred to initiate action to correct environmental defects. Priority decisions are not entirely in the hands of health workers and public administrators; related groups, including politicians, members of advisory committees, professional organizations, the press, and the general public should be kept well informed, so as to create a favorable climate for environmental pollution planning. It was stated by the Committee that representative groups, with the participation of the public, should be encouraged as much as possible to evaluate programs and to hold discussions in order to indicate priority needs.

Völgyes, in "Politics and Pollution" (65) stated that until the second half of the twentieth century man had never really begun to clean up the environment. All of the efforts to deal with pollution failed because those pursuing them had limited ways of exerting political pressure on the rulers of the time. Even today, politics is the key to implementing technical solutions to the problems posed by a constantly deteriorating environment. Politics--the relationship of man and society, government and people--is the key to the ability of controlling pollution, and regardless of the political system, it is primarily political considerations which define the possible limits on the control of the physical environment.

It was further stated by Völgyes that another significant problem with pollution relates to differences of opinion concerning national priorities. While the prosperous middle class views the problem of pollution as a primary concern, this view is not shared by the residents of the inner-cities and ghettoes of that country. To the residents of these areas, the problem of pollution is not a primary concern.

Purdom, in "Environmental Planning and Management" (38) stated that assessment of needs will likely produce a range of problems of varying intensity with each problem possibly affecting a variable number of people, some the total community, and others only segments of the population. The total result may be a list of possible actions which would exceed the assessed or presumed capability of response. This requires the assignment of priorities to order the rise of scarce resources to produce the blend of activities which will result in the greatest benefit and will most nearly meet the demands of the public. It was further stated that it must be recognized that the fixing of priorities is not necessarily a matter of rule, but involves social values--the professional values of the engineer and physician and the cultural values of the various segments of the community, including the professionals. It is difficult for the professionals to recognize their own bias, both cultural and professional, and the influence this has on their appraisals and priorities. Priorities should consider these factors: population affected, severity of results, relationship to other community concerns, benefits and costs, cultural beliefs, resources (i.e., money, manpower, equipment, facilities, etc.), state of the art of solutions (i.e., technical knowledge), legal authority or mandate, and politics. Usually the total number of persons affected is a prime consideration. Total numbers and averages can obscure very severe problems among select groups, e.g., women, children, the aged, workers, the economically or socially disadvantaged, and the affluent. Severity may be evaluated in terms of death, disease or disability. The value of life presents a curious anomaly. American society espouses a belief that human life is of great value, perhaps beyond evaluation, yet social actions are taken which indicate that it has a variable value in comparison with other factors.

Decisions involving public policy may sometimes be taken without consciously considering their full influence on life. It is the role of the professional to determine the factors which affect the quality of life and point them out to the public, their representatives and public administrators. It was also stated by Purdom in "Environmental Planning and Management," p. 548 that from the professional point of view, four levels of environmental pollution have been projected, in the order of public health importance:

1. survival - epidemics and fatal injuries controlled;
2. freedom from disease and disability;
3. efficient and productive human performance; and
4. desirable quality of life.

It should be recognized that desirable social action may have to be deferred where the state of knowledge offers no suggestions or possible solutions. It should be stressed, however, that perfect knowledge is seldom available and is not required. Great social harm can occur while awaiting for more information. In areas where solutions to problems are not conceivable, research is indicated. Availability of skilled manpower, equipment, facilities, etc., may seriously restrict the scope and intensity of activity, whereas other programs are initiated to overcome the deficiency. Cultural habits and beliefs determine the acceptability and, consequently, probably success, of projected programs. It is no solution to advocate the thorough cooking of certain foods if people generally consume the foods uncooked or partially cooked. Population in some areas has grown so rapidly that the benefits of social and economic programs to improve the quality of life have been negated. Yet, thus far, many proposals aimed at limiting conceptions and births are found unacceptable to substantial segments of the population.

The evaluation which goes into the fixing of priorities must take place in the context of the total community interest. Water pollution control facility needs are evaluated at the same time as needs for educational facilities or other worthy needs. On a different level of concern, the influence of the proposed solution on other parts of the system should be evaluated. This has not been done. There is a penchant for approaching complex urban problems on a piecemeal basis; witness the multiplicity of single-purpose public authorities established to deal with only one problem, such as sewage, solid waste, water resource development, etc.

Finally, it was stated by Purdom on p. 550 that benefit-cost analysis is a system for relating the variables in alternative solutions. Too frequently, benefit-cost analysis has resulted in a least financial cost approach. Since many social values cannot be defined in financial terms, solutions based upon this type of analysis alone are inadequate and may be socially unacceptable. A better approach is one where social goals are defined; thus the benefit-cost analysis is then used to evaluate alternative means of achieving the stated goal. This is a subject of controversy between economists and health planners. Considerations which influence priorities would not be complete without considering politics. For an elected official who must seek a vote of confidence in two years, short-range results may be most important. Those elected for 4-6 year terms may have a longer perspective. Of greater consequence, but not so readily recognized, are the political upheavals that sweep the world, such as the current phenomenon of rising expectations concerning the quality of life.

Agee, in "Priority Allocation" (1) presented priorities allocations for environmental clean-up. Among federal priorities he listed a better balanced program in the best interest of the country as a whole. He pointed out that some think the Environmental Protection Agency (EPA) has moved from a water-quality-based program to a technology-based program but suggested that re-evaluation of the legislation will show it did not direct EPA to consider water quality. Considerations somehow have gotten away from cost-benefit bases and there is a need to strike a balance. There is a need for better balance between activities of states and local groups and federal. Past action has been lopsided in favor of federal decisions. Agee's personal view is that the role of the federal government is standard setting, regulation development and turning the program over to local people to administer. EPA should be responsible for providing technical assistance, research and training. EPA has overly strived for uniformity and has not given enough attention to state and local priorities.

Technical Considerations

From the technical point of view criteria for setting priorities are well established. The third report of the WHO Expert Committee on Environmental Sanitation (45) stated:

> While the general objective of environmental sanitation as a fundamental function of the health department is to work towards a state of positive community health and well-being, specific objectives will vary with the state of development of the community. In the early stages, the basic needs of environmental sanitation must be provided, but as the community develops there should be a progressive expansion of sanitary services to provide better standards of health and improved conditions of living.
>
> The basic sanitary need of a community is the elimination of the gross causes of communicable disease, which are usually an insanitary water-supply, contamination from human excreta, and insect vectors of disease. The provision of facilities to take care of these basic needs does not however offer a complete answer to the problem. There must, in addition be a concomitant understanding of the importance of health and an effort to practise its elementary rules. In some areas, conditions such as gross overcrowding prevent improvement in health standards, and in others inadequate levels of nutrition do so. To serve this ultimate purpose sanitation must be part (albeit one of the essential parts) of a general plan of community improvement which has, as its objective, the provision of an improved standard of well-being and living conditions.
>
> As health standards are raised, the comfort, attention to convenience, and efficiency of the population become increasingly important, and will require further improvements in water-supply, more effective excreta disposal, and a consideration of such factors as refuse disposal, housing, and food and milk control.[1]

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[1]Wld Hlth Org. techn. Rep. Ser., 1954, No. 77, p. 9.

These statements are still important today, and the Committee considers them a valid background to the establishment of criteria for environmental health programs, including the water pollution control programs in many parts of the world. It must be understood that there is no universally applicable rule for establishing priorities and making decisions. Choices are based on various facts and considerations and may vary from country to country according to local conditions. In general, the setting of priorities may be based on a series of assessments common to any priority-decision process. These include:

1. What are the benefits of the program?

2. Is it reasonable from the economic viewpoint?

3. How does it fit in with the country's prevailing needs?

4. How much political support is it likely to receive?

It was further stated that from the technical point of view the performance and theoretical benefits of a program may be emphasized, but from the standpoint of public executives, who are in a position to make financial decisions, the economic aspects, such as financial feasibility, repayment possibilities, and the most effective and efficient use of the available funds, deserve more attention.

Crews, (10) described how to establish priorities in mine drainage reduction using the cost-effectiveness approach on twenty-seven watersheds in the Susquehanna River Basin which are severely degraded by acid mine drainage pollution. As a result of the acid discharges, many uses of the streams, such as water supply and recreation, are precluded. In the past, acid mine drainage abatement programs did not look beyond the immediate problem area. No considerations were given to the blending effect of natural alkalinity in other streams. Since the abatement of acid mine drainage pollution is extremely costly, a method of minimizing these cost was needed. Abatement on some of these watersheds will ccst more than others, but because of their location, pollution from a few is relatively more important. It become clear that a priority schedule needed to be established to create a systematic, cost-effective approach. The first step in establishing this system was a preliminary estimate of the costs associated with abating the acid mine drainage in each watershed. Abatement measures included in this study ranged from lime neutralization below the acid discharges to source correction by backfilling strip mines and installing deep mine seals. An abatement plan could have been set up to tackle the least costly first. Such a system would have some definite advantages:

1. Initially, some progress could be shown for relatively little expenditure; and

2. if the decision-making bodies wanted to stop or change the nature of the abatement program, they could easily do so after the first few watersheds were completed.

It was further stated that in establishing a priority system costs should be considered as well as the resulting increased stream usage. Once a methodical priority system has been established on relative merit, the macro systems analysis has served its purpose. The next step is to apply a systematic approach to each watershed unit in order to achieve, for the least cost, the usefulness desired for definite downstream reaches. To achieve this at minimum cost, the natural alkalinity within any given watershed must be put to use; or simply stated, abatement measures must be designed to complement the natural blending tendencies of the waterways.

Calabrese, in "Pollutants and High-Risk Group" (8) stated that every organization, including both federal and state environmental regulatory agencies, has budgetary limits and, therefore, must develop priority lists for prospective projects. Each region of the country has its own particular problems due to its unique geographical setting, the type of industry, or for other reasons. However, despite the uniqueness of each region, there are some general considerations of high-risk populations which should be applied to the development of a pollutant ranking system in any region:

1. Identification of the actual pollutant level and the general toxicological properties of the pollutant. This includes a recognition of the pollutant levels that produce toxic responses in both the general public and the specific hypersusceptible segments of the population.

2. Characterization of the population with regard to age structure, sex ratios, racial background, and generalized health status (e.g., disease prevalence). This information is needed to determine the identification and quantification of high-risk groups. With such information, it is possible to determine the number of individuals who live in areas that have relatively high levels of pollutants to which they would be at high risk.

3. Consideration of the severity of the disease in priority determinations. Higher priorities should be given to preventing diseases of an irreversible nature.

Priority Models

Criteria adopted by developed countries for assigning priorities as well as a priority model developed by individuals, namely the priority model adopted by England (61, 62, 67), U.S.A. (32), the Darby model (13), the Reid and Discenza model (41), and the Soetiman model (60), will be presented in the following section.

England Priority Rating Model

England is divided into 9 Water Authorities which are responsible for three main services (61, 62, 67), namely:

1. Sewerage, defined as the transportation of sewage from premises to a point of treatment;

2. Sewage treatment, the treatment of sewage being carried out at sewage treatment works, and

3. Water supply.

Each method of priority ratings of each Authority is different from the other. The priority rating system from three water authorities, i.e., Wessex Water Authority, South West Water Authority, and Southern Water Authority, will be presented in this section.

The system of priority assessment used by Wessex Water Authority (67) is based on the ranking in priority order of 14 purposes intended to cover all the possible ends to which water authority schemes can be directed. Schemes are assigned a purpose and this determines priority. The 14 classifications of capital expenditures by purpose are as follows:

	Doe Purpose	Priority-Weighting Factor (points out of ten)
1.	To maintain or replace the existing system (at present levels of service and environmental standards).	9
2.	To meet growth in demand by existing consumers (at present levels of service and environmental standards).	8
3.	To improve present levels of service to the consumer	8
4.	To meet anticipated housing development (including infilling).	9
5.	To meet anticipated commercial and industrial development.	9
6.	To meet public health requirements (including health and safety of employees).	10

7.	To improve the present quality of potable water supply rivers	7
8.	To improve the present quality of other non-tidal rivers	4
9.	To improve the present quality of estuarial waters and beaches.	2
10.	To improve the present quality of coastal waters and beaches.	4
11.	To increase operating efficiency (through cost savings).	9
12.	To provide first-time services to existing properties.	8 water supply 4 sewerage
13.	To improve recreational facilities and amenities.	3
14.	To achieve other purposes (if any).	1

Furthermore, each item of the classification is broken down into several categories, and each category is assigned by certain scoring points. The final points scored under each of the purpose headings are transferred from the detailed part of the form to the head of the form, where they are multiplied by the percentage cost allocated to that purpose and by the weighting factor given to the purpose. After multiplication, the points scored under each purpose are summed. For further explanation, Appendix B presents the priority rating sheets for sewage treatment, including the explanatory notes.

The South West Water Authority (61) used a simpler method than did Wessex Water Authority in the priority rating system. The South West Water Authority used seven parameters, i.e., Benefit of Scheme, Area To Be Served, Scale of Development, Urgency of Implementation, Meeting Statutory Obligations, Financial Implications, and Optimization of Resources. Further, each parameter is broken down into subparameters and the points are assigned to each subparameter. More detailed information on the points rating system is presented in Appendix C.

The Southern Water Authority (SWA) priority assessment (62) applies only to schemes not already released by the current and previous capital programs. Priority assessments in the SWA are concerned with problems rather than solutions and it is this distinction which is significant in the case of those larger schemes which are subject to project appraisal. Priority assessment defines and evaluates a problem, and the assessment will not change subsequently, unless the problem changes or there is a significant change in estimated cost. Project appraisal will then be able to concentrate on the possible solutions to the problem. Figure 6 is a diagram showing procedures for priority assessment.

The first step, to observe the constraints within which water authorities operate, is to make a preliminary classification into three groups:

1. Statutory or contractual obligations.

2. Necessary schemes (where an actual or potential substandard situation exists).

3. Optional schemes.

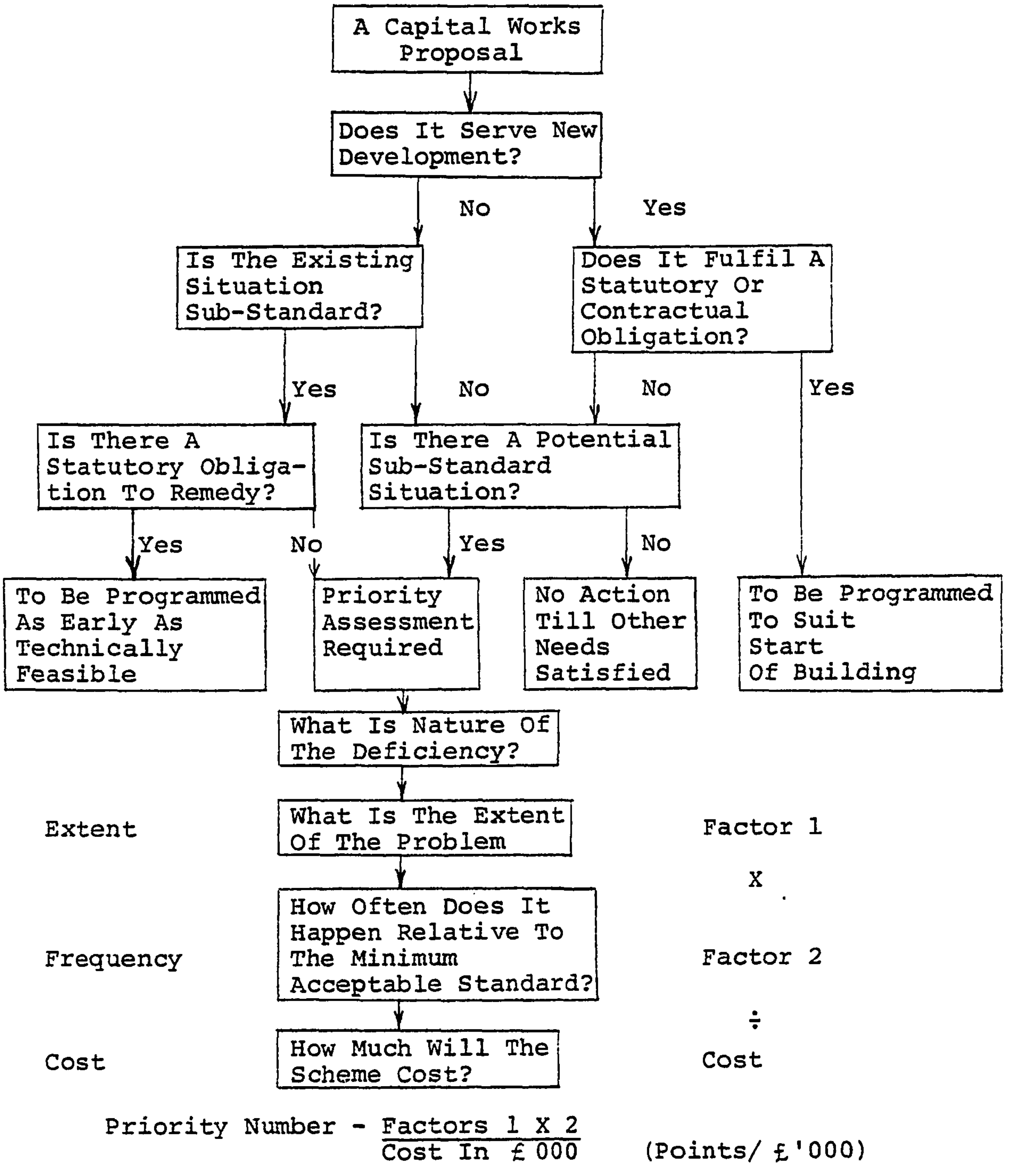

Figure 6 Diagram Showing Procedure for Priority Assessment

Source: Southern Water Authority, Priority Assessment for Capital Works User Manual, England, April 1979.

It is assumed that the first group must proceed in any event, and that the available money will run out before the third group is reached. Attention is therefore concentrated on the second group. The situation which gives rise to the scheme is then examined. According to the nature of the deficiency, weighting factors are assigned for the extent of the problem and the frequency of occurrence. For schemes to serve new development the same procedure is applied but to potential rather than actual situations. The two factors derived from extent and frequency are then multiplied together to give points. If a situation infringes more than one standard, the deficiencies are assessed separately up to this stage and then summed. The points total is then divided by the cost of the alleviating scheme in £'000 to give the priority number which can be regarded as a benefit/cost ratio in which the benefits are expressed as points rather than £ (62). The use of the cost of the scheme as a divisor is an essential feature of the method, tending to maximize the benefits to SWA consumers relative to the scarce resource, capital expenditure. However, if it is not to encourage schemes which are cheap to build but may be expensive to run, or to reject those whose major benefit is revenue savings, the assessment method must also incorporate allowance for future revenue effects. This is done by defining cost as being net present cost, including both capital cost and discounted net running costs. The standards for service, factor for extent, frequency, dividing factor for cost and special considerations such as new development are presented in Appendix D.

U.S.A. Priority Rating Model

Recent environmental legislation at both federal and state levels has provided strict controls to protect the integrity and quality of the nation's watercourses. Specifically relating to water quality, the Federal Water Pollution Control Act Amendments of 1972 (PL92-500) establish the national goal of zero discharge of pollutants by 1985. The Act further establishes an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife, as well as the protection of water-based recreation; these interim goals are to achieved by July 1, 1983 (13).

Environmental Protection Agency (EPA) regulations, 40 CFR 35.915, require that each state develop a statewide project priority listing to determine the funding priority for municipal wastewater facility construction grant projects (32). This is especially important when there are more projects than available grant money. The listing must consider:

1. the severity of pollution problems,
2. the population affected,
3. the need for preservation of high quality waters,
4. national priorities, if any,
5. total funds available, and
6. project and treatment works sequence.

Although there are differences in the method, formula, model or priority rating system in every state, all models of the state are designed to address the above list of considerations. Two models, i.e., Oklahoma State and Connecticut State priority rating systems, will be described below:

The State of Oklahoma priority rating system (32) used the formula:

$$P = \frac{S(Pa)}{T} + U + Q + H, \text{ where,}$$

P = project priority number

S = segment ranking factor

Pa = population factor

T = project type factor

U = water use factor

Q = effluent quality factor

H = health hazards factor

Each of these factors is described in Appendix E. A simpler model is used by Connecticut's Construction Grant Priority List (9). This model establishes priority numbers based on a number of water-quality-ralated criteria which results in each project being ranked in terms of its importance to water quality on the grant priority list. Based on this system, those projects with greater importance to water quality would receive federal and state grants prior to those projects with lesser overall importance. Points will be assigned to each proposed project based on the criteria listed below. After totalling each criteria a project may receive a maximum of 80 points. A point score derivation list indicating how the priority number for each project was derived follows this section.

		Points	
1.	Severity of pollution problem.	20	
2.	Population affected by the project.	15	
3.	Need for preservation of high quality waters.	10	
4.	Projects needed to meet enforceable provisions.[1]		15
5.	Projects desirable in terms of water quality improvement.[1]	15	10
6.	Projects which are not discharges (desirable to prevent future problems).[1]		5
7.	Benefits to downstream users of receiving streams: public health and health of aquatic ecosystems, recreation, industry, agriculture.	10	
8.	General water quality improvement expected due to project.	10	

Darby Model

Darby presented a methodology which can be implemented by water resources regulatory authorities to establish local water quality management priorities (13). The model utilizes an approach to management which does not require extensive field

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[1]Mutually exclusive criteria. Projects receiving less than 15 points from this section would be automatically adjusted to 15 points when a project receives a state order to abate pollution. Such a modification will be made during the life of construction grant priority lists without public notice or hearing.

sampling and investigation, but rather makes use of readily available data. Indirect indicators of watershed characteristics and land use planning are used to predict overall water quality conditions of the watersheds. This methodology is currently used by the Allegheny County Health Department to establish implementation priorities for the small urban streams in the region.

In mathematical terms, the model is as follows:

$$I_{ij} = \frac{100\ X_{ij}}{A_j \sum_{k=1}^{61} X_{ik}} \qquad i = 1, 2, \ldots, 21 \quad j = 1, 2, \ldots, 61$$

where:

I_{ij} = watershed activity indicator value for variable i in watershed j, in percent per square mile.

A_j = area of watershed j, in square miles.

X_{ij} = raw data values for variable i measured for watershed j.

A group of twenty-one indirect indicators of watershed activity were chosen to represent the factors thought to be responsible for the generally degraded conditions of the sixty-one county watersheds. The twenty-one indicators are listed in Table 8. The discriminant functions were used to classify all sixty-one watersheds into four perceived quality groups, and to identify those watersheds which are not

Table 8. WATERSHED ACTIVITY INDICATORS

Watershed activity		Indicator
I. Municipal Waste Disposal	1.	Number of sewage treatment plants.
	2.	Fraction of existing sewage treatment plant capacity presently utilized.[a]
	3.	Biochemical oxygen demand discharged daily in the effluent of sewage treatment plant.
	4.	Number of combined sewer overflows.
	5.	Number of unsewered residences.
	6.	Number of direct discharges of domestic sewage.
II. Solid Waste Disposal	7.	Number of solid waste disposal sites.
	8.	Number of mine dumps.
III. Urbanization	9.	Population.
	10.	Fraction of usable land presently developed.[a]
	11.	Number of road-stream crossings.
IV. Acid Mine Drainage	12.	Number of strip mines.
	13.	Number of deep mines.
	14.	Number of mine workers.
	15.	Length of stream adjacent derelict land.
V. Industrial Waste Disposal	16.	Number of industrial waste treatment plants.
	17.	Number of direct discharges of industrila waste.
	18.	Length of stream adjacent industrial land.
VI. Siltation	19.	Area of vacant usable land.
	20.	Area of land with slope greater than 25 percent.
VII. Stream Potential	21.	Assimilative capacity.

[a]Dimensionless fraction, not expressed as per cent per square mile.

Source: Darby, W. P., et al. "Establishing Local Water Quality Management Priorities," Journal of Environmental Systems, Vol. 7(3), 1977-78, p. 268.

characterized well by the discriminant functions. As such, they represent a choice of watersheds for special studies and field sampling and which should receive an in-depth study to characterize water quality conditions.

Reid and Discenza Model

This model was intended to select the compatible water and wastewater treatment processes (41). However, this model is flexible; it also can be used with a slight modification in raw data inputs and data processing, for assigning priority for rural/urban water supply and wastewater disposal programs because a priority assignment is nothing more than selecting project localities. Particularly for technological alternatives, one of the criteria that will be used in this study is similar to compatible water and wastewater treatment processes as a final output of this model. The model illustrated in Figure 7 has the ability to bring together a number of critical inputs relating to the effective installation and use of various water and wastewater treatment methods, processes, and combinations of processes. The output of the model is a list of the plausible alternatives for water and/or wastewater treatment in developing country communities. This output allows planners or projects engineers to look at all the plausible processes and their related costs, plus the operation, maintenance, and manpower requirements associated with each of the various processes. This technique will

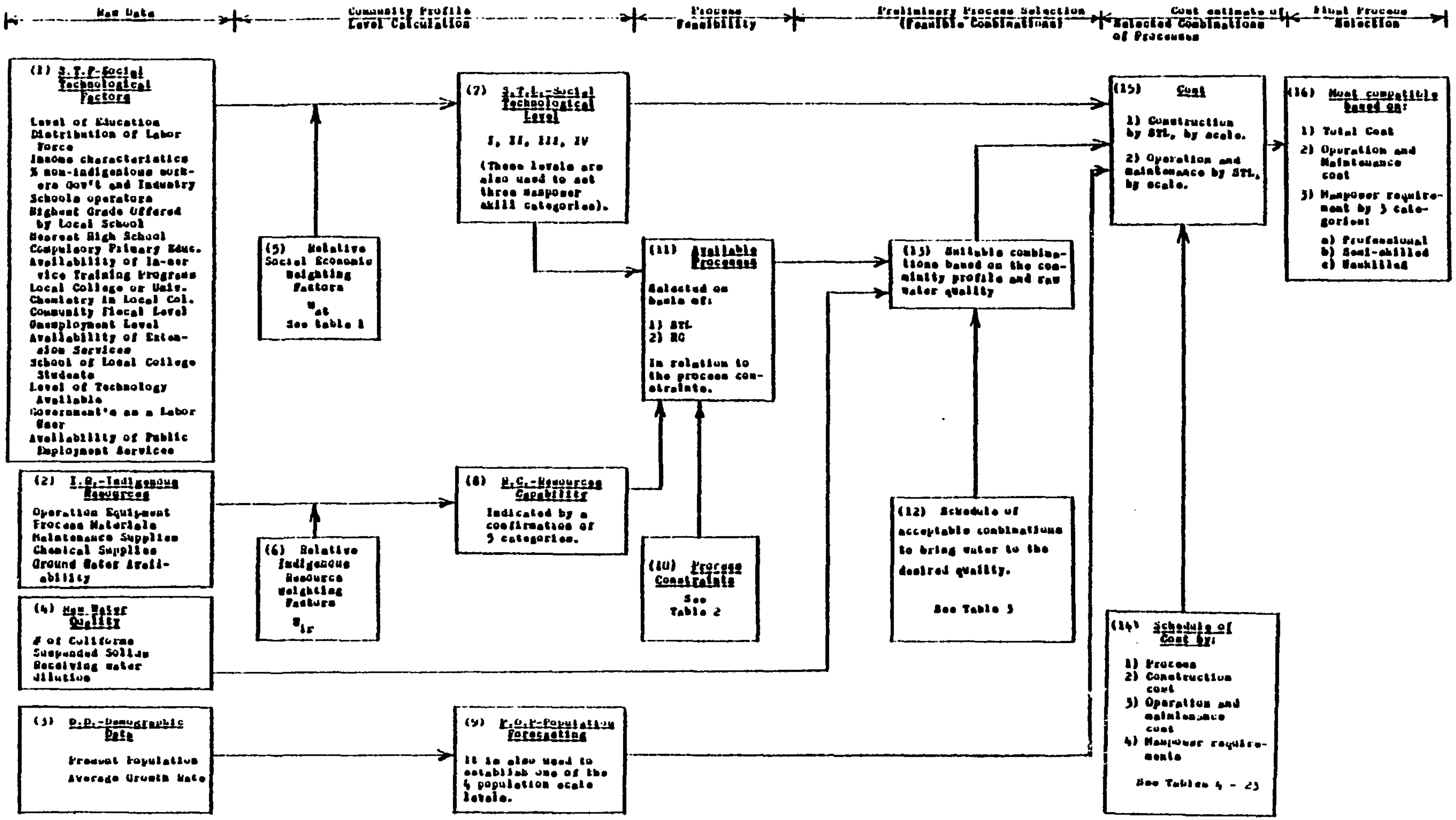

Figure 7 THE COMPLETE INFORMATION FLOW OF WATER AND WASTEWATER TREATMENT PROCESSES SELECTION MODEL
Source: Reid and Discenza, _Prediction Methodology for Suitable Water and Wastewater Treatment Processes_, The University of Oklahoma, the Office of Research Administration, 1975, p. 6.

eliminate the problem of overlooking good processes for water and wastewater treatment. The key elements of this approach are (41):

1. The systematic evaluation of the importance and interrelationships of all relevant aspects of the problem, such as technical, economic, social, political, and cultural factors.

2. The assessment of alternative courses of action.

3. An analysis of in-country costs as the basis on which policies can be determined and decisions made.

The model illustrated in Figure 7 uses 18 inputs that describe socioeconomic conditions, 31 inputs that describe the indigenous resources, two inputs that describe the demographic profile, and three inputs that describe the raw water quality. This constitutes the raw data. The methodology uses the stepwise approach, block-by-block process, consisting of 16 steps. However, in this study this methodology will be cited only for the description of the raw data which is relevant to the data used to assign a priority for the Indonesian Urban Excreta and/or Wastewater Disposal Program.

The first group of raw data inputs is concerned with sociocultural and socioeconomic factors that are essential parts of any community or group of people. The variables were selected on the basis of their availability at the local level and how they reflect the level of development at the community level. Eighteen socioeconomic and sociocultural variables are used; their characteristics are briefly described in Appendix F.

The second group of raw data inputs is concerned with the indigenous resources available within the community. Data about the local resources and the present technology available for a community is based on the variables shown below. The list is made up of chemical supplies and mechanical materials needed for the operation of a wide variety of water and waste-water treatment systems. The availability of these items is matched, within the model, against the requirements of the various processes. Those processes which require materials or resources not locally available are eliminated from the plausible treatment alternatives suggested by the model. The data input variables related to these local resources and materials also is presented in Appendix F.

The third group of raw data used as input into the model consists of demographic inputs. These inputs to the model are designed to be those most readily available. These inputs include: present population, and annual population growth rate.

The fourth and final group of inputs consists of the results on tests performed on the raw water. This group contains three different measurements.

1. The number of the coliform groups of bacteria as an indicator of pollution in terms of parts per million (ppm).

2. The degree of suspended solids in the water in terms of ppm.

3. The receiving water dilutions as specified by the Biochemical Oxygen Demand (BOD - 5 day, 20°C) content of the wastewater or sewage.

Further on Reid and Discenza (41) in Prediction Methodology for Suitable Water and Wastewater Treatment Processes stated that the model has been successfully tested in the community of Nakuru, which is located in the Rife Valley Region of Kenya, one of the developing countries for which this model was developed in 1975.

Soetiman Model

This model was intended to establish priorities among Indonesian rural water supply programs, which means to develop criteria for selecting which among the proposed projects should be executed first (60). Existing priority models were deemed unsuitable for application in Indonesia at the present time because of the particular program strategies and conditions prevailing, and also because of the lack of well-trained personnel, especially at the levels where the selection of the project localities is made. The model developed in this study is very simple and unique, as illustrated in Figure 8. In mathematical terms this is expressed as follows:

$$PI_j = \sum_{i=1}^{10} W_i . S_{ij} .$$

where PI = Priority Index

W = Weight of each parameter

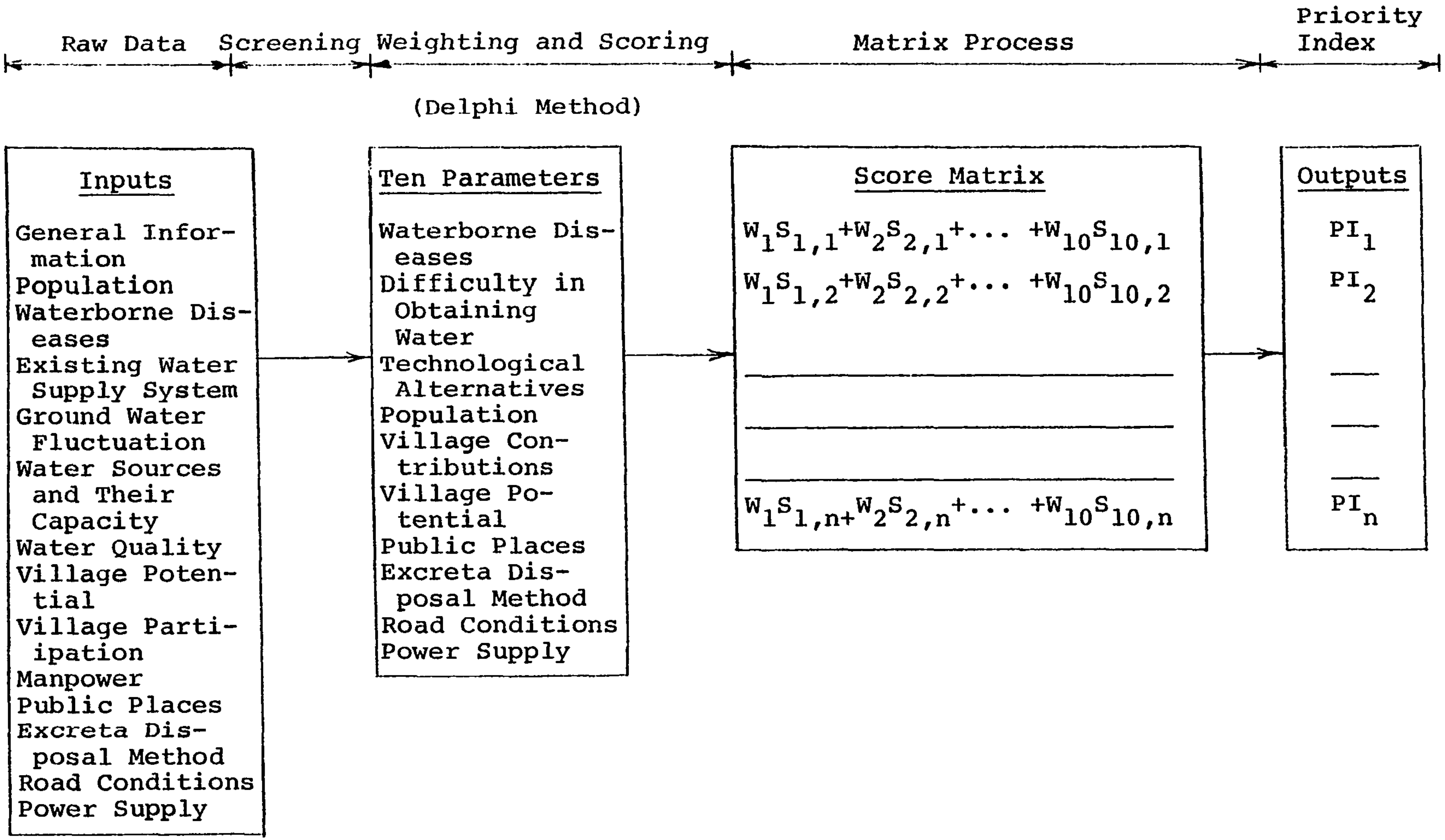

Figure 8. A FLOW DIAGRAM OF PRIORITY SETTING MODEL FOR THE INDONESIAN RURAL WATER SUPPLY PROGRAM

Source: Soetiman, A Priority Setting for Rural Water Supply Program in Indonesia, Unpublished Ph.D. dissertation, University of Oklahoma, Norman, 1977.

S = Score of each parameter in each village.

i = A subscript denoting the i-th parameter.

j = A subscript denoting the j-th village.

The villages represent matrix rows and the parameters represent matrix columns. The entries consist of the product of weight times score of each parameter, that is $W_i . S_{ij}$.

The parameters consist of the following ten elements: waterborne diseases, difficulty in obtaining water, technological alternatives, population, village contribution, village potential, public places, excreta disposal, road conditions, and power supply. The Delphi method is applied in this study to determine the weight of each of the ten parameters, based on their relevance and importance in relation to the water supply program. The average weight for each parameter is then calculated. The highest weight is 16.1 for village contributions. Three other parameters--waterborne diseases, difficulty in obtaining water, and technological alternatives--received high weights, 14.9, 14.4, and 13.9, respectively. Population received only 11.5, just slightly above the mean value of 10, and occupied the fifth rank. Village potential received 9.0, below the mean value, and occupied the sixth rank, and public places received 6.9 and occupied the seventh rank. The three parameters which received the lowest weights were excreta disposals, power supply and road conditions receiving 5.4, 4.4, and 3.5 respectively.

The scoring process consisted of the categorization of the data and score assignment of each category. Efforts were made in categorization to quantify as many of the parameters as possible in order to facilitate application to the model.

To test the model, the data were obtained from the Indonesian government and were processed to demonstrate the utilization of the model. This will provide guidelines for the planners who are involved in the Indonesian Rural Water Supply Program at the regency level by giving them an example of practical use.

The data available then will be categorized and scored for each parameter. The PI value is then calculated. The higher the PI value the higher the priority of the village to receive the safe water system first.

CHAPTER III

METHODOLOGY

Introduction

A brief discussion of the several priority models presented in the previous chapter will be described in this section.

The priority models used by England Water Authorities is intended for the sewerage scheme and no possibility for excreta disposal. The classification, as well as the breaking down of categorization deals with existing sewage treatment and sewerage, and usually the project localities, is intended for intensification and/or extensification. This model is not suitable for Indonesian conditions, since, at present, only four cities have sewerage and none of them have any sewage treatment. Also, the beneficial uses of river water, estuarial water and beaches have not been defined, certainly not at the present time, in Indonesia, so that the quantification of variables will not be available in Indonesia.

The Oklahoma State Priority Rating is also not suitable for Indonesian conditions at the present time because the Oklahoma priority rating model uses the segment ranking factor for every stream in the state. Indonesia has not yet developed such a factor. As in the case of England priority models the

Oklahoma priority model is also used beneficially for the receiving stream which has not yet been well-defined by the Indonesian government.

A much simpler model has been used by the state of Connecticut, i.e., by adding points for every criterion. There is no basic formula to determine ranking variables; however, it does not indicate how the point of each criterion is implemented, which requires practical experience and to some extent personal judgment.

The Darby model is applied to establish implementation priorities for small urban streams in a region. This model requires that personnel involved have a background in mathematical statistics and engineering. Since this model can apply only to a small and specific region, whereas the characteristics of a region vary from one place to another, this model is not suitable to Indonesian conditions as a whole, since the Indonesian urban excreta/wastewater disposal program is carried out nationally by the central government.

The Reid and Discenza model was originally intended to select a suitable combination of water and/or wastewater treatment processes; however, with some modification it can also be used to select the project localities of the urban excreta/wastewater disposal program, since a priority setting is nothing more than the selection of project localities. This model is presently suitable for planning of urban water and/or wastewater treatment processes in Indonesia because the raw data required for this model are also applicable to the urban areas in Indonesia; if not, similar data may be substituted.

The Soetiman model was intended to develop a priority setting for the Indonesian Rural Water Supply Program, suitable to its strategy and also suitable to Indonesian rural conditions and characteristics, and the qualifications of the personnel at the Regency Offices who are to use the model. This model has been tested successfully in selecting priorities among 89 villages, and leads to the conclusion that the priority model developed in Soetiman's study is suitable to the present need for the Indonesian Rural Water Supply Program in selecting project localities.

Model Development

Although the Soetiman priority model is intended to select project localities among Indonesian Rural Water Supply programs, however, by modification in parameters, the mathematical terms can also be applied to the urban excreta/wastewater disposal program, using the process of utilization of the Reid and Discenza model. The parameter used to develop project localities for the urban excreta/wastewater disposal program consists of five parameters, namely, health hazards (HH), population density (PD), city potential (CP), water supply conditions (WSC), and technological alternatives (TA); hence the mathematical terms will be as follows:

$$PI_j = \sum_{i=1}^{5} W_i \cdot S_{ij}$$

where: PI = Priority Index.

W = Weight of each parameter.

S = Score of each parameter in each city.

i = A subscript denoting the i-th parameter.

j = A subscript denoting the j-th city.

The proposed five parameters are based on the strategy of the Indonesian Urban Excreta/Wastewater Disposal Program, its relevance to the program, its suitability to the Indonesian urban conditions and characteristics, and its feasibility in applying them to the data available.

Based on the above criteria the priority setting model for the Indonesian urban excreta and/or wastewater disposal program is developed as illustrated in Figure 9. Originally, the model was a modification of the Soetiman Model (60) and Reid and Discenza Model (41). The inputs of the priority setting model, which are designed to be collected at the local level, consist of excreted infectious diseases, demographic information, data related to existing land use, local resources, including manpower availability, inputs relating to the present water supplies, and inputs relating to the choice of appropriate technology, such as topography, hydrology, river characteristics, sociocultural characteristics, etc. The model next selected a parameter to be considered. The weighting of the five parameters was assigned by the experts committee. Each parameter was then broken down into several categories. The score of each category was also assigned by the experts committee. The

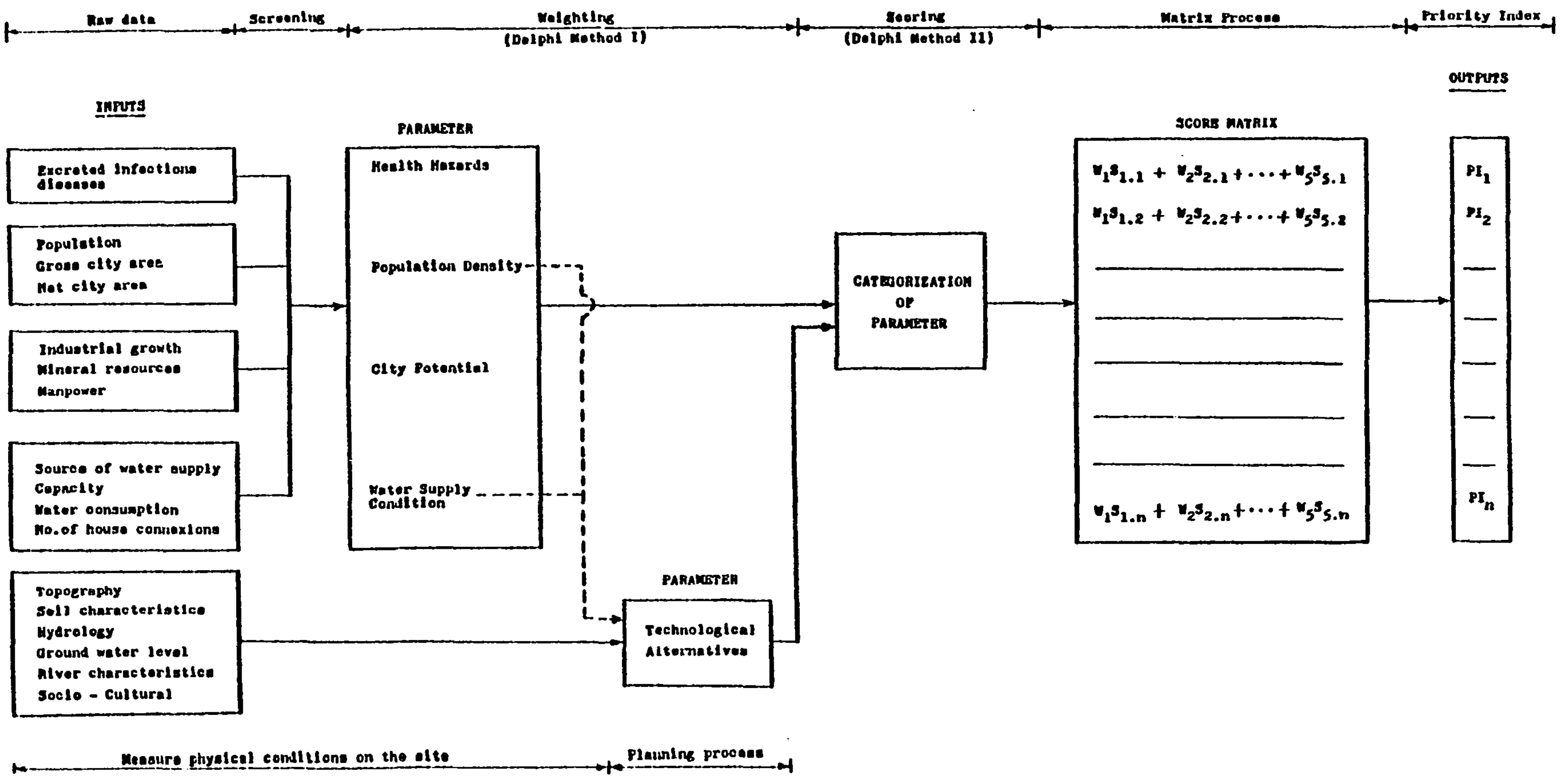

Figure 9 A Flow Diagram of Priority Setting Model for the Indonesian Urban Excreta and/or Wastewater Disposal Program

next step is the priority computation, using the matrix process of the linear combination of variables to determine ranked priorities. The output of the model is a list of priority index values of every city being considered for project localities. The higher the priority index value the higher the priority of the city to receive the facility of excreta and/or wastewater disposal system.

The difference between the Urban Excreta/Wastewater Priority Setting Model and the Soetiman Model for Rural Water Supply Program is that in the first both weighting of parameter as well as scoring categorization of each parameter is evaluated by expert opinion, whereas, in the Soetiman Model only weighting of parameter is evaluated by expert opinion.

A discussion of the relevance of each parameter to the above-mentioned criteria is as follows.

Health Hazards

Neglect of sanitation would definitely imply poorer health and higher risk of the contraction of infectious diseases. Poor or nonexistent excreta/wastewater disposal systems can affect adversely and even catastrophically every beneficial use of water and create nuisances or hazards to public health, which constitutes one of the principal sources of morbidity and mortality in this country. Two main categories of water-associated health hazards are:

a. Hazards from biological agents that may affect man following ingestion of water or other forms of water contact. The principal biological agents transmitted in this way can be grouped into the following categories: viruses, pathogenic bacteria, protozoa, and helminths. The associated organisms and diseases due to excreted infections of this group are presented in Table 9 as presented by the World Bank paper in Appropriate Sanitation Alternatives: A Technical and Economic Appraisal (70). The higher the water pollution the higher the incidence of these diseases. Low income and high prevalence of disease are strongly and positively correlated, both within advanced nations and among lesser-developed parts of the world. In many areas the incidence of a single disease, such as schistosomiasis, dysentery, or typhoid fever has been thought to have profound effects on economic and social life. Cholera, typhoid fever, and dysentery have been known to be associated with polluted water, in which the causative organisms are transported and survive until they enter, directly or indirectly, the human host. Mortality rates for these diseases are relatively high and are endemic in the whole of Indonesia, especially when direct use of surface waters for drinking purposes is still common in this country.

b. Hazards from chemical pollutants, usually resulting from discharges of industrial wastes. Untreated or partially-treated industrial wastewater will frequently cause pollution when discharged to surface waters and this might well have health consequences if the water is subsequently used for public supply (36). However, even if the resource is not used for water supply, there may be secondary impacts on public health.

Table 9 EXCRETED INFECTIONS

Biological group	Organism	Disease	Reservoir
VIRUSES	Polio virus	Poliomyelitis	Man
	ECHO virus	Various	Man
	Cocksackie virus	Various	Man
	Hepatitus A virus	Infectious hepatitis	Man
	Rotavirus	Gastroenteritis in children	?
BACTERIA	Salmonella typhi	Typhoid fever	Man
	S. paratyphi	Paratyphoid fever	Man
	Other salmonellae	Food poisoning	Man & animals
	Shigella spp.	Bacillary dysentery	Man
	Vibrio cholerae	Cholera	Man
	Other vibrios	Diarrhoea	Man
	Pathogenic E. coli	Gastroenteritis	Man
	Yersinia spp.	Yersinosis	Animals & Man
	Campylobacter spp.	Diarrhoea in children	Animals & Man
PROTOZOA	Entamoebic histolytica	Amoebic dysentery and liver abscess	Man
	Giardia lamblia	Diarrhoea and malabsorption	Man
	Balantidium coli	Mild diarrhoea	Man & Animals
HELMINTHS	Ascarislumbricoides	Ascariasis	Man-soil-man
	Clonorchis sinensis	Clonorchiasis	Animal or man snail-fish-man
	Opisthordies felineus	Opisthorchiasis	Animal-snail-fish-man
	O. viverrini	"	"
	Diphyllobothrium latum	Diphyllobothriasis	Animal or man-copepod-fish-man
	Enterobius vermicularis	Enterobiasis	man-man
	Fasciola hepatica	Fascioliasis	Sheep-snail-aquatic-vegetation-man
	Fasciolopsis buski	Fasciolopsiasis	Pig or man-snail-aquatic vegetation-man

Table 9 continued

Biological group	Organism	Disease	Reservoir
	Gastrodiscoides hominis	Gastrodiscoidiasis	Pig-snail-aquatic vegetation-man
	Heaterophyes	Heterophyiasis	Dog or cat-snail-fish-man
	Ancylostoma duodenale	Hookworm	Man-soil-man
	Hecator americanus	"	"
	Hymenolepis spp.	Hymenolepiasis	Man or rodent-man
	Metagonimus yokogawai	Metagonimiasis	Dog or cat-snail-crayfish-man
	Paragonimus westermani	Paragonimiasis	Animal or man-snail-crayfish-man
	Schistosoma haema-tobium	Schistosomiasis	Man-snail-man
	S. Mansoni	"	"
	S. Japonicusn	"	Animal or man-snail-man
	Strongyloides stercoralis	Strongyloidiasis	Man or dog (?)-man
	Taenia sagimata	Taeniasis	Man-cow-man
	Taenia solium	"	Man-pig-man or man-man
	Trichuristrichiura	Trichuriasis	Man-soil-man

Source: The World Bank, Appropriate Sanitation Alternatives; A Technical and Economic Appraisal, Final Draft, Vol. 1, 1978, p. 50.

Where a receiving water has previously been used for recreation (say, bathing), the loss of such an amenity through pollution might cause psychological problems for a low-income population having few relaxing pastimes in a hot climate; or other medical problems will arise if the recreational use is continued. Another possibility is that the ecological impact of waste discharges is such that an important food source, such as fish or shellfish, is affected and the nutrition of the population suffers. This may be through elimination of the organism itself or due to contamination of the organism by concentration of pollutants in passage through the food chain.

These indirect health damages are difficult to quantify and assign cause but they are nevertheless important. The most obvious health risk from industrial effluent discharges to surface waters, however, is when they are used for potable supply. In developing countries, surface waters are regularly used untreated, or after only household storage to settle out large particles. The danger of industrial pollution is more serious than in developed countries where piped supplies are widespread. Contamination of the water with bacteria, virus or parasites will generally be less important than in the case of domestic waste discharges, except when animal-processing industrial wastewaters are discharged without treatment. Water pollution due to biodegradable organic matter will result in dissolved oxygen depletion and render the water unsuitable for normal household use. However, of much greater health concern is the presence of toxic materials, such as heavy metals or known poisons in industrial effluents. Modern industry uses and produces a wide range of dangerous chemicals, many of them synthetic and persistent (non-biodegradable), which might well be present in waste discharges even in very low concentrations. Although some of these may have clinical or sub-clinical effects, others might have chronic effects which are difficult to ascertain by using current toxicological evaluation techniques (36). Only rarely in the case of industrial effluent discharges, and then usually after accidental spillage, will large concentrations of dangerous materials be present. However, in this country, such chemical risks are on a small scale compared with the hazards from microbial pollution of water, except for a few metropolitan areas where heavy industrial estates grow rapidly, such as in the capital city of Jakarta and other metropolitan areas, i.e., Bandung, Surabaya, Medan, and Ujung Pandang. Since these cities are considered metropolitan areas, the government decided to prioritize them in providing all facilities, including the excreta/wastewater disposal program. Therefore, hazards from industrial chemical pollutants will not be covered in this study.

Another chemical pollutant results from agricultural runoff which carries fertilizers and crop protection chemicals into surface waters, as reported by Soesanto (59) and that DDT is still used today because of its effectiveness and comparatively low cost. In 1974, about 1,400 tons of DDT (75%) were used for malaria control. Other insecticides which are used are Dieldrin, Arcotine, Pyrethrin, and Malathion. A considerable part of the fertilizers used for paddy fields will be washed away by irrigation water; they flow into rivers, estuaries or other bodies of water. A major problem with trace levels of potentially dangerous materials in agricultural runoff and in industrial effluents has been their analysis. Although instrumental techniques have been refined in recent years, this expertise has yet to be transferred to most developing countries. Consequently, it will be difficult to monitor effluents for complex chemicals until the analytical capability of controlling authorities has been improved.

Therefore, since this dissertation is limited to the human excreta/wastewater disposal program, both hazards from industrial waste discharges and agricultural runoff will not be covered in this study.

Population Density

This parameter is associated with the economy of the project, which means that the larger the population density to be served, the lower the per capita cost. Hansen, et al. (25), outline an analysis of four excreta removal systems from a technical, financial and economic point of view in order to discuss how different engineering approaches and different levels of customer service reflect on the financial requirements as well as on the economic costs and social benefits to society.

The cost of implementing four sanitation systems was computed for a number of presumed population densities.

Four excreta removal schemes are introduced below in order to prepare for the subsequent evaluation of urban sanitation.

FSW - Full sewerage and water supply. Plumbing is provided to each dwelling, because the sewers would not function without adequate flow.

AP - Aqua privies with piped liquid disposal. Sewers may be installed with less slope and smaller diameters than for FSW; consequently, the construction requires less excavation.

VT - House vault and vacuum truck. In this scheme only excreta are removed from the plot. A vacuum truck empties the vault.

CB - House pail and community block.

The four proposed sanitation schemes are different in their technical functions and levels of service to the user. A provisional ranking in terms of user convenience would indicate the order already used, i.e., FSW - AP - VT - CB.

The result of this analysis is depicted in Figure 10 which indicates the variation in total present value of the four alternative systems for the range 0-15 percent of the interest rates and planning horizons of 30 and 60 years. It can be seen that the ranking of the vacuum truck VT system versus the sewered aqua privy scheme AP appears to reverse,

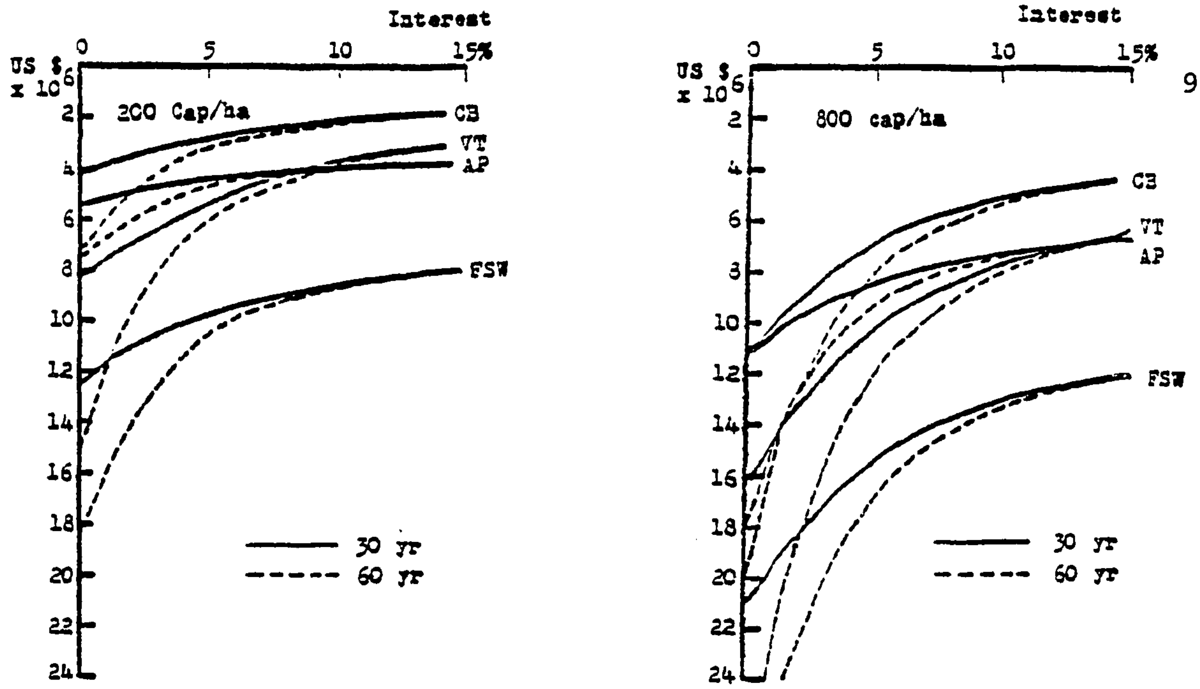

Figure 10 PRESENT VALUES FOR DIFFERENT POPULATION DENSITIES, SYSTEMS, PROJECT LIFETIME, AND INTEREST RATES

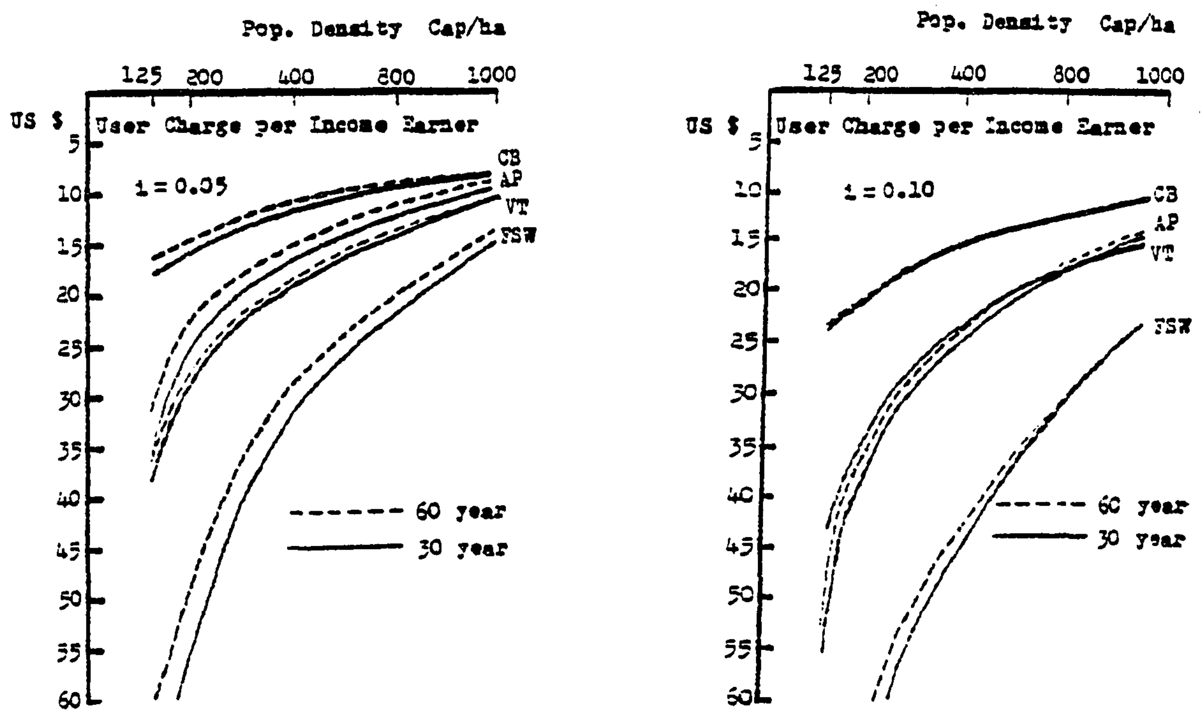

Figure 11 USER CHARGE PER INCOME EARNER FOR DIFFERENT POPULATION DENSITIES, SYSTEMS, PROJECT LIFETIME, AND INTEREST RATES

Source: Hansen, J. A., et al., "Appraisal of Four Alternative Excreta Removal Systems for Urban Areas in Developing Countries," Progress in Water Technology, Nos. 1/2, Pergamon Press Ltd., 1978, p. 242.

depending on the applied interest rate and population density. Further, Hansen, et al. found that user charge as shown in Figure 11 depends strongly on the density of the population, in addition to the interest rate at which capital is available, though to a somewhat smaller degree. In this context the user charge refers to the required charge per income earner who is presumed to support an additional four people.

City Potential

This parameter is related to the availability of local resources in terms of economic growth potential, such as industrial development, mineral resources, and manpower. The higher the city potential the higher the capability of the city to operate and maintain the excreta/wastewater disposal system. This parameter also represents the ability and willingness of the consumers to pay for capital and running costs of the selected technology. The World Health Organization for South East Asia (74) stated that financial self-sufficiency for basic sanitary services depends finally on the willingness of the consumers to pay. But willingness to pay also rests on ability to pay. Further, it was stated that the ability and willingness of houseowners in unsewered urban areas to pay for a better excreta disposal system than the obnoxious bucket has not been properly assessed. In a separate WHO for South East Asia Regional Office (SEARO) study it has been pointed out that, with each bucket latrine costing the houseowner about 12-18 $ US per year and the local authority, another 12-20 $ US per year, the conservancy system was financially burdensome, that the economic loss is more intensive than is apparent, and that the conversion of the bucket latrine into a household sanitary latrine would be a financial advantage and economic gain. It appears, however, that past legacies, self-defeating procedures, and lack of perception in engineering and financial planning of sewer systems and latrine conversion measures have inhibited progress. It is an area where the urban dweller is a victim of deficiencies in civic planning and management, despite his ability and willingness to pay. The absence of a conservancy system, as in Thailand and Indonesia, has helped the household latrine program.

Saunders and Warford (58) stated that there are a number of arguments against relying entirely upon the willingness of consumers to pay as a criterion for supplying them with sanitary facilities. These include consideration of external benefits, the extent of consumer knowledge, and ability to pay. Furthermore, the ability to pay depends on availability of local resources. In other words, ability to pay is equivalent to city potential.

Water Supply Condition

To improve public health conditions in urban areas, the government plans to provide water supply system facilities throughout the country. At present, Indonesia has a total of over 200 urban water supply systems; the rest have no such system.

The target of the urban water supply program in Indonesia could not meet the Second United Nations Development Decade (II UNDD) goals; that is, to supply piped water systems to all municipal areas and regency capital cities with a water consumption rate of 150 liter per capita per day and a house connection distribution system by the end of the Second Five-Year Development Plan, March 31, 1979. Although the II UNDD goals are commendable, they are very difficult to achieve due to Indonesia's lack of capital. The assumptions of II UNDD were based on the estimate that in 1970 about 70 percent of the urban population in developing countries had access to a piped water supply, but, in fact, in Indonesia it was only about 20 percent. So the concern of this parameter is that if the city already has water supply facilities, it will reduce the number of these facilities to be built in the urban area and the budget for water supply could be later applied to the excreta/wastewater disposal project. This will increase the number of project localities.

Technological Alternatives

This parameter represents the type of excreta/wastewater collection and wastewater treatment system to be installed, based on required effluent characteristics and the capability of the city to operate and maintain the system. The concern of this parameter is to choose the simplest and most economical systems appropriate for developing countries with hot climates. The choice of the most appropriate method for all areas should involve a careful consideration of social, cultural, and institutional factors, as well as technology. Factors of local conditions, such as topography, soil characteristics, level of ground water table, etc., will determine the type of excreta/wastewater treatment facilities to be installed. The selection also depends on the availability and cost of water supplies, the lay of the land, and the standard of living.

Reid and Discenza Model (41) can be used to select a wastewater treatment process as described in Chapter II. The World Bank paper (70) outlines the selection process for the choice of appropriate technology. The selection process begins by identifying all of the technological alternatives available for providing the good or service desired (in this case, sanitation). Within that setting there will usually be some technologies which can be readily excluded for technical or social reasons. For example, septic tanks requiring large drainage fields would be technically inappropriate for a site with high population density. Similarly, a composting latrine would be socially inappropriate for people who have strong cultural objections to the sight or handling of excreta. Some technologies may require institutional support which is infeasible, given the social environment. Once these exclusions have been made, one is left with the range of technically and socially feasible alternatives. For these technologies, cost estimates are prepared which reflect their true resource cost to the economy.

Figure 12 shows how the technical, social and economic aspects are actually coordinated and interrelated (70). A technology may fail technically if the user's social preferences militate against properly maintaining it. The economic cost of a system is heavily dependent upon social factors, such as labor productivity, as well as technical parameters. However, because it is operationally difficult to employ simultaneous (or even iterative) decision processes, this study uses a stepwise approach with feedback across disciplines. For simplicity it is assumed that separate individuals or groups are responsible for each part, although in practice responsibilities may overlap. In Step 1 each specialist collects the information necessary to make his respective exclusion test. For the engineer and sociologist this data collection would usually take place in the community to be served. The economist would talk with both government and municipal officials to obtain the information necessary to calculate shadow rates and to determine the availability of grant funds or other subsidy instruments. Then the engineer and sociologist would apply the information they have collected to arrive at preliminary lists of technically and socially feasible alternatives. In the third step the economist prepares cost estimates for those technologies which have passed technical and social tests, and

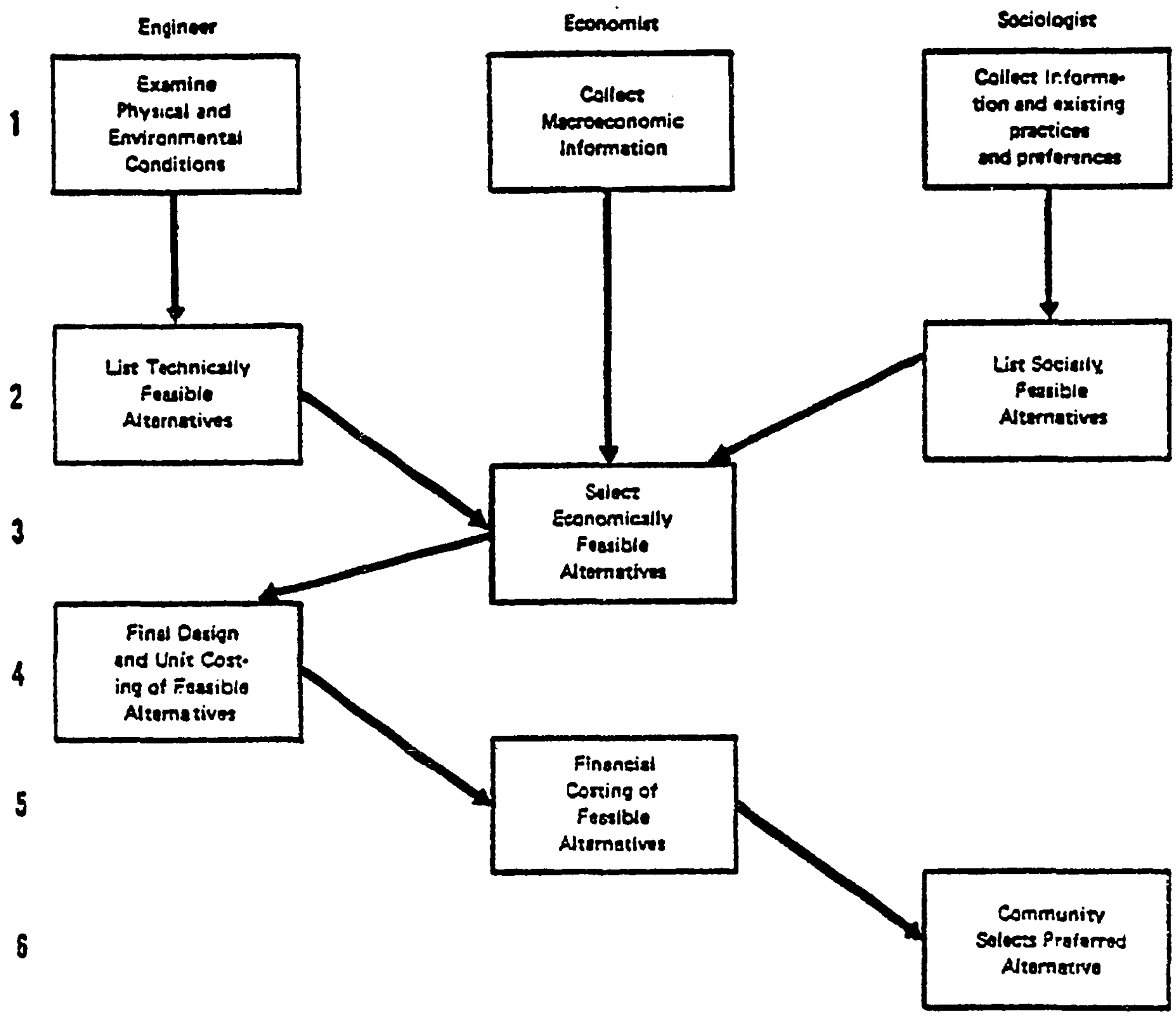

Figure 12 THE WORLD BANK RECOMMENDED STRUCTURE OF FEASIBILITY STUDIES FOR SANITATION PROGRAM PLANNING

Source: World Bank, Appropriate Sanitation Alternatives: A Technical and Economic Appraisal, Energy, Water and Telecommunications Department, Vol. 1, Washington, D.C., October 1978, p. 7.

selects the least-cost alternative for each technology. As the fourth step, the engineer prepares final designs and unit costs for those choices. At this stage the social information collected in Step 1 should be used to determine the siting of the latrine on the plot, the size of the superstructure, the materials to be used for the seat or slab, and other details whose technical and economic import may be low but which make a major difference in the way the technology is accepted and used in the community. The final designs should also incorporate features necessary to maximize the health benefits from each technology. Final designs are used in the fifth step to determine financial costs based on national and municipal funding availability. The final step is for the sociologist to present and explain the alternatives and their costs to the community for final selection.

Appendix G presents an algorithm which can be used as a guide to the selection of the most appropriate sanitation technology for any given community in developing countries.

Delphi Technique

The Delphi Method is a name that has been applied to a technique used for the elicitation of opinions, with the object of obtaining a group response of a panel of experts (7). Helmer (26) points out that the Delphi Technique eliminates committee activity, thus further reducing the influence of certain psychological factors, such as specious persuasion, the unwillingness to abandon publicly-expressed opinions, and the band wagon effect of majority opinion. This technique replaces direct debate by a carefully designed program of sequential individual interrogations (best conducted by questionnaires) interspersed with information and opinion feedback derived by computed consensus from the earlier parts of the program. Some of the questions directed to the respondents may, for instance, inquire into the reasons for previously expressed opinions and a collection of such reasons may then be presented to each respondent in the group, together with an invitation to reconsider and possibly revise his earlier estimates.

As pointed out earlier, Delphi replaces direct confrontation and debate by a carefully planned, orderly program of sequential, individual interrogations usually conducted by questionnaires. The series of questionnaires is interspersed with feedback derived from the respondents. Respondents are also asked to give reasons for their expressed opinions and these reasons are subjected to a critique by fellow respondents. The technique puts the emphasis on informed judgment. It attempts to improve the panel or committee approach by subjecting the views of individual experts to each other's criticism in ways that avoid face-to-face confrontation and provide anonymity of opinion and of arguments advanced in defense of those opinions.

The first step in the application of the Delphi Method is the selection of a group of experts. Wise decision makers have always depended upon the advice of experts but often the consultation with specialists has been haphazard and there has been no attempt to collate differences of opinion among the experts. Brown (7) stated that the selection of experts is an intricate problem even when the category of expertise needed is well-defined. A man's expertise might be judged by his status among his peers, by his years of professional experience, by his own self-appraisal of relative competence in different areas of inquiry, by the amount of relevant information to which he has access or by some combination of objective indices and a priori judgment factors.

The Delphi Method is applied in this study to determine the weight of each parameter and score assignment of categorization of each parameter. Because the experts will be asked to assign two factors, i.e., to determine the weight and score assignment of each category, this method is called Double Delphi Technique. The weight and score assignment to be assigned should be based on the relevance and importance of each parameter in relation to the excreta/wastewater disposal program.

A panel of experts who are devoting some of their time to the study of the excreta and/or wastewater disposal program was formed. The panel included thirty-seven experts selected from representatives of the following agencies:

1. United Nations

   United Nations Development Program (UNDP)
   World Health Organization (WHO)
   United Nations Children's Fund (UNICEF)

2. The World Bank

   International Bank for Reconstruction and Development

3. International/National Research Institute

   International Development Research Center, Canada
   National Environmental Engineering Research Institute, India
   Environmental Research Institute, Thailand
   Water Research Commission, Petroria, South Africa

4. U.S.A. State Health Department & Environmental Protection Agency

   State of Oklahoma
   State of Nebraska

5. Consulting Engineers

6. Universities

   Institute of Technology Bandung, Indonesia
   Ross Institute of Tropical Hygiene, London, England
   University of New Castle Upon Tyne, England
   Delft University of Technology, Delft, Netherland
   University of Gothenburg, Sweden
   Institute of Environmental Studies, Toronto, Canada
   University of New South Wales, Australia
   Asian Institute of Technology, Bangkok, Thailand
   University of Science and Technology, Ghana, Africa
   University of Texas, El Paso, U.S.A.

7. Directorate of Sanitary Engineering, Directorate General of Housing, Building, Planning and Urban Development, Ministry of Public Works, Jakarta, Indonesia.[1]

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[1]Only respond up to second round out of four rounds.

The Delphi process was conducted by sending questionnaires four times to reach a reasonable conclusion.

In the first round each expert was asked his or her opinion on the proposed parameters and to distribute 100 points among the parameters. However, due to the various opinions among the panel members about the proposed parameters and distribution weight of each parameter, the second questionnaire was sent to minimize the variation of opinions.

In the second round, it was necessary to combine parameter health hazards and parameter severity of pollution problems into one parameter, namely, severe health hazards.

In the third round, the experts were asked to redistribute 100 points among the five parameters that have been agreed upon. The list of panel members is presented in Table 10. A questionnaire listing five parameters is shown in Table 11. Thirty-seven completed questionnaires were received and summarized in Table 12. In this round the word "severe" was deleted from severe health hazards, so from now on this parameter just uses the words health hazards.

In the fourth round, each parameter was broken down into category for score processing. Parameter health hazard, population density, city potential, and water supply conditions was broken down into six categories, whereas parameter technological alternatives were broken down into four categories. The panel member is divided into five groups, each group consisting of seven members. Each group was requested to

Table 10

LIST OF THE PANEL MEMBERS FOR DELPHI METHOD

No	Name	Title
1	Bachmann, Dr. G.	Sanitary Engineer, Environmental Health Technology and Support Division of Environmental Health, World Health Organization, Geneva, Switzerland.
2	Bartone, Dr. C.	Systems Analyst, PAHO/WHO, Lima, Peru.
3	Beyer, M. G.	Senior Advisor, Drinking Water Programmes, UNICEF, New York, U.S.A.
4	Bradley, Dr. D. J.	Professor, Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, England.
5	Cleveland, Dr. J. G.	Chief Planning and Research, Tulsa City County Health Department, Oklahoma, U.S.A.
6	Donaldson, D.	Sanitary Engineer, Department of Environmental Sciences and Engineering, Pan American Health Organization, Washington, D.C., U.S.A.
7	Gearheart, Dr. R. A.	Professor and Chairman; Department of Environmental Resource Engineering, Humbolt State University, Arcata, California, U.S.A.
8	Gould, Dr. B. W.	Associate Professor and Head of Water Engineering Department, The University of New South Wales, Australia.
9	Guo, Dr. P. H. M.	World Health Organization Water Pollution Control Advisor, Seoul, Korea.

Table 10 continued

No	Name	Title
10	Harper, J.	Chief Air & Water Pollution Control Commission, Mississippi, U.S.A.
11	Helmer, Dr. R.	Deputy Director, Regional Seas Programme Activity Center, United Nations Development Programme, Dübendorf, Switzerland.
12	Huisman, Prof. Ir. L.	Professor of Sanitary Engineering, University of Technology, Delft, The Netherlands.
13	Lee, E. W.	World Health Organization Regional Advisor in Environmental Health for the Western Pacific, Manila, The Philippines.
14	Malina, Dr. J. F.	Professor of Civil Engineering Chairman of the Dept. of Civil/ Environmental Health Engineering, University of Texas, Austin, U.S.A.
15	McGarry, Dr. M. G.	Acting Director, Health Sciences Division, International Development Research Centre, Ottawa, Canada.
16	Muttamara, Prof. Mrs. S.	Assistant Professor, Environmental Engineering Division, Asian Institute of Technology, Bangkok, Thailand.
17	Odendaal, P. E.	Chief Advisor, Water Research Commission, Pretoria, South Africa.
18	Oey, Dr. H. S.	Associate Professor of Civil Engineering Department, University of Texas at El Paso, U.S.A.

Table 10 continued

No	Name	Title
19	Okun, Dr. D. A.	Professor of Environmental Engineering Department, University of North Carolina, Chapel Hill, North Carolina, U.S.A.
20	Pescod, M. B.	Tyne & Wear Professor of Environmental Control Engineering, University of Newcastle upon Tyne, England.
21	Pineo, C. S.	Consulting Engineer, Maryland, U.S.A.
22	Raman, V.	Head Sewage Treatment Division, National Environmental Engineering Research Institute, Nagpur, India.
23	Reyes, Dr. W. L.	Sanitary Engineer, World Health Organization, Regional Office for South East Asia, New Delhi, India.
24	Ringenberg, J. D.	Head Water Pollution Control Division, Nebraska Department of Environmental Control, U.S.A.
25	Rylander, Prof. Dr. R.	Professor, M. D., Department of Environmental Hygiene, University of Gothenburg, Sweden.
26	Saunders, Dr. R. J.	Senior Economist, Water and Waste Unit, Energy, Water and Telecommunications Department, I.B.R.D., The World Bank, Washington, U.S.A.
27	Setamanit, Prof. Dr. S.	Director, Environmental Research Institute, Chulalongkorn University, Bangkok, Thailand.

Table 10 continued

No	Name	Title
28	Sheedy, Dr. J. D.	Environmental Engineer, Oklahoma State Health Department, Oklahoma, U.S.A.
29	Singh, Prof. R. C.	Incharge, Environmental Engineering, Department of Civil Engineering, Indian Institute of Technology, New Delhi, India.
30	Soemarto, Dr. S.	Associate Professor, Head of the Department of Sanitary Engineering, Institute of Technology Bandung, Indonesia.
31	Soetiman, Dr.	Senior Lecturer, Department of Sanitary Engineering, Institute of Technology Bandung, Indonesia.
32	Spangler, Dr. C. D.	Consulting Sanitary Engineer, Maryland, former International Bank for Reconstruction and Development, Washington, U.S.A.
33	Therkelsen, H. H.	Senior Environmental Engineer Cowinconsult, Consulting Engineers & Planners, Virum, Denmark.
34	Thung, Dr. H. J.	Chief Engineer, Construction Grant Program Water Quality Service, Oklahoma State Health Department, Oklahoma, U.S.A.
35	Wanielista, Dr. M.	Acting Chairman, Department of Civil Engineering, University of Central Florida, U.S.A.
36	Whyte, Dr. A.	Professor, Institute for Environmental Studies, University of Toronto, Canada.
37	Wright, Dr. A. M.	Head, Civil Engineering Department, University of Science and Technology, Kumasi, Ghana, West-Africa.

Table 11

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1	Severe Health Hazards	____
2	Population Density	____
3	City Potential	____
4	Water Supply Condition	____
5	Technological Alternatives	____
	Total =	100

Date: ____________________

Name: ____________________

Title: ____________________

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If you have any comments/suggestions, please use space at the back.

Table 12

DISTRIBUTION OF PARAMETER WEIGHTS BY THE PANEL MEMBERS

	Name	Parameter				
		Health Hazards	Population Density	City Potential	Water Supply Condition	Technological Alternatives
1	Dr. G. Bachmann	30	25	15	20	10
2	Dr. C. Bartone	50	15	10	0	25
3	Mr. M. G. Beyer	10	30	40	10	10
4	Dr. D. J. Bradley	30	30	10	30	0
5	Dr. J. G. Cleveland	40	10	30	10	10
6	Mr. D. Donaldson	30	20	30	10	10
7	Dr. R. A. Gearheart	25	10	10	20	35
8	Dr. B. W. Gould	40	20	15	10	15
9	Dr. P. H. M. Guo	40	20	10	20	10
10	Mr. J. Harper	40	20	15	20	5
11	Dr. R. Helmer	50	10	10	30	0
12	Prof. L. Huisman	35	25	20	15	5
13	Mr. E. W. Lee	40	15	15	15	15
14	Dr. J. F. Malina	40	10	5	40	5
15	Dr. M. G. McGarry	30	20	15	15	20
16	Prof. Mrs. S. Muttamara	35	18	15	20	12
17	Mr. P. E. Odendaal	50	10	10	10	20
18	Dr. H. S. Oey	25	15	25	20	15
19	Dr. D. A. Okun	30	10	10	30	20
20	Prof. M. B. Pescod	50	20	10	10	10

Table 12 continued

	Name	Parameter				
		Health Hazards	Population Density	City Potential	Water Supply Condition	Technological Alternatives
21	Mr. C. S. Pineo	25	20	20	17	18
22	Mr. V. Raman	30	15	20	15	20
23	Dr. W. L. Reyes	25	20	25	15	15
24	Mr. J. D. Ringenberg	50	20	10	10	15
25	Prof. R. Rylander, M.D.	60	10	10	10	10
26	Dr. R. J. Saunders	40	20	20	10	10
27	Dr. S. Setamanit	30	20	15	25	10
28	Dr. J. D. Sheedy	30	20	15	30	5
29	Prof. R. C. Singh	50	20	10	10	10
30	Dr. S. Soemarto	25	20	15	30	10
31	Dr. Soetiman	20	30	30	15	5
32	Dr. C. D. Spangler	40	10	10	30	10
33	Mr. H. H. Therkelsen	20	40	10	20	10
34	Dr. H. J. Thung	20	30	20	25	5
35	Dr. M. Wanielista	30	15	5	30	20
36	Dr. A. Whyte	35	20	10	30	5
37	Dr. A. M. Wright	25	15	30	10	20
	Average Weight	35	19	16	18	12

determine the score of each category of one parameter by distributing 60 points among those six categories for the first four parameters and 40 points among the four categories for the fifth parameter. The form of questionnaire for assigning scores of each category for the five parameters is presented in Appendix H. In this round the average weight of each parameter was given to the 37 panel members, who returned the completed questionnaires to obtain their further comments or suggestions.

Following is a brief discussion about the general opinions of some experts, experts' opinions about proposed parameters, the result of the Delphi Method and weight determination for each parameter using the average values.

General Experts Opinions

Ballance[1]

Ballance commented that Einstein once said: "Everything should be made as simple as possible, but not simpler." He felt the author has attempted to oversimplify a complex problem. He doubts that the parameters can apply in the same intensity throughout all of Indonesia, or that some of them apply at all. For example, population, per se, is relatively

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[1] Dr. R. C. Ballance is a sanitary engineer at Division of Environmental Health, World Health Organization, Geneva, Switzerland. He contributed for the first round, therefore his name does not appear in Table 10 list of panel members as well as in Table 12 distribution of parameter weights by the panel members. However, his opinion is useful for this report.

unimportant; population density is very important. In the absence of adequate sanitation, high population density causes health hazards and pollution problems. Ballance further questioned sociocultural conditions, central government policy, and climate.

With respect to Ballance's comment that the author has attempted to oversimplify a complex problem, it can be mentioned that it is true, more parameters should be included in the analysis to make the evaluation more meaningful. However, the problem in developing countries in general is a lack of available data and difficulty in assessing and measuring reliable data. Therefore, the selection of appropriate parameters is very restrictive. Concerning sociocultural conditions, this factor is included in the technological alternatives parameter, since the choice of most appropriate methods for all areas should involve a careful consideration of social, cultural, and institutional factors, as well as technology. For example, a composting latrine would be socially inappropriate for people who have strong cultural objections to the sight or handling of excreta. Concerning central government policy, it has been described in Chapter I. With respect to the climate, this factor has few variations throughout the country. There is little difference in temperature, rainfall intensity, wind velocity, and humidity of all cities in Indonesia. Therefore, climate is not appropriate to be considered as a parameter.

Bartone

Bartone commented that it is difficult to weight each variable without knowing how it will be used. He has assumed that the author intends to formulate some linear combination of variable such as $\sum_{i=1}^{5} P_i X_i$ to determine ranked priorities. If that were the case then he objects to the inclusion of the fourth parameter on water supply conditions. This would better serve as a binary decision variable, since the extreme case of no water supply would preclude waste disposal systems of certain types in an urban context. That is, it would be possible to formulate the following:

$$X_4(P_1X_1 + P_2X_2 + P_3X_3 + P_5X_5)$$

where $X_4 = 0$ or 1. This does not apply, of course, to excreta disposal schemes.

This comment is a very good point to be considered. However, since this dissertation deals with the excreta and/or wastewater disposal program, the author prefers to use a linear combination of variables to determine ranked priorities, since the other model suggested by Bartone could not apply to excreta disposal schemes.

Donaldson

Donaldson commented that the problem in doing the weighting is that one is not only concerned with individual cities but with an overall program. For example, it would be difficult for a Ministry not to do something in a city where people were dying due to health conditions, in spite of the lack of "city potential." Further, he stated one must remember that politics plays an important role in this matter.

The comments of Donaldson are true; and the authors agree that politics plays an important role in determining priorities. However, it is difficult to include politics as a parameter, since it cannot be measured and is not a subjective case.

Gould

Gould stated that weightings for excreta disposal will be different with wastewater disposal. This can be explained by the fact that local conditions will determine the type of treatment facilities, whether it is excreta disposal or waste-water disposal. Therefore, this dissertation deals with both of them. Excreta and/or wastewater disposal systems depend on the technological alternatives that might be applied to the local conditions.

Hope[1]

Hope commented that he would give a little more weight to the population factor, since the number of people affected

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[1]Hope is Sanitary Engineer, U.S. Environmental Protection Agency, Missouri. He contributed up to the second round, therefore his name is unlisted in Table 10, list of panel members, as well as in Table 12, distribution of parameter weights by the panel members. However, his opinion is useful for this report.

influences the pressure for correction. That is, a large city's pollution is more important to the country as a whole than that in isolated towns. However, he further stated specific problems will modify the factors anyway, so this is less important than the understanding that the ranking is merely a convenience for examination and not an inflexible measuring rod.

It should be noted that political pressures will warp social or economic programs in ways not usually considered in these studies. What these pressures might be in Indonesia are not necessarily the same as those in the United States or the USSR but they exist, they will have an effect, and in the practical prosecution of any public programs must be taken into consideration. He also stated that this becomes difficult sometimes, since there is a general conspiracy to act as though "politics" is dirty and therefore does not exist. But it is as much a fact of life as sewage and has a way of being introduced into all decisions.

With respect to this comment, the response is similar to Donaldson's statement on political.

McGarry

McGarry suggested that there are many other variables to consider, such as political and cultural. Concerning the political factor, the response is similar to Donaldson's political statement. With respect to the cultural factor, the response is similar to Ballance's sociocultural suggestions.

Mertodiningrat[1]

Mertodiningrat stated that in the Indonesian government policy on the human settlement improvement program, the priority is for the low-income groups who inhabit the urban areas.

With respect to this statement, this is a good point to be considered in this study. He also stated that parameter health hazards and severity of pollution problems could adequately represent the priority mentioned earlier.

Concerning this comment, it was concluded that these two parameters are combined into one parameter, namely, severe health hazard. Later on the word "severe" was deleted.

Pescod

Pescod stated that it is difficult to think in terms of complete urban wastewater disposal for a city in most developing countries. Regional disposal systems are likely to be installed rather than a total master plan scheme. Under these conditions, the priorities will differ, depending upon the area under consideration. For example, an industrial estate will have quite a different weighting of the five parameters

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[1]Mertodiningrat is Director of Sanitary Engineering Directorate, Directorate General of Housing, Building, Planning and Urban Development, Ministry of Public Works, Jakarta, Indonesia. He contributed up to the second round, therefore his name does not appear in Table 10, list of panel members, as well as in Table 12, distribution of parameter weights by the panel members. However, his opinion is useful for the purposes of this report.

than a low-cost housing area. He further stated that he does not believe the author's blanket approach is feasible for any large city in developing countries. His weighting is based on residential areas. In addition, there would be interaction among the parameters, again varying with the area to which they are applied.

With respect to this statement, it might be true that the blanket approach is not feasible for any large city in developing countries, since characteristics of large urban areas and low to medium urban areas are very different, especially in industrial development which creates nuisance industrial waste discharges. Fortunately, there are only five cities in Indonesia, including the capital, which are considered as metropolitan areas where heavy industrial estates grow rapidly. The government has made an overall master plan for those cities financed by the World Bank loan, including wastewater disposal. Therefore, those five cities have highest priority for development and will not be covered in this study.

Concerning the comment that there are interactions among the parameters, the author realizes that population density and water supply conditions relate to parameter health hazards. Also, population density and water supply conditions will determine the type of excreta/wastewater disposal system to be installed. Therefore, these parameters relate also to parameter technological alternatives. However, the concern of the parameter population density is associated with the economy of the project, which means that the larger the population density to be served, the lower the per capita cost of the project. Or, in other words, this parameter is associated with the user charge which depends strongly on the density of population, as stated by Hansen, et al. (25).

The concern of parameter water supply conditions is to increase the number of project localities, which means that if the city already has water supply facilities then the budget for water supply could be applied to the excreta/wastewater disposal project. Moreover, excreted infectious diseases are not only transmitted by water but can be transmitted directly or through other means, such as vegetables, animals etc. The concern of city potentials is related to the availability of local resources, which means the higher the city potential the higher the capability of the city to operate and to maintain the excreta/wastewater disposal facilities. Moreover, these three parameters are not the only ones which determine the type of excreta/wastewater disposal facilities to be installed, but there are many factors that will affect the technological alternatives, such as social, cultural, level of ground water table, soil characteristics, topography, etc.

Raman

Raman suggested more parameters, such as finance, costing, and pollution.

With respect to this suggestion, it can be mentioned that finance and costing are incorporated into the technological alternatives heading. Concerning pollution, it is included in health hazards parameter, as mentioned by Mertodiningrat and other experts.

Setamanit

Setamanit suggested health hazards and severity of pollution problem be combined into one parameter, having one more parameter, say, level of income of the population.

Concerning the combination of health hazards and severity of pollution problem, the response is similar to Mertodiningrat's second comment. In regard to having parameter level of income, this is a good point to be considered. However, at the present time this data is not available and difficult to assess because incomes are not stable and do not come from merely one source for most people living in low urban areas.

Therkelsen

Therkelsen commented that the proposed parameters cannot be measured on the same scale, since some are planning goals and others apply to the physical conditions on the site. It is also felt that a parameter such as local ground conditions (permeability on the soil, level of ground water table, etc.) should be included, and due regard should be paid to local preferences and habits regarding sanitation.

With respect to Therkelsen's first comment, it is a very good point to be considered, and it is true that the proposed parameter cannot be measured on the same scale, at least at the present time. Although he did not mention which one is included in the planning goals and which one is included in the application to physical conditions on the site, however, it can be concluded that technological alternatives parameter is a planning goal whereas the other four parameters apply to the physical conditions on the site. It will be proven later on that technological alternatives parameters cannot be validated at this time, since the Indonesian government just started to develop urban excreta/wastewater disposal facilities recently, On April 1, 1979. Concerning the second comment to include local ground conditions as parameters, it can be mentioned that local ground conditions are incorporated into the technological alternatives parameter.

Thung

Thung commented that the parameter severity of pollution problem falls into the same category with parameter health hazards. He assumed that in a developing country the public health problem as a result of environmental pollution is generally deemed more critical than the damage caused by water pollution to the environment. He realized the fact that to make the evaluation more meaningful, more parameters should be included in the analysis. However, the selection of pertinent or appropriate parameters is quite restrictive. Thung suggested we add another parameter, such as physical quality of the environment, or aesthetic value of the environment. Finally, Thung personally felt that the financial capability of the local or central government is the determining factor for the construction of wastewater treatment facilities.

With respect to Thung's first comment that the parameter severity of pollution problem falls into the same category with parameter health hazards, the response is similar to Mertodiningrat's second comment.

It is true that to make the evaluation more meaningful, more parameters should be included in the analysis. However, in most developing countries the data necessary to be evaluated is very limited and usually difficult to assess at the present time, such as physical quality of the environment or aesthetic value of the environment. Concerning the financial capability of the local or central government, it can be mentioned that cost is incorporated into the technological alternatives heading.

Experts Opinions on the Proposed Parameters

Following is a brief discussion about experts opinions on the proposed five parameters.

Health Hazards

Spangler commented that this parameter is the most important reason for pollution control. But he wondered how to measure this in various communities. Most communities lack adequate reporting of mortality and especially morbidity. Hospital records may include people from outside the city where the hospital is located. Many cases of disease are never reported. He further stated that in any event, this is a very important parameter.

Singh stated that in case there is indeed a serious danger to health in the absence of a wastewater disposal system, he will give all the 100 points to it. Hence, the word "severe" must be deleted.

With respect to Spangler's comments, it is true that there is a lack of adequate reports of mortality and especially morbidity. But these cases just happened in rural areas where medical facilities are very limited and people are reluctant to go to the hospital or clinic since they have to travel a few kilometers on foot or ride on bicycles. Also, in rural areas most people are uneducated. They prefer to go to shaman rather than to the hospital when they become ill, because the cost to treat the diseases is much cheaper compared to that of the hospital or clinic. This condition is different in urban areas where facilities of any kind are much better than rural areas.

It is true also that hospital records may include people from outside the city; however, in those records, they also provide the name of the patient, age, sex, kind of disease they suffer, the address and the city the patient comes from. Therefore, they are able to identify the number of cases of certain diseases from those patients living in an urban area or those from other cities.

Concerning the suggestion of Singh to delete the word "severe" from severe health hazards, it is reasonable to follow his suggestion, since the word "severe" is a measure of health hazards.

Population Density

Notosugondo[1] suggested that population density be given high weight, if not the highest. The basis of his thinking is that the main cause of health hazards, pollution problems, and shortage of water supply is (in many cases) the high population density which is not simultaneously supported by the minimum facilities required. He stated that, in fact, it is not easy to distribute those weights among the parameters because those parameters are actually not independent, but are interrelated with each other.

Oey commented that parameter health hazards and population density are interrelated and not entirely independent.

Spangler commented that usually health hazards increase with population density, therefore density should have some weight.

Singh commented that relating population density to economics alone is not adequate. Population density leads to unsanitary conditions, insufficient outlets for fire fighting water, etc. In fact, towns with larger populations generally

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[1]Hidayat Notosugondo is Secretary of Directorate General of Housing, Building, Planning and Urban Development, Ministry of Public Works, Jakarta, Indonesia. He contributed up to the second round, therefore his name does not appear in Table 10 list of panel members, as well as in Table 12, distribution of parameter weights by the panel members. However, his opinion is useful in this report.

are prosperous and can bear more expenditure per capita on a dependable sewage disposal system, although actually they can be served more economically. Yet the requirement of wastewater disposal may be at least equally pressing for smaller communities.

Notosugondo and Spangler have the same opinion that population density should have some weight. It can be seen later in the next section that population density occupies the second range in the distribution of parameters weight. With respect to Notosugondo and Dr. Oey's comments that the parameters are interrelated with each other, the response is similar to Pescod's second comment.

Concerning Singh's comments, it is a good consideration.

City Potential

Wright stated that since city potential indicates ability of community to pay for capital and running costs of the selected technology, this parameter is the most important for priority setting. The same opinion came from Beyer that this parameter should have some weight.

Singh wondered whether we can really assess future city potential, say, after 30 years, with the changing pattern of economy, such as the oil crisis, etc. He stated that we seem to prefer desolate areas for certain industries.

Concerning Singh's statement, it can be explained that in case there is a changing pattern of any kind, including the economy pattern, constant review and revisions should be made and reported to the central government for a certain period of time.

The author believes that there will be several substitutional resources for the oil crisis; for instance, the production of alcohol through microbial fermentation utilizing yeast cultures on agricultural substrates such as sugar-cane, sugar beets, potatoes, corn, etc. Through this fermentation procedure ethanol is produced by anaerobic fermentation of glucose to ethanol and carbon dioxide. The ethanol obtained can be distilled to obtain pure ethanol, which can be utilized as a fuel in the pure form or mixed with gasoline to produce gasohol, which is also utilized as a fuel. The advantage of alcohol as a fuel is that agricultural products are renewable, and are always available.

Water Supply Condition

Okun commented that this parameter is related to health hazards.

Spangler stated he believed that having reasonable access to a safe water supply should be the top priority to improve health. Until most of the country has a safe water supply, he would give a low priority to wastewater disposal.

Soetiman commented that in general water supply conditions in Indonesia are below standard, with not many variations, therefore he would give low weight to this parameter.

Singh commented that in theory it is correct that there ought to be some net revenue from water supply to subsidize wastewater treatment. But in practice, political, social and economic constraints make it difficult even to have a self-supporting water supply. Further, he suggested that wastewater disposal must be considered essential after piped water supply is provided. The greater use of water due to ease in availability calls for efficient disposal of wastewater; otherwise, some diseases that spread by contact with contaminated water (not ingestion), may slow an upward trend, and sanitary conditions may deteriorate by provision of water supply alone.

With respect to Okun's comment, the response is similar to Pescod's second comment.

Concerning Soetiman's comment, it is true that water supply conditions are below standard; however, compared to excreta/wastewater disposal facilities the water supply conditions are much better. Concerning variation of water supply, it was stated in Chapter I of this paper that water consumption varies from nil to several hundred liters per capita per day with a different number of house connections.

With respect to Spangler and Singh's comments, they are good points to be considered.

Technological Alternatives

Ballance commented that the technological alternatives are few; either on-site disposal through discharge to the soil (impractical where population density is high) or conveyance sewers away to a point where they can be treated and discharged to a sink (river, ocean, soil).

Spangler stated that whatever type of disposal of body wastes is selected, it should be within the economic ability of the beneficiaries to pay for it, unless the government has abundant funds for subsidies, which most do not. The costs of conventional water carriage sewer systems in most developing countries are so high that such a solution is not economically feasible. In cities even as large as Jakarta, it may be that only the densely populated central city can afford a sewer system. The rest of the cities may have various kinds of sanitary latrines or septic tanks with tile fields or leaching cesspools (soakaways). The sullage or grey water may be disposed of on the plot, if large enough, or into storm drainage channels. If sites are available, sullage can be treated in stabilization ponds. Conventional sewers are not only expensive to construct but they use from 25 to 45 percent of the water supply for toilet flushing. Additional costs of treatment are extremely high. Even in the United States some people are beginning to wonder whether water-flush toilets were really a good idea. Spangler further stated that health education is a very important part of whatever technological solution is decided upon. People must be educated and trained to use even simple latrines and to keep them clean and tight against the entry of flies or mosquitoes to the pit. Also, sullage water should be handled, so it does not result in the propagation of flies or mosquitoes. Sullage can be used to hand-flush water sealed latrines, to irrigate small gardens, to sprinkle to keep dust down in yard or road, all of which can go into soakways or storm drains. People educated and trained in good sanitary practices can maintain almost any sanitary disposal method in a satisfactory manner.

Soetiman com[illegible] not important, since the altern[illegible] water are few.

Wri[illegible]cal alternativ[illegible] another in[illegible] technolog[illegible]

W[illegible] a criteria[illegible] technologic[illegible]

Sing[illegible] efficient and [illegible]using a nuisance, health[illegible] handling. In spite of the best p[illegible], careless handling does occur. Last, but [illegible] least, the dignity of human beings must not be sacrificed.

to the pit. Also, sullage water should be handled, so it does not result in the propagation of flies or mosquitoes. Sullage can be used to hand-flush water sealed latrines, to irrigate small gardens, to sprinkle to keep dust down in yard or road, all of which can go into soakways or storm drains. People educated and trained in good sanitary practices can maintain almost any sanitary disposal method in a satisfactory manner.

Soetiman commented that this parameter is not important, since the alternatives for disposing of excreta/wastewater are few.

Wright commented that once we introduce technological alternatives as a separate parameter, we create a need for another important parameter, namely, "acceptability" of technology to users.

Whyte commented that he did not see this parameter as a criteria for priority setting. He further commented that technological alternatives should always be available.

Singh suggested that the system should not only be efficient and simple but also robust and incapable of causing a nuisance, health hazards and accidents, by careless handling. In spite of the best precautions and supervision, careless handling does occur. Last, but not the least, the dignity of human beings must not be sacrificed.

From the above expert comments it can be concluded that there are few technological alternatives which can be applied in developing countries. Their suggestion to use appropriate technology is a good point to be considered.

Average Weight Distribution of the Parameters

The average weight of each parameter which was evaluated by panel members is summarized in Table 13, arranged in order of magnitude.

Table 13

AVERAGE WEIGHT DISTRIBUTION OF THE FIVE PARAMETERS

No.	Parameter	Average weight
1	Health hazards (HH)	35
2	Population density (PD)	19
3	Water supply condition (WSC)	18
4	City potential (CP)	16
5	Technological alternatives (TA)	12
	Total	100

This table was then sent to the 37 panel members, who returned the completed questionnaire to obtain their further comments or suggestions. Table 13 indicates that the highest weight is 35 for parameter health hazards, and population density is next in importance, with average weight of 19. The lowest weight of 12 for technological alternatives parameter was considered by some panel members not very important since for low-income urban areas in developing countries the alternatives in sanitary excreta/wastewater removal systems have few variations. The table indicates that the highest weight is almost threefold of the lowest weight. As illustrated in Table 12, 29 experts assigned as the highest weight for parameter health hazards in which 7 out of them assigned equally as the highest weight together with other parameters. The figures range from 10 to 60. Population density, which occupies the second rank with average weight of 19 just slightly below the mean value 20, is assigned as the highest weight by 4 experts in which 2 out of them assigned equally as the highest weight together with other parameters. The figures range from 10 to 40. Water supply conditions received 18 and occupied the third rank. The figures range from 0 to 40. The two last parameters which received the lowest weights are city potential and technological alternatives: 16 and 12, respectively. Technological alternatives is assigned as the highest weight by only one expert. The figures range from 0 to 35. Since there is no panel member who disagrees with the average weight distribution presented in Table 13, it can be concluded that the average weight for each parameter is a reasonable figure to work with. Therefore, the figures presented in Table 13 are workable in assigning priority for the Indonesian urban excreta and/or wastewater disposal program at the present time.

Analysis of Cognative Indices

To analyze the weight distribution of parameters which had been assigned by the panel members, the correlation of cognative indices will be examined based on four categories of the 37 respondents (experts), namely, (1) level of education, (2) major field/specialization, (3) profession/occupation, and (4) continent origin and international agencies. Each category is broken down into several subcategories and the average weight distribution of each parameter is then calculated. The level of education category is broken down into three subcategories, the major field/specialization is broken down into five subcategories, whereas category profession/occupation and continent origin and international agencies both are broken down into six subcategories; thus, totally there are 20 subcategories of respondents. Tables 14, 15, 16 and 17 show the average weight distribution of each parameter for each subcategory of the 37 respondents, so the cognative indices of respondents can be correlated.

It can be seen from Tables 14, 15, 16 and 17 that in all cases parameter HH receives the highest weight with a range of 27 to 50. The highest weight of HH was assigned by experts whose major field other than environmentalist, namely

Table 14

AVERAGE WEIGHT DISTRIBUTION OF THE FIVE PARAMETERS BASED ON LEVEL OF EDUCATION OF EXPERTS

Level of education	# of experts	Parameters				
		HH	PD	CP	WSC	TA
Engineer	5	44	17	13	13	13
Master	8	31	23	20	15	11
Doctor/Ph.D.	24	34	18	15	21	12

Table 15

AVERAGE WEIGHT DISTRIBUTION OF THE FIVE PARAMETERS BASED ON MAJOR FIELD/SPECIALIZATION OF EXPERTS

Major Field/ Specialization	# of experts	Parameters				
		HH	PD	CP	WSC	TA
Environmental Engineer	20	31	19	17	20	13
Environmental Hygiene/ Health	7	35	20	13	24	8
Water Supply Services	3	27	23	23	15	12
Water Pollution Control	4	40	18	14	16	12
Others (MD, System analyst, economist)	3	50	15	13	7	15

Table 16

AVERAGE WEIGHT DISTRIBUTION OF THE FIVE PARAMETERS BASED ON PROFESSION/OCCUPATION OF EXPERTS

Profession/ Occupation	# of experts	Parameters				
		HH	PD	CP	WSC	TA
United Nations	8	34	19	18	15	12
The World Bank	1	40	20	20	10	10
National/International Research Inst.	4	35	16	15	16	18
State Health Department	5	36	20	18	19	7
Consulting Engineer	3	29	23	13	22	13
Faculty	16	35	18	14	21	12

Table 17

AVERAGE WEIGHT DISTRIBUTION OF THE FIVE PARAMETERS BASED ON CONTINENT ORIGIN AND INTERNATIONAL AGENCIES OF EXPERTS

Continent origin and international agencies	# of experts	Parameter				
		HH	PD	CP	WSC	TA
USA & Canada	12	32	17	15	23	13
Europe	5	39	25	12	17	7
Asia	6	32	21	17	19	11
Africa	2	37	13	20	10	20
Australia	1	40	20	15	10	15
International Agencies	11	35	19	18	16	12

medical doctor, economist and system analyst, whereas the lowest weight of 27 was assigned by experts whose major field is water supply services. In most cases TA receives the lowest weight except the weight assigned by experts whose profession is in National/International Research Institute and by experts whose major field is other than environmental. In both cases TA receive the second rank of weight.

From the above discussion it can be concluded that HH occupies the first rank and TA occupies the fifth rank in the weighting of parameters. The remaining parameters, namely, PD, CP, and WSC, compete with each other for the second, third and fourth rank, depending on the categorization and sub-categorization. The highest weight of PD was assigned by European experts from the continental origin category with the average weight of 25, whereas the lowest weight of PD was assigned by African experts from the continental origin category with the average weight of 13. The highest weight of CP was assigned by experts of water supply services from the major field/specialization category with the average weight of 23, whereas the lowest weight of CP was assigned by European experts continental origin category with the average weight of 12. The highest weight of WSC was assigned by environmental health experts from the major field/specialization category with the average weight of 24, whereas the lowest weight of WSC was assigned by experts whose major field is other than environmental with the average weight of 7. The highest weight of TA was assigned by experts whose profession is in national/international research institute with the average weight of 18, whereas the lowest weight of TA was assigned by State Health Department experts from the continental category with the average weight of 7. From 20 subcategories, PD occupies 14 times as the second rank of weighting in which 2 of them occupy the same rank with CP and WSC. WSC occupies five times as the second rank, whereas CP occupies one time as the second rank.

From the above discussion it can be concluded that PD deserves to receive the second rank of weighting parameter, WSC the third rank, and CP the fourth rank. This ranking is in line with the results of weight distribution of the total 37 respondents.

It seems that the assignment of weighting parameter by experts whose profession is faculty is well distributed since two of the parameter weights above mean value of 20 and the other three parameters below the mean value, and the highest weight almost threefold than the lowest weight. The others well distributed of parameters weight are by those whose level of education is Doctor, by those whose major field is environmental health, and by those experts from USA and Canada, and continental Asia. However, since the multidicipliner approach is preferable by the Delphi technique, the average weight distribution assigned by 37 respondents will be used in prioritizing urban excreta/wastewater project localities.

Categorization of Parameters and Scoring Process

The scoring process consists of the categorization of the data and score assignment of each data category by the experts committee. Efforts have been made in categorization to quantify as many of the parameters as possible in order to facilitate application to the model. As mentioned earlier, the score assignment of each category is evaluated by the experts committee in order to obtain a reliable score. The thirty-seven panel members are divided into five groups, as many as proposed parameter, and each group is requested to determine the score of each category of one parameter. Parameter health hazards, population density, city potential, and water supply condition is broken down into six categories, whereas parameter technological alternatives is broken down into four categories. The experts in each group are requested to determine the score of each category of one parameter by distributing 60 points among those six categories for the first four parameters and 40 points among the four categories for the fifth parameter.

The following is a brief discussion of the categorization of each parameter and the results of scoring categorization by the panel members.

Health Hazards

Categorization of health hazards can be evaluated in several ways. Among others are:

1. To identify how dangerous each disease is and the role of water in transmitting those diseases. Bradley lists infective diseases in relation to water supply and excreta infections (6) in terms of frequency, severity and chronicity, as can be seen in Table 18. However, it is difficult to assign a score of each category of health hazards because, actually, there are many combinations of the diseases categorized as health hazards.

2. To quantify the severity of pollution problem by identifying the appearance of odors, concentration of dissolved oxygen, biochemical oxygen demand, fish kills in streams, and other biological/chemical characteristics. However, these data are not readily available and are difficult to assess at this time for most cities in the country.

3. Another possibility for categorization of health hazards is evaluated in terms of social and economic impact of diseases and, to the extent possible, quantified as described by Weisbrod (67). The general approach of his study is to attempt quantitative estimates of a number of effects of specific parasitic diseases by comparing labor productivity, school performance, and birth and death rates for persons with and without the disease, but comparable in a number of other important ways. This is to assume that were it not for disease, the "ill" persons would have the behavioral characteristics of their "healthy" counterparts. Such an assumption is

Table 18

MAIN INFECTIVE DISEASES IN RELATION TO WATER SUPPLIES AND EXCRETED INFECTIONS

Disease	Frequency	Severity	Chronicity
Cholera	+	+++	
Typhoid	++	+++	
Leptospirosis	+	++	
Tularaemia	+	++	
Paratyphoid	+	++	
Infective hepatitis	++	+++	+
Some enteroviruses	++	+	
Bacillary dysentery	++	+++	
Amoebic dysentery	+	++	++
Gastroenteritis	+++	+++	
Skin sepsis and ulcers	+++	+	+
Trachoma	+++	++	++
Conjunctivitis	++	+	+
Scabies	++	+	+
Yaws	+	++	+
Leprosy	++	++	++
Tinea	+	+	
Louse-borne fevers		+++	
Diarrhoeal diseases	+++	+++	
Ascariasis	+++	+	+
Schistosomiasis	++	++	++
Guinea worm	++	++	+
Gambian sleeping sickness	+	+++	+
Onchocerciasis	++	++	++
Yellow fever	+	+++	

Source: Bradley, D. J., "Health Aspects of Water Supplies in Tropical Countries," *Water, Wastes and Health in Hot Climates*, John Wiley & Sons, London, 1977, p. 9.

less valid the greater the prevalence and severity of the given disease. This is so because of the probable consequences of large changes in social and economic variables. If the eradication or control of an endemic disease were expected to bring about a sizable increase in the labor supply, for example, the short-run result, with the stocks of land and capital unchanged, would be a drop in the economy's capital-labor and land-labor ratios, with a resulting decrease in the marginal productivity of all the "healthy" as well as the "sick." It would be erroneous to assume that if such a disease were controlled or eradicated, workers who currently have that disease would be as productive as are the workers who currently do not have the disease. With an increase in total labor supply, the marginal productivity of healthy labor would be expected to fall. Similarly, if it were found that birth rates were lower among sick women, it would not necessarily be true that a significant decrease in the amount of illness would lead to a large, permanent increase in the number of births. Pressure of population growth might bring about a reduction in birth rates among healthy persons.

These examples illustrate the most difficult problem that exists for any effort to assess the social and economic impact of disease in developing countries as distinguished from advanced countries. In the latter, the major public health diseases have already been eliminated.

Although a direct link between economic output and improved health might seem obvious, it is empirically difficult, especially on a program level, to demonstrate. Saunders and Warford (58) stated that one attempt to find the effects of schistosomiasis and four other parasitic diseases on labor productivity on St. Lucia failed to demonstrate an association between the severity of the disease and the daily output of workers on a banana estate and at a light industry plant. This study, however, plagued not only by the normal problems of field studies, also prompted the valid question of whether or not schistosomiasis and the other diseases are sufficiently severe on St. Lucia to affect productivity.

4. Goldman (19) attempted to evaluate health hazards in terms of social and economic cost of damage. Cost estimates of damage caused by pollution are difficult to make. Various estimates are tossed around, but generally they are not based on solid research or calculation. The task is made even more complex because so many things affected by pollution, e.g., swimming in a river, are impossible to price. Even when pricing the damages is no impediment, a decision must nonetheless be made as to how far back the researcher should go in counting up the damages.

5. Therefore, categorization of health hazards may be evaluated in terms of mortality and morbidity caused by those diseases (excreted infections), expressed per 100,000 population per year. The data of the diseases are readily available at the local health department, so that mortality and morbidity

rates can be easily calculated. Actually, in calculating the rates of mortality and morbidity, it is necessary to define the kind of population, whether it is the general population or those in particular, sex, age, marital status, etc. However, this categorization will be complicated, and for simplicity it is better to evaluate mortality and morbidity in terms of general population.

This parameter is categorized as follows:

a. Mortality[1] greater than 75, morbidity[1] greater than 1,000.

b. Mortality greater than 75, morbidity less than or equal to 1,000.

c. Mortality between 25 and 75, morbidity greater than 1,000.

d. Mortality between 25 and 75, morbidity less than or equal to 1,000.

e. Mortality less than 25, morbidity greater than 1,000.

f. Mortality less than 25, morbidity less than or equal to 1,000.

The score assignment of categorization is evaluated by five experts and the results of average scores is illustrated in

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[1]Both mortality and morbidity expressed per 100,000 population per year.

Table 19.

Table 19

SCORE ASSIGNMENT OF CATEGORIZATION FOR PARAMETER HEALTH HAZARDS BY PANEL MEMBERS

	Name of Experts					
Category	Bartone	Lee	Pescod	Rylander	Spangler	Average Score
a	24	50	20	18	16	25.6
b	17	4	16	12	14	12.6
c	10	3	10	11	12	9.2
d	6	1	8	9	9	6.6
e	3	1	4	6	6	4.0
f	0	1	2	4	3	2.0

Population Density

In the categorization of the data of each category, the density used in this study is net density, which can be defined as the number of people per hectare in a specific area including local access roads, amenities, and local parks. The use of gross density, which is simply the number of people living in a defined area divided by the area to give the number of persons per hectare, is misleading and has led to confusion and error in the past. Densities should always be related to defined urban uses if comparisons are to be made. Gross densities can, of course, be used, but care should be exercised with any conclusions reached as a result of such an analysis.

This parameter is categorized as follows:

a. Population density greater than 400 cap/ha.

b. Population density between 325 and less than 400 cap/ha.

c. Population density between 250 and less than 325 cap/ha.

d. Population density between 175 and less than 250 cap/ha.

e. Population density between 100 and less than 175 cap/ha.

f. Population density less than 100 cap/ha.

The score assignment of categorization is evaluated by five experts and the results of average scores are illustrated in Table 20.

City Potential

Ideally, it is better to express the city potential in terms of income per family, but for most of the city the data is not available, and also it is difficult to assess because incomes are not stable and do not come from merely one source for most people living in low urban areas. Saunders and Warford (58) stated that even if the real income level was known, there is the second question: What amount of a family's real income can be spent on water and excreta/wastewater disposal?

Table 20

SCORE ASSIGNMENT OF CATEGORIZATION FOR PARAMETER POPULATION DENSITY BY PANEL MEMBERS

	Name of Expert					
Category	Gould	Harper	Huisman	Muttamara	Soetiman	Average Score
a	20	20	25	20	14	19.8
b	15	13	17	15	13	14.6
c	10	12	10	10	10	10.4
d	7	10	5	5	9	7.2
e	5	4	2	5	8	4.8
f	3	1	1	5	6	3.2

Therefore, it is better to express city economic growth potential in terms of industrial development, availability of mineral resources (such as oil, natural gas, coal, tin, nickel, etc.) and manpower. Industrial development is evaluated in terms of high or low growth industry. High-growth industry is defined when the product of the industry can supply most people in the country with cigarettes, sugar, textiles, or exported products. Low-growth industry is defined when the product of the industry can only supply local consumption, such as home industry of handicraft, etc. The availability of mineral resources will indicate high-growth industry of the related resources, so that industry is excluded in the categorization and score processing.

In terms of manpower requirements, WHO suggests a variety of disciplines involved, as in the following list:

Professional workers: sanitary and public health engineers, civil, chemical, biological, and public health inspectors.

Sub-professional and skilled workers: health assistants, technicians, operators, workshop and office staff, corresponding to the various professional groups.

Semi-skilled and unskilled workers: health aides, drivers, plant operators, laborers, orderlies.

For most of the cities in Indonesia, the types of personnel required as suggested by WHO are not available. Therefore, for the simplicity of categorization and scoring, the availability of manpower is expressed in terms of whether there are sanitary or civil engineers working for the city or whether engineers are not available.

This parameter is categorized as follows:

a. High-growth industry, mineral resources and civil or sanitary engineers available.

b. High-growth industry, no mineral resources, civil or sanitary engineers available.

c. Low- or no-growth industry, mineral resources and civil or sanitary engineers available.

d. Low- or no-growth industry, no mineral resources, civil or sanitary engineers available.

e. Low- or no-growth industry, mineral resources available, no sanitary or civil engineers.

f. All of industry, mineral resources, sanitary or civil engineers are not available.

The score assignment of categorization is evaluated by five experts and the resultant average scores are illustrated in Table 21.

Table 21

SCORE ASSIGNMENT OF CATEGORIZATION FOR PARAMETER CITY POTENTIAL BY PANEL MEMBERS

	Name of Experts					
Category	Beyer	Cleveland	Donaldson	Reyes	Saunder	Average Score
a	25	17	30	16	25	22.6
b	15	14	10	13	20	14.4
c	10	10	10	10	10	10.0
d	5	8	5	8	0	5.2
e	3	6	5	8	5	5.4
f	2	5	0	5	5	2.4

One comment came from Reyes which stated that two categories are excluded from the possible combination, namely, (1) High-growth industry, no mineral resources and no civil or sanitary engineers, and (2) High-growth industry, mineral resources available and no civil or sanitary engineer available.

With respect to this comment, it is true that two possible combinations are excluded. Usually in the city where high-growth industry and mineral resources are available, it is always balanced by availability of manpower, such as sanitary or civil engineers. However, in case one out of two combinations exist in a city, a possible solution can be solved as follows.

Since a three-dimension matrix was used in the combination of category and assuming each dimension has equal scores, so the score of high-growth industry, no mineral resources and no civil or sanitary engineer is assigned similar to category (d), whereas the score of high-growth industry, mineral resources available and no civil or sanitary engineer available is assigned similar to category (c). This was done by assuming that each dimension in the combination matrix has equal scores.

Water supply condition

With few exceptions, since most of the water supply quality in Indonesia does not meet national standards of drinking water quality promulgated by the Ministry of Health, categorization will be based on quantity of water consumption and percentage of population served by house connections.

This parameter is categorized as follows:

a. Water consumption greater than 200 l/cap/day, population served by house connection greater than or equal to 35 percent.

b. Water consumption between 100-200 l/cap/day, population served by house connection greater than or equal to 35 percent.

c. Water consumption less than 100 l/cap/day, population served by house connection greater than or equal to 35 percent.

d. Water consumption greater than 200 l/cap/day, population served by house connection less than 35 percent.

e. Water consumption between 100-200 l/cap/day, population served by house connection less than 35 percent.

f. Water consumption less than 100 l/cap/day, population served by house connection less than 35 percent.

The score assignment of categorization is evaluated by five experts and the results of average scores are illustrated in Table 22.

Table 22

SCORE ASSIGNMENT OF CATEGORIZATION FOR PARAMETER WATER SUPPLY CONDITION BY PANEL MEMBERS

	Name of Experts					
Category	Malina	Oey	Sheedy	Wanielista	Whyte	Average Score
a	15	20	20	20	10	17.0
b	10	12	15	15	15	13.4
c	5	10	10	12	20	11.4
d	15	9	5	8	5	8.4
e	10	5	5	5	5	6.0
f	5	4	5	0	10	4.8

Technological Alternatives

The categorization of technological alternatives is based on economic costs prepared by the World Bank and International Development Research Center. Those alternatives which are clearly outside the bounds of consumer affordability (such as Western type) are excluded. There are a number of studies that have attempted an economic comparison between different urban systems (56). The general method is the same; that is, to determine the least cost solution while considering certain factors such as population density and interest rates. Only the capital and operating costs are considered. The fact that these studies utilize an abstract site limits their application to actual conditions, though the methodology is instructive. A number of engineering master plans have made economic comparisons of two or more systems, but these are also least financial cost calculations that give a very crude picture indeed, as they cannot realistically take into account side benefits.

The difficulties with evaluating different systems on the basis of economic comparisons are multiple. The cost benefits of the different technologies are not equally understood, and the data on some of the systems are quite meager. It is difficult, if not impossible, to take into account, in money terms, the social-cultural-medical aspects of sanitation without distorting them or losing their significance. It is difficult to incorporate important factors, such as the extent of off-shore costs versus the use of locally available materials. Finally, it is impossible to compare the economics of the systems that are essentially engineering works (cartage and waterborne) with systems that could be implemented on an individual scale (on-site). Table 23 summarizes in a very general way some of the significant characteristics of the three classes of systems, waterborne, cartage, and on-site. These characteristics will, of course, vary from country to country, and final decisions would require quantitative data.

Table 23

A SUMMARY OF THE SIGNIFICANT CHARACTERISTICS
OF THE THREE CLASSES OF SYSTEMS

	Waterborne	Cartage	On-site
Capital cost	High	High/low	Low
Operating cost	Low	High	Low
Offshore cost component	High	High/low	Nil
Water consumption	High	Low/nil	Low/nil
Optimal density	High density (high rise)	High density (low rise)	High and low density (low rise)
Adaptability to incremental implementation	Nil	High	High
Adaptability to self-help	Nil	Low	High
Reuse potential	High	High	High/low

Source: Rybczynski, W. et al.; <u>A State-of-the-Art Review and Annotated Bibliography, Low-Cost Technology Options for Sanitation</u>, IDRC, 1978.

This parameter is categorized as follows:

a. The On-site Options: pit latrine, pit privy, cesspool, Reid's odorless earth closet (ROEC), aqua privy, communal/low-cost septic tanks, compost privy, etc.

b. The Cartage Options: night soil collection, house vault and vacuum truck, composting, etc.

c. The Waterborne Options or Septic Tank:[1] waterborne sewerage with conventional treatment, such as stabilization pond, aqua culture, hyacinths pond, marine waste disposal, etc., or septic tank.

d. The Western Type: waterborne sewerage with complete treatment.

The score assignment of categorization is evaluated by five experts and results of average scores are illustrated in Table 24.

As can be seen from Tables 19, 20, 21, 22 and 24, the lowest average score is 2.0 for category (f) of parameter health hazards and the highest score is 25.6 for category (a) of parameter health hazards, as well. To simplify in calculation of priority index, the highest score is made equal to 10 by dividing this number by 2.56; consequently, all average

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[1]There are indications that in urban areas septic tanks will often cost more on a per-household basis than conventional waterborne sewerage.

Source: -McGarry, M. G. "Waste Collection in Hot Climates: A Technical and Economic Appraisal," Water, Wastes and Health in Hot Climates, edited by Feachem, R. et al., A Wiley-Interscience Publication, 1977, p. 251.

-The World Bank, Appropriate Sanitation Alternatives: A Technical and Economic Appraisal, Final draft, Vol. 1, 1978, p. 50.

Table 24

SCORE ASSIGNMENT OF CATEGORIZATION FOR PARAMETER TECHNOLOGICAL ALTERNATIVES BY PANEL MEMBERS

	Name of Experts					
Category	Gearheart	Pineo	Raman	Soemarto	Thung	Average Score
a	7	10	20	15	15	13.4
b	10	0	5	5	5	6.3
c	20	25	8	10	15	19.5
d	3	5	7	10	5	6.0

scores of each category also should be divided by 2.56 to obtain an equal ratio, and make it a round number.

Table 25 summarizes the average score of each category for each parameter after dividing all numbers by 2.56.

Table 25

AVERAGE SCORE DISTRIBUTION OF EACH CATEGORY FOR EACH PARAMETER

	Parameter				
Category	Health hazards	Population density	City potential	Water supply condition	Technological alternatives
a	10	8	9	7	5
b	5	6	6	5	2
c	4	4	4	4	8
d	3	3	2	3	2
e	2	2	2	2	
f	1	1	1	2	

CHAPTER IV

TEST OF THE MODEL

Introduction

To demonstrate the usefulness of the model, a test will be executed for several cities in Indonesia. This test will provide guidelines to the planners who are involved in the Indonesian Urban Excreta/Wastewater Disposal Program.

As mentioned earlier, the funds, plans, designs and supervision of construction is executed by the central government, i.e., Directorate of Sanitary Engineering, so the priority setting will be made at the national level. In every province, the central government appointed a project manager who is a well-trained engineer. He is responsible for the success of the urban water supply and excreta/wastewater disposal program within the province areas. He must consider the political situation in his territory and keep the projects under control. The raw data necessary to meet all parameters can be collected by the project manager, since he knows much more about the urban conditions and characteristics in his area, besides community needs than do the officials of the central government. The questionnaire presented in Appendix J can be used as a tool for collecting the raw data necessary. Additional data and information, if desirable, are easy to obtain at the city level.

Since the urban excreta/wastewater disposal program has just begun, April 1, 1979, one parameter, namely, technological alternatives, cannot be validated because the choice of the most appropriate method of every city should involve a careful consideration of social, cultural and institutional factors. At the present time the government is conducting several surveys/feasibility studies for excreta/ wastewater purposes; thus what kind of disposal is appropriate for every local condition cannot be decided as yet.

In data processing, all of the parameter categories are presented in lists and tables, and all parameters are quantified. The guidelines will be presented in such a way that they are self-explanatory and easy to understand, especially in data analysis, categorization and score assignment.

Data Collection and Validation

Actually, the necessary data to test the priority model can be obtained using a questionnaire, as presented in Appendix J. However, since this procedure will take a long period of time, the author collected the data from water supply feasibility studies and master plans for several hundred cities in Indonesia. The Directorate of Sanitary Engineering, Directorate General of Housing, Building, Planning and Urban Development, Ministry of Public Works, have made several feasibility studies/master plans, as well as engineering designs for urban water supply throughout the country. The master plan for big cities has been financed from international aid and U.N. agencies grants as well as loans, whereas medium and smaller cities were financed from government budgets. The feasibility studies, master plans, and engineering designs were conducted by foreign as well as local consulting engineers. The author gathered the data necessary to meet the categories of all parameters from these consulting engineers, most of which were located at Jakarta and Bandung. From several hundreds of feasibility studies and master plans of urban water supply made by several consulting engineers, 80 cities were selected to test the model, because these cities possessed the most complete data necessary to test the model. The data, such as net population density, city potential and water supply condition were very easy to obtain. However since the master plans are used for water supply purposes, only waterborne diseases are reported. Fortunately, there are some consulting engineers who keep other data of diseases, such as excreted infectious diseases, which are not reported in the master plans. Also, information on other excreted infectious diseases is available at the Central Bureau of Statistics, so that mortality and morbidity caused by those diseases can be calculated. Table 26 shows the raw data requirements to meet all categories of parameters, except parameter technological alternatives.

Table 26

RAW DATA REQUIREMENTS TO TEST THE PRIORITY MODEL

ISLAND City	HEALTH HAZARDS		NET POPULATION	CITY POTENTIAL			WATER SUPPLY CONDITION	
	MORTALITY per 100,000	MORBIDITY per year	DENSITY cap/ha	INDUSTRIAL GROWTH a)	MINERAL RESOURCES a)	MANPOWER	Water Consumption l/cap/day	% Pop. Served by H.C. b)
SUMATRA								
1. Takengon	48	870	121	0	0	0	130	7
2. Kisaran	12	588	147	0	0	0	56	10
3. Tanjungbalai	88	1,765	408	0	0	0	77	40
4. Pematang Siantar	26	1,779	395	Cigarettes, etc.	0	1	28	35
5. Bukit Tinggi	7	613	124	0	0	5	250	17
6. Sawah Lunto	24	768	75	0	Coal	0	375	1
7. Lubuk Sikaping	35	1,247	51	0	0	0	0	0
8. Padang	44	3,545	183	Crumb rubber, etc.	Cement	5	417	22
9. Sekayu	97	1,205	126	0	0	0	0	0
10. Baturaja	26	2,548	278	0	Cement	0	0	0
11. Mulaboh	30	1,894	166	0	0	0	0	0
12. Lahat	18	3,848	140	0	Coal	0	128	20
13. Pangkalpinang	6	1,455	188	0	Tin	1	123	14
14. Muara Bungo	22	1,942	52	0	0	0	0	0
15. Kuala Tungkal	24	833	98	0	0	0	0	0
16. Bangko	121	12,500	70	0	0	0	0	0
17. Manna	70	2,450	28	0	Tin	0	0	0
18. Tembilahan	18	1,185	46	Lumber	0	0	0	0

a) High industrial growth is indicated by the type of industry in the related column. Low- or no-growth industry is indicated by 0.

b) H.C. = House Connection

Table 26 continued

ISLAND City	HEALTH HAZARDS		NET POPULATION	CITY POTENTIAL			WATER SUPPLY CONDITION	
	MORTALITY per 100,000	MORBIDITY per year	DENSITY cap/ha	INDUSTRIAL GROWTH	MINERAL RESOURCES	MANPOWER	Water Consumption l/cap/day	% Pop. Served by H.C.
JAVA								
19. Bogor	76	3,125	412	Pharmacy, etc.	Cement	5	101	38
20. Majalengka	39	2,640	173	0	0	0	21	10
21. Majalaya	45	1,465	121	Textile	0	0	0	0
22. Bekasi	57	2,550	315	0	0	1	0	0
23. Cirebon	97	2,164	329	Fisheries, etc.	Oil	5	150	40
24. Ciamis	9	2,700	148	0	0	1	28	24
25. Indramayu	84	7,818	138	0	0	0	147	1
26. Salatiga	10	1,875	129	0	0	0	99	25
27. Sragen	35	949	281	Sugar	0	0	0	0
28. Rembang	15	1,146	175	0	0	0	231	5
29. Kudus	28	834	249	Cigarettes, etc.	0	1	0	0
30. Jowana	42	2,814	258	0	0	0	104	10
31. Purwodadi	19	2,021	266	0	0	0	87	12
32. Magelang	18	978	300	0	0	2	242	44
33. Purwokerto	40	845	225	0	0	1	168	10
34. Tegal	12	1,500	368	0	0	0	140	18
35. Surakarta	14	1,890	392	Cigarettes	0	2	135	14
36. Bojolali	25	2,542	186	0	0	0	280	20
37. Gresik	86	3,904	286	Petro chemicals	Cement	2	173	10
38. Mojokerto	34	894	319	Sugar	0	1	225	9
39. Jombang	24	1,050	227	Sugar	0	0	214	6
40. Malang	15	712	316	Cigarettes, etc.	Caoline	4	117	39
41. Wonosari	41	2,022	220	0	0	0	0	0
42. Lumajang	20	1,945	114	0	0	0	127	10
43. Jember	11	745	202	Coffee	0	2	210	10

Table 26 continued

ISLAND City	HEALTH HAZARDS MORTALITY per 100,000	MORBIDITY per year	NET POPULATION DENSITY cap/ha	CITY POTENTIAL INDUSTRIAL GROWTH	MINERAL RESOURCES	MANPOWER	WATER SUPPLY CONDITION Water Consumption l/cap/day	% Pop. Served by H.C.
44. Sampang	8	817	184	0	0	1	12	80
45. Pamekasan	32	2,740	198	0	0	0	88	30
46. Lamongan	33	644	100	0	Gips	0	159	8
47. Pacitan	25	2,119	148	0	0	0	24	10
48. Probolinggo	19	2,455	216	Sugar	0	1	126	3
KALIMANTAN								
49. Balikpapan	57	3,408	216	0	Oil	4	172	2
50. Sampit	46	1,807	128	Crumb rubber	0	0	0	0
51. Pangkalan Bun	77	963	95	Lumber	0	0	0	0
52. Tarakan	28	1,660	97	0	Oil	1	0	0
53. Ketapang	94	5,000	76	Lumber	0	0	0	0
54. Samarinda	86	3,125	201	Plywood	Natural gas	4	33	14
55. Banjarmasin	90	4,703	180	Crumb rubber	0	5	34	17
56. Palangka Raya	18	2,011	141	0	0	4	64	15
57. Barabai	57	1,969	99	Lumber	0	0	0	0
58. Pontianak	85	7,046	348	Crumb rubber	0	5	88	19
59. Kandangan	29	438	168	Lumber	0	0	0	0
60. Martapura	38	1,425	264	Paper	Diamonds	1	0	0
SULAWESI								
61. Menada	17	1,064	240	Assembly	0	5	168	50
62. Limboto	53	2,112	125	Fried Oil	0	0	0	0
63. Kotamubagu	0	828	97	0	0	0	0	0

Table 26 continued

ISLAND City	HEALTH HAZARDS MORTALITY per 100,000	MORBIDITY per year	NET POPULATION DENSITY cap/ha	CITY POTENTIAL INDUSTRIAL GROWTH	MINERAL RESOURCES	MANPOWER	WATER SUPPLY CONDITION Water Consumption l/cap/day	% Pop. Served by H.C.
64. Palopo	28	879	104	0	0	0	176	7
65. Majene	37	620	121	0	0	0	182	1
66. Raha	64	7,142	89	0	0	0	0	0
67. Bau-bau	49	1,814	74	0	0	0	8	8
68. Watampone	40	2,685	101	0	0	0	129	2
69. Pare-pare	24	2,242	65	0	0	1	133	4
BALI								
70. Denpasar	25	870	249	0	0	4	14	45
71. Klungkung	29	1,134	135	0	0	1	63	10
72. Kintamani	32	1,925	187	0	0	1	126	2
73. Bangli	35	1,430	124	0	0	0	88	4
74. Sumbawa besar	50	991	95	0	0	0	0	0
75. Selong	79	2,561	94	0	0	0	0	0
76. Kupang	27	1,024	105	0	0	1	77	8
IRIAN JAYA								
77. Merauke	41	2,000	82	0	Copper	0	67	15
78. Sorong	38	2,485	158	0	Oil	0	87	20
79. Serui	72	2,756	87	0	0	0	0	0
80. Fak-Fak	25	1,245	106	0	0	0	77	14

Since the purpose of the test is to demonstrate the data processing and utilization of the model, it is not necessary to work on all of the cities for the purpose of testing the model, because it would be very time-consuming and space-consuming. Therefore, only 80 cities representing 19 provinces out of 27 will be tested for priority computation.

Score Processing

Categorization of the data and score assignment of each data category will be presented in this section to provide a clear example. As can be seen from Table 26, mortality rates caused by excreted infections range from 0 to 121 per 100,000, whereas morbidity rates range from 438 to 12,500 per 100,000. One interesting point is that no mortality is present in city No. 63 and morbidity is low, although there are no water supply facilities provided by the government. This city belongs to category (f) for health hazards with a score of 1. The highest mortality and morbidity is city No. 16 with mortality greater than 75 and morbidity greater than 1,000; therefore this city belongs to category (a) with a score of 10. The same category should be applied to cities Nos. 3, 9, 16, 23, 25, 51, 53, 54, 55, 58, and 59 since these cities have the same conditions as city No. 16. Table 27 presents categorization and scoring for parameter health hazards; it can be seen that the data meets most categories of this parameter. Table 28 presents categorization and scoring for parameter population density. The net

Table 27

CATEGORY AND SCORE FOR HEALTH HAZARDS PARAMETER

No.	City	Category	Score
1.	Takengon	d	3
2.	Kisaran	f	1
3.	Tanjungbalai	a	10
4.	Pematang Siantar	a	10
5.	Bukit Tinggi	f	1
6.	Sawah Lunto	f	1
7.	Lubuk Sikaping	c	4
8.	Padang	c	4
9.	Sekayu	a	10
10.	Baturaja	c	4
11.	Mulaboh	c	4
12.	Lahat	e	2
13.	Pangkalpinang	e	2
14.	Muara Bunga	e	2
15.	Kuala Tungkal	f	1
16.	Bangko	a	10
17.	Manna	c	4
18.	Tembilahan	e	2
19.	Bogor	a	10
20.	Majalengka	c	4
21.	Majalaya	c	4
22.	Bekasi	c	4
23.	Cirebon	a	10
24.	Ciamis	e	2
25.	Indramayu	a	10
26.	Salatiga	e	2
27.	Sragen	d	3
28.	Rembang	e	2
29.	Kudus	d	3
30.	Jowana	d	3
31.	Purwodadi	e	2
32.	Magelang	f	1
33.	Purawokerto	d	3
34.	Tegal	e	2
35.	Surakarta	e	2
36.	Bojolali	c	4
37.	Gresik	a	10
38.	Mojokerto	d	3
39.	Jombang	e	2
40.	Malang	f	1
41.	Wonosari	c	4
42.	Lumajang	e	2

Table 27 continued

No.	City	Category	Score
43.	Jember	f	1
44.	Sampang	f	1
45.	Pamekasan	c	4
46.	Lamongan	d	3
47.	Pacitan	c	4
48.	Probolinggo	e	2
49.	Balikpapan	c	4
50	Sampit	c	4
51.	Pangkalan Bun	b	5
52.	Tarakan	c	4
53.	Ketapang	a	10
54.	Samarinda	a	10
55.	Banjarmasin	a	10
56.	Palangka Raya	e	2
57.	Barabai	c	4
58.	Pontianak	a	10
59.	Kandangan	d	3
60.	Martapura	c	4
61.	Menado	e	2
62.	Limboto	c	4
63.	Kotamubagu	f	1
64.	Palopo	d	3
65.	Majene	d	3
66.	Raha	c	4
67.	Bau-bau	c	4
68.	Watampone	c	4
69.	Pare-pare	e	2
70.	Denpasar	d	3
71.	Klungkung	c	4
72.	Kintamani	c	4
73.	Bangli	c	4
74.	Sumbawa Besar	d	3
75.	Selong	a	10
76.	Kupang	c	4
77.	Merauke	c	4
78.	Sorong	c	4
79.	Serui	c	4
80.	Fak-Fak	c	4

Table 28

CATEGORY AND SCORE FOR POPULATION DENSITY PARAMETER

No.	City	Category	Score
1.	Takengon	e	2
2.	Kisaran	e	2
3.	Tanjungbalai	a	8
4.	Pematang Siantar	b	6
5.	Bukit Tinggi	e	2
6.	Sawah Lunto	f	1
7.	Lubuk Sikaping	f	1
8.	Padang	d	3
9.	Sekayu	e	2
10.	Baturaja	c	4
11.	Mulaboh	e	2
12.	Lahat	e	2
13.	Pangkalpinang	d	3
14.	Muara Bunga	f	1
15.	Kuala Tungkal	f	1
16.	Bangko	f	1
17.	Manna	f	1
18.	Tembilahan	f	1
19.	Bogor	a	8
20.	Majalengka	e	2
21.	Majalaya	e	2
22.	Bekasi	c	4
23.	Cirebon	b	6
24.	Ciamis	e	2
25.	Indramayu	e	2
26.	Salatiga	e	2
27.	Sragen	c	4
28.	Rembang	d	3
29.	Kudus	d	3
30.	Jowana	c	4
31.	Purwodadi	c	4
32.	Magelang	c	4
33.	Purawokerto	d	3
34.	Tegal	b	6
35.	Surakarta	b	6
36.	Bojolali	d	3
37.	Gresik	c	4
38.	Mojokerto	c	4
39.	Jombang	d	3
40.	Malang	c	4
41.	Wonosari	d	3
42.	Lumajang	e	2

Table 28 continued

No.	City	Category	Score
43.	Jember	d	3
44.	Sampang	d	3
45.	Pamekasan	d	3
46.	Lamongan	e	2
47.	Pacitan	e	2
48.	Probolinggo	d	3
49.	Balikpapan	d	3
50.	Sampit	e	2
51.	Pangkalan Bun	f	1
52.	Tarakan	f	1
53.	Ketapang	f	1
54.	Samarinda	d	3
55.	Banjarmasin	d	3
56.	Palangka Raya	e	2
57.	Barabai	f	1
58.	Pontianak	b	6
59.	Kandangan	e	2
60.	Martapura	c	4
61.	Menado	d	3
62.	Limboto	e	2
63.	Kotamubagu	f	1
64.	Palopo	e	2
65.	Majene	e	2
66.	Raha	f	1
67.	Bau-bau	f	1
68.	Watampone	e	2
69.	Pare-pare	f	1
70.	Danpasar	d	3
71.	Klungkung	e	2
72.	Kintamani	d	3
73.	Bangli	e	2
74.	Sumbawa Besar	f	1
75.	Selong	f	1
76.	Kupang	e	2
77.	Merauke	f	1
78.	Sorong	e	2
79.	Serui	f	1
80.	Fak-Fak	e	2

population density, which is defined as the number of people per hectare in a specific area including local access roads, local open parks and amenities, is used in the categorization. The net population density ranges from 51 to 412 capita per hectare. The categorization is easy to apply, so no further explanation is necessary.

The data for parameter city potential is also presented in Table 26.

As mentioned earlier, a three-dimension matrix was used in the categorization of the city potential parameter, namely, availability of industrial growth, mineral resources and manpower. Category (a) should be applied to city Nos. 8, 19, 23, 37, 40 and 54 with a score of 9 since high industrial growth, mineral resources and manpower are available in those cities. Most cities, i.e., 32 out of 80, are applied to category (f) with a score of 1 since no local resources are available in those cities. However, the data meets most categories of parameter city potential, as presented in Table 29.

Table 30 shows categorization and scoring for parameter water supply condition. Since water supply condition in most cities are below standard, only one city, namely, city No. 32, belongs to category (a) with a score of 7. However, the data meets most of the categories of this parameter. The categorization is easy to apply, so no further explanation is necessary.

Table 29

CATEGORY AND SCORE FOR CITY POTENTIAL PARAMETER

No.	City	Category	Score
1.	Takengon	f	1
2.	Kisaran	f	1
3.	Tanjungbalai	f	1
4.	Pematang Siantar	b	6
5.	Bukit Tinggi	d	2
6.	Sawah Lunto	e	2
7.	Lubuk Sikaping	f	1
8.	Padang	a	9
9.	Sekayu	f	1
10.	Baturaja	e	2
11.	Mulaboh	f	1
12.	Lahat	e	2
13.	Pangkalpinang	e	4
14.	Muara Bunga	f	1
15.	Kuala Tungkal	f	1
16.	Bangko	f	1
17.	Manna	e	2
18.	Tembilahan	d	2
19.	Bogor	a	9
20.	Majalengka	f	1
21.	Majalaya	d	2
22.	Bekasi	d	2
23.	Cirebon	a	9
24.	Ciamis	d	2
25.	Indramayu	f	1
26.	Salatiga	f	1
27.	Sragen	d	2
28.	Rembang	f	1
29.	Kudus	b	6
30.	Jowana	f	1
31.	Purwodadi	f	1
32.	Magelang	d	2
33.	Purawokerto	d	2
34.	Tegal	f	1
35.	Surakarta	b	6
36.	Bojolali	f	1
37.	Gresik	a	9
38.	Mojokerto	b	6
39.	Jombang	d	2
40.	Malang	a	9
41.	Wonosari	f	1
42.	Lumajang	f	1

Table 29 continued

No.	City	Category	Score
43.	Jember	b	6
44.	Sampang	d	2
45.	Pamekasan	f	1
46.	Lamongan	e	2
47.	Pacitan	f	1
48.	Probolinggo	b	6
49.	Balikpapan	c	4
50.	Sampit	h	2
51.	Pangkalan Bun	h	2
52.	Tarakan	c	4
53.	Ketapang	d	2
54.	Samarinda	a	9
55.	Banjarmasin	b	6
56.	Palangka Raya	d	2
57.	Barabai	d	2
58.	Pontianak	b	6
59.	Kandangan	d	2
60.	Martapura	a	9
61.	Menado	b	6
62.	Limboto	d	2
63.	Kotamubagu	f	1
64.	Palopo	f	1
65.	Majene	f	1
66.	Raha	f	1
67.	Bau-bau	f	1
68.	Watampone	f	1
69.	Pare-pare	f	1
70.	Denpasar	d	2
71.	Klungkung	d	2
72.	Kintamani	d	2
73.	Bangli	f	1
74.	Sumbawa Besar	f	1
75.	Selong	f	1
76.	Kupang	d	2
77.	Merauke	e	2
78.	Sorong	e	2
79.	Seriu	f	1
80.	Fak-Fak	f	1

Table 30

CATEGORY AND SCORE FOR WATER SUPPLY CONDITION PARAMETER

No.	City	Category	Score
1.	Takengon	e	2
2.	Kisaran	f	2
3.	Tanjungbalai	c	4
4.	Pematang Siantar	c	4
5.	Bukit Tinggi	d	3
6.	Sawah Lunto	d	3
7.	Lubuk Sikaping	f	2
8.	Padang	d	3
9.	Sekayu	f	2
10.	Baturaja	f	2
11.	Mulaboh	f	2
12.	Lahat	e	2
13.	Pangkalpinang	e	2
14.	Muara Bunga	f	2
15.	Kuala Tungkal	f	2
16.	Bangko	f	2
17.	Manna	f	2
18.	Tembilahan	f	2
19.	Bogor	b	6
20.	Majalengka	f	2
21.	Majalaya	f	2
22.	Bekasi	f	2
23.	Cirebon	b	5
24.	Ciamis	f	2
25.	Indramayu	e	2
26.	Salatiga	f	2
27.	Sragen	f	2
28.	Rembang	d	3
29.	Kudus	f	2
30.	Jowana	e	2
31.	Purwodadi	f	2
32.	Magelang	a	7
33.	Purawokerto	e	2
34.	Tegal	e	2
35.	Surakarta	e	2
36.	Bojolali	d	3
37.	Gresik	e	2
38.	Mojokerto	d	3
39.	Jombang	d	3
40.	Malang	b	5
41.	Wonosari	f	2
42.	Lumajang	e	2

Table 30 continued

No.	City	Category	Score
43.	Jember	d	3
44.	Sampang	c	4
45.	Pamekasan	f	2
46.	Lamongan	e	2
47.	Pacitan	f	2
48.	Probolinggo	e	2
49.	Balikpapan	e	2
50.	Sampit	f	2
51.	Pangkalan Bun	f	2
52.	Tarakan	f	2
53.	Ketapang	f	2
54.	Samarinda	f	2
55.	Banjarmasin	f	2
56.	Palangka Raya	f	2
57.	Barabai	f	2
58.	Pontianak	f	2
59.	Kandangan	f	2
60.	Martapura	f	2
61.	Menado	b	5
62.	Limboto	f	2
63.	Kotamubagu	f	2
64.	Palopo	e	2
65.	Majene	e	2
66.	Raha	f	2
67.	Bau-bau	f	2
68.	Watampone	e	2
69.	Pare-pare	e	2
70.	Denpasar	c	4
71.	Klungkung	f	2
72.	Kintamani	e	2
73.	Bangli	f	2
74.	Sumbawa Besar	f	2
75.	Selong	f	2
76.	Kupang	f	2
77.	Merauke	f	2
78.	Sorong	f	2
79.	Serui	f	2
80.	Fak-Fak	f	2

Table 31

SUMMARY OF SCORES OF THE FOUR PARAMETERS
FOR THE 80 CITIES

No.	City	Health Hazards	Population Density	City Potential	Water Supply Condition
1.	Takengon	3	2	1	2
2.	Kisaran	1	2	1	2
3.	Tanjungbalai	10	8	1	4
4.	Pematang Siantar	10	6	1	4
5.	Bukit Tinggi	1	2	2	3
6.	Sawah Lunto	1	1	2	3
7.	Lubuk Sikaping	4	1	1	2
8.	Padang	4	3	9	3
9.	Sekayu	10	2	1	2
10.	Baturaja	4	4	2	2
11.	Mulaboh	4	2	1	2
12.	Lahat	2	2	2	2
13.	Pangkalpinang	2	3	4	2
14.	Muara Bunga	2	1	1	2
15.	Kuala Tungkal	1	1	1	2
16.	Bangko	10	1	1	2
17.	Manna	4	1	2	2
18.	Tembilahan	2	1	2	2
19.	Bogor	10	8	9	5
20.	Majalengka	4	2	1	2
21.	Majalaya	4	2	2	2
22.	Bekasi	4	4	2	2
23.	Cirebon	10	6	9	5
24.	Ciamis	2	2	2	2
25.	Indramayu	10	2	1	2
26.	Salatiga	2	2	1	2
27.	Sragen	3	4	1	2
28.	Rembang	2	3	1	3
29.	Kudus	3	3	6	2
30.	Jowana	3	4	1	2
31.	Purwodadi	2	4	1	2
32.	Magelang	1	4	2	7
33.	Purawokerto	3	3	2	2

Table 31 continued

No.	City	Health Hazards	Population Density	City Potential	Water Supply Condition
34.	Tegal	2	6	1	2
35.	Surakarta	2	6	6	2
36.	Bojolali	4	3	1	3
37.	Gresik	10	4	9	2
38.	Mojokerto	3	4	6	3
39.	Jombang	2	3	2	3
40.	Malang	1	4	9	5
41.	Wonosari	4	3	1	2
42.	Lumajang	2	2	1	2
43.	Jember	1	3	6	3
44.	Sampang	1	3	2	4
45.	Pamekasan	4	3	1	2
46.	Lamongan	3	2	2	2
47.	Pacitan	4	2	1	2
48.	Probolinggo	2	3	6	2
49.	Balikpapan	4	3	4	2
50.	Sampit	4	2	2	2
51.	Pangkalan Bun	5	1	2	2
52.	Tarakan	4	1	4	2
53.	Ketapang	10	1	2	2
54.	Samarinda	10	3	9	2
55.	Banjarmasin	10	3	6	2
56.	Palangka Raya	2	2	2	2
57.	Barabai	4	1	2	2
58.	Pontianak	10	6	6	2
59.	Kandangan	3	2	2	2
60.	Martapura	4	4	9	2
61.	Menado	2	3	6	5
62.	Limboto	4	2	2	2
63.	Kotamubagu	1	1	1	2
64.	Palopo	3	2	1	2
65.	Majene	3	2	1	2
66.	Raha	4	1	1	2
67.	Bau-bau	4	1	1	2
68.	Watampone	4	2	1	2

Table 31 continued

No.	City	Health Hazards	Population Density	City Potential	Water Supply Condition
69.	Pare-pare	2	1	1	2
70.	Denpasar	3	3	2	4
71.	Klungkung	4	2	2	2
72.	Kintamani	4	3	2	2
73.	Bangli	4	2	1	2
74.	Sumbawa Besar	3	1	1	2
75.	Selong	10	1	1	2
76.	Kupang	4	2	2	2
77.	Merauke	4	1	2	2
78.	Sorong	4	2	2	2
79.	Serui	4	1	1	2
80.	Fak-Fak	4	2	1	2

The scores for the four parameters for the 80 cities are summarized in Table 31.

Priority Computations

The linear combination of variable $\sum_{i=1}^{5} W_i . S_{ij}$ is used to determine ranked priority or priority index. The mathematical terms represent matrix system in which the cities represent matrix rows and the parameters represent matrix columns. The entries consist of the product of weight times score of each parameter; that is $W_i . S_{ij}$. Both the value of W_i and S_{ij} was determined using the Double Delphi Method. The value of W_i was summarized in Table 13 and the value of S_{ij} was summarized in Table 25. The scores of the four parameters for the 80 cities were summarized in Table 31. Thus, the product of $W_i . S_{ij}$ can easily be determined and the value of priority index PI is the summation of $W_i . S_{ij}$. The values of PI for the above 80 cities have been computed and presented in Table 32.

Discussion of Results

As can be seen from Table 32 the PI value ranges from 106 to 736. The higher the PI value the higher the priority of the city to receive the facility of excreta/wastewater disposal system first. Parameter health hazards, which receives the highest weight in selecting project localities, is the most important and greatly affects the priority index value, especially category (a) with a score of 10. The difference

Table 32

PI VALUES FOR 80 CITIES IN INDONESIA

	CITY	$W_i . S_{ij}$ Health Hazards	Population Density	City Potential	Water Supply Condition	PI
1.	Takengon	105	38	16	36	195
2.	Kisaran	35	38	16	36	125
3.	Tanjung Balai	350	152	16	72	590
4.	Pematang Siantar	350	114	96	72	632
5.	Bukit Tinggi	35	38	32	54	159
6.	Sawah Lunto	35	19	32	54	140
7.	Lubuk Sikaping	140	19	16	36	211
8.	Padang	140	57	144	54	395
9.	Sekayu	350	38	16	36	440
10.	Baturaja	140	76	32	36	284
11.	Mulaboh	140	38	16	36	230
12.	Lahat	70	38	32	36	176
13.	Pangkal Pinang	70	57	64	36	227
14.	Muara Bungo	70	19	16	36	141
15.	Kuala Tungkal	35	19	16	36	106
16.	Bangko	350	19	32	36	421
17.	Manna	140	19	32	36	227
18.	Tembilahan	70	19	32	36	157
19.	Bogor	350	152	144	90	736
20.	Majalengka	140	38	16	36	230
21.	Majalaya	140	38	32	36	246
22.	Bekasi	140	76	32	36	284
23.	Cirebon	350	114	144	90	698
24.	Ciamis	70	38	32	36	176
25.	Indramayu	350	38	16	36	440
26.	Salatiga	70	38	16	36	160
27.	Sragen	105	76	32	36	249
28.	Rembang	70	57	16	54	197
29.	Kudus	105	57	96	36	294
30.	Jowana	105	76	16	36	233

Table 32 continued

	CITY	$W_i.S_{ij}$ Health Hazards	Population Density	City Potential	Water Supply Condition	PI
31.	Purwodadi	70	76	16	36	198
32.	Magelang	35	76	32	126	269
33.	Purwokerto	105	57	32	36	230
34.	Tegal	70	114	16	36	236
35.	Surakarta	70	114	96	36	316
36.	Bojolali	140	57	16	54	267
37.	Gresik	350	76	144	36	606
38.	Mojokerto	105	76	96	54	331
39.	Jombang	70	57	32	54	213
40.	Malang	35	76	144	90	345
41.	Wonosari	140	57	16	36	249
42.	Lumajang	70	38	16	36	160
43.	Jember	35	57	96	54	242
44.	Sampang	35	57	32	72	196
45.	Pamekasan	140	57	16	36	249
46.	Lamongan	105	38	16	36	195
47.	Pacitan	140	38	16	36	230
48.	Probolinggo	70	57	96	36	259
49.	Balikpapan	140	57	64	36	297
50.	Sampit	140	38	32	36	246
51	Pangkalan Bun	175	19	32	36	262
52.	Tarakan	140	19	64	36	259
53.	Ketapang	350	19	32	36	437
54.	Samarinda	350	57	144	36	587
55.	Banjarmasin	350	57	96	36	539
56.	Palangka Raya	70	38	32	36	176
57.	Barabai	140	19	32	36	227
58.	Pontianak	350	114	96	36	596
59.	Kandangan	105	38	32	36	211
60.	Martapura	140	76	144	36	396
61.	Menado	70	57	96	90	313

Table 32 continued

CITY		$W_i \cdot S_{ij}$				
		Health Hazards	Population Density	City Potential	Water Supply Condition	PI
62.	Limboto	140	38	32	36	246
63.	Kotamubagu	35	19	16	36	106
64.	Palopo	105	38	16	36	195
65.	Majene	105	38	16	36	195
66.	Raha	140	19	16	36	211
67.	Bau-bau	140	38	16	36	230
68.	Watampone	140	38	16	36	230
69.	Pare-pare	70	19	32	36	157
70.	Denpasar	105	57	32	72	266
71.	Klungkung	140	38	32	36	246
72.	Kintamani	140	57	32	36	265
73.	Bangli	140	38	16	36	230
74.	Sumbawa Besar	105	19	16	36	176
75.	Solong	350	19	16	36	421
76.	Kupang	140	38	32	36	246
77.	Merauke	140	19	32	36	227
78.	Sorong	140	38	32	36	246
79.	Serui	140	19	16	36	211
80.	Fak-fak	140	38	16	36	230

between the score of category (a) and the score of category (b) which had been determined by panel members is very wide; it was known that the score of category (a) is twofold of the score of category (b), which means a difference of 175 points in calculating the priority index. Health hazards vary from one city to another due to differences in environmental conditions; and the data meets all categories.

With respect to the population density parameter, the validity of the data is reliable because it resulted from the consulting engineer's investigations. As can be expected, the county capital cities are more dense than those cities in the remote areas because most activities are centralized in the capital cities. The net population density varies from one city to another and the data meets all categories of this parameter with weighting multiplied by scoring ranging from the lowest value 19 to the highest value 152.

Similar to the population density parameter, the city potential and water supply condition parameters are reliable and easy to validate because of the consulting engineer's investigations. The city potential parameter, which receives the fourth rank in the weighting of parameters, is important because it reflects the ability and capability of the community to operate and maintain urban excreta/wastewater disposal facilities to be installed. The data also meets all categories of this parameter with weighting multiplied by scoring ranging from the lowest value 16 to the highest value 144.

The remaining parameter, water supply condition, is not so varied due to the fact that most of the existing urban water supply facilities are below standard, especially the number of house connections. Only one city belongs to category (a), i.e., city No. 32, with water consumption 242 l/cap/day and population served by house connection 44 percent. Most of the cities belong to category (e) or (f) with weighting multiplied by scoring equal to 36. Since the Indonesian government is attempting to improve all urban water supply facilities throughout the country, in the future this parameter will be more meaningful to validate for priority computation.

Concerning the technological alternatives parameter, although it was excluded in the priority computation, the results of the scoring categorization are interesting. As can be expected, the Western type would have the lowest score because of high capital costs and operation and maintenance. However, the cartage options also have the lowest score, similar to the Western type with a score of two. Although capital costs of cartage options is lower than waterborne sewerage, followed by conventional treatment appropriate for developing countries, the score of waterborne sewerage is much larger, i.e., fourfold of cartage options. This is due to low operating costs of waterborne sewerage and nil adaptability to self-help. Another more interesting point is that the waterborne sewerage with a score of 8 is larger than on-site options with a score of five, although capital and operating costs of on-site options are low and need only low or nil water consumption. This may be due to the high adaptability to self-help for on-site options.

As can be seen from Table 32, the results of the test of the model seem to be workable, since the figures vary from one city to another, and the range of figures is broad enough, although only four of five parameters were used. The highest PI value is more than sixfold of the lowest value. However, since there are two or more cities with similar PI values, such as cities Nos. 1, 46, 64, and 65 with a PI value of 195, the central government might increase the priority index of those cities under consideration for special reasons, such as political considerations or vociferous demands for service.

From the above discussions it can be concluded that the priority model developed in this study is suitable to the present needs for the Indonesian Urban Excreta and/or Wastewater Disposal Program in selecting the project localities. It should be kept in mind that reliability and validity of the data is the key to the success of the Indonesian Urban Excreta and Wastewater Disposal Program, which will cover more than 26 million people living in urban areas. It is important that the data forms be completed by an individual or team quite familiar with the community involved, such as provincial project manager of the Directorate of Sanitary Engineering. Every possible effort should be made to complete all of the questions included in the data forms. When reliable data are not available, estimates should be used which reflect variations attributable to local circumstances and conditions. In short, careful attention should be given to completing and supplying the information requested on the data forms, since successful use of the model depends on this information.

Since most cities will grow with respect to time in terms of socioeconomic and physical development, it is necessary to review and update the priority index list for a certain period of time because some cities grow more rapidly than others, and local conditions will also change. For example, a city that does not have water supply facilities this year might have such facilities in the near future, so that the category of water supply condition will change; thus the score of categorization will also change. Therefore, it is necessary to review and update the priority index list for a certain period of time, say, every three years.

CHAPTER V

SUMMARY AND CONCLUSIONS

Two-thirds of the world's population live in developing countries. Economic underdevelopment manifests itself in disease, premature death, poverty, unsanitary conditions, undernourishment, underemployment, meager schooling, illiteracy, and other conditions of life that are universally considered to be unsatisfactory. The existence of these conditions side-by-side with economic underdevelopment is not a matter of chance. Health, sanitary housing, employment opportunities, education, scientific and technical knowledge, are all produced by resources taken from the common national fund. The resources comprise both skilled and unskilled labor, natural resources, buildings, factories, hospitals and water treatment facilities inherited from the past. If the total resources are scanty, then health, food, housing, and employment needs can only be met to a very limited extent. Resources are, in fact, always inadequate in relation to the needs to be satisfied; one characteristic of resources is their scarcity. Basically, there are only two ways of improving average living conditions: one is to increase resources, and the other is to make the best possible use of those available. If the aggregate of natural resources is increased and more of them are used and if a larger proportion of the population is trained, new factories, hospitals, water and waste treatment plants are built more rapidly than population increases and then average living conditions will improve. But to do this, more resources will be necessary and they too will have to come from the common national fund.

The rapidly accelerating, unplanned urbanization that is occurring in Indonesia has greatly exceeded the ability of most cities concerned to provide adequate excreta and/or wastewater disposal services for the vast influx of new inhabitants. As a consequence, widespread and serious water pollution has occurred, causing several diseases. Human excreta is the principal source of the pathogenic organisms carried by water, which constitute the vehicles of transmission to susceptible hosts. Specifically, the enteric diseases, including cholera, typhoid, dysentery, the diarrhoeal diseases, and others of viral nature are the leading causes of death and disability in this country. Recent outbreaks of cholera in 1974 have again called attention to the perils of continued neglect of community excreta/wastewater disposal facilities. Enteric diseases are widely endemic in this country and exact a heavy toll in mortality and morbidity. While there is every reason to collect and treat excreta/wastewater, the financial resources to achieve this goal are not readily available because in the past national priorities of investment placed pollution control at a low level. The Second Five-Year

Development Plan (1974-1979) mentions only research surveys and feasibility studies for urban sewerage, and no specific investment programs are outlined. Aware of the consequences of the water pollution impact, the Indonesian government plans to place urban excreta/wastewater disposal in the Third Five-Year Development Plan, which was started on April 1, 1979. Since sources, especially money, are very limited, it is felt that a priority model is needed to ensure that limited government money is spent more wisely and that the people believe the program is being implemented fairly.

In principle, the Ministry of Public Works is responsible for planning, designs, and supervising construction throughout Indonesia. Within the Ministry, the Directorate of Housing, Building, Planning and Urban Development and, more particularly, the Directorate of Sanitary Engineering, are responsible for urban water supply and sanitation. In implementing the urban water supply and sanitation program, the Indonesian government is receiving assistance from WHO in terms of experts in planning and supervision; from UNICEF in terms of materials and equipment; and from UNDP and USAID in terms of manpower development.

As any other programs concerned with the delivery of services to the public, the urban excreta/wastewater disposal program is subject to many constraints. A serious limitation on the effectiveness of the water pollution control program is the present rate of urbanization and the concurrent growth of population. Pollution problems grow more rapidly than do the resources available to control them, and programs planned today may already be inadequate before they can be implemented. The main categories of constraints in implementation of the urban excreta/wastewater disposal program in Indonesia are money and manpower and social and political factors.

Based on the analysis of this study to develop a priority rating model for project localities, the following conclusions can be drawn:

1. The inputs of the model, which are designed to be collected at the local level, consist of excreted infectious diseases, demographic information, data related to existing land use, local resources including manpower availability, inputs relating to the present water supplies, and inputs relating to the choice of appropriate technology, such as topography, hydrology, river characteristics, sociocultural characteristics, etc. The output of the model is a list of priority index values of every city being considered for project localities. The higher the priority index value the higher the priority of the city to receive the facility of the excreta and/or wastewater disposal system.

2. In mathematical terms, the linear combination of variables was used to determine ranked priorities. Thus, it is necessary to develop parameters which should be relevant to the strategy of the Indonesian urban excreta and/or wastewater disposal program and feasible in applying them to the

data available. The proposed parameters are health hazards (HH), population density (PD), city potential (CP), water supply condition (WSC), and technological alternatives (TA). A Double Delphi technique was applied in this study to determine the weight of each parameter and score assignment of categorization of each parameter. HH received the highest weight with a value of 35, and PD is next in importance with average weight of 19. The lowest weight of 12 for TA was not considered by some panel members to be very important, since for low-income urban areas in developing countries the alternatives are not varied enough in sanitary excreta and/or wastewater removal systems. The remaining parameters WSC and CP received the third and fourth rank with average weight of 18 and 16 respectively.

3. To make the evaluation of priority setting more meaningful, some experts suggested that other parameters be added. Among others are level of income, physical quality of the environment or aesthetic value of the environment. However, the problem in developing countries in general, is a lack of available data and difficulty in assessing and measuring reliable data. Therefore, the selection of appropriate parameters is very restrictive. Climate is also suggested as a parameter. However, since the climate throughout the country is very similar, this factor is not meaningful to be considered as a parameter. Other suggested parameters to be added are sociocultural, finance, costing, permeability of the soil, and

level of ground water table. Concerning these suggestions, it can be mentioned that those factors are incorporated into the technological alternatives parameter.

4. To analyze the weight distribution of parameters which had been assigned by panel members, the cognative indices based on four categories of the 37 respondents were correlated. The four categories of respondents are:

(1) Level of education.

(2) Major field/specialization.

(3) Profession/occupation.

(4) Continent origin and international agencies.

Each category was broken down into several subcategories and the average weight distribution of each parameter was then calculated. From the analysis of twenty subcategories, it can be concluded that HH occupied the highest weight, followed by PD, WSC, CP, and TA. This ranking is in line with the assignment of parameter weight distribution by thirty-seven respondents. The highest weight of HH was assigned by respondents whose major field is other than environmental, whereas the lowest weight was assigned by respondents whose major field is water supply services. The highest weight of PD was assigned by European respondents, whereas the lowest weight was assigned by African respondents. The highest weight of CP was assigned by respondents whose major field is water supply services, whereas the lowest weight was assigned by European respondents. The highest weight of WSC was assigned by enviornmental health respondents, whereas the lowest weight was assigned by respondents whose major field is other than environmental. The highest weight of TA was assigned by respondents whose profession is in national/international research institute, whereas the lowest weight was assigned by respondents from the State Health Department and by European respondents. The assignment of weighting parameters by respondents whose profession is faculty, whose level of education is Doctor, whose major field is environmental health, and those respondents from U.S.A. Canada, and the Asian continent are well distributed, since two of the parameters weights are above mean value of 20 and the other three parameters are below the mean value, and the highest weight of HH is almost threefold than the lowest weight of TA. However, since a multidisciplinary approach is preferable by the Delphi Method, the average weight distributions assigned by thirty-seven respondents were used in prioritizing urban excreta and/or wastewater project localities.

5. The scores of categorization of parameters were also assigned by distinguished panel members. The categorization of HH was based on mortality and morbidity caused by excreted infectious diseases. The categorization of parameter PD was based on the range of net population density with range interval of 75 cap/ha. The categorization of CP is expressed in terms of the availability of local resources, namely, industrial growth, mineral resources and manpower. The

categorization of WSC was based on water consumption and the percentage of people served by house connections. Finally, the categorization of TA was based on on-site options, cartage options, waterborne sewerage, followed by conventional treatment appropriate for developing countries and the Western type.

6. To demonstrate the usefulness of the model, a test was conducted for 80 cities in Indonesia. The results of the test indicated that the model seems to be workable, since the figure of priority index varies from one city to another, and the range of figures is broad enough, although only four of five parameters were used, because TA parameters could not be decided upon at this time. The highest PI value is more than sixfold of the lowest value. Therefore, the priority model developed in this study is suitable to the present need for the Indonesian urban excreta and/or wastewater disposal program in selecting the project localities. In calculating the priority index, the first three parameters, namely, HH, PD and CP, affect much of the priority index values because the data covers most categories. The WSC did not, to any extent, affect the priority index value because at the present time most existing urban water supply situations are below standard, especially the number of house connections. Thus, many cities had the same scores for this parameter; that is, lower scores. Since the Indonesian government is attempting to improve all urban water supply facilities throughout the country, in the

future this parameter will be more meaningful to validate for priority computation. However, all of the data are reliable and easy to validate.

7. In practice, for special reasons, such as political considerations or vociferous demands for service, the central government might increase the priority index of the cities under consideration, especially when there are two or more cities having a similar PI value.

8. Since most cities will grow with respect to time in terms of socioeconomic and physical development and since some cities grow more rapidly than others, it is necessary to review and update the priority index list for a certain period of time, because data validation of some cities will change, thus the score of categorization as well.

9. At the present time, the only possible measure of HH is mortality and morbidity caused by excreted infectious diseases. In the near future, when laboratory analyses of rivers, streams, lakes, and estuaries have been conducted for the purpose of the urban excreta and/or wastewater disposal feasibility study and master plan, other measurements of HH might be evaluated in terms of severity of the water pollution problem, such as the appearance of odor, fish kills in the rivers, measurements of BOD, DO, coliform, toxic materials, etc.

10. It should be kept in mind that the reliability and validity of the data is the key to the success of the Indonesian urban excreta and/or wastewater disposal program,

which will cover more than 26 million people living in urban areas. It is important that the data forms be completed by an individual or team that is quite familiar with the community involved, such as provincial project manager of the Directorate of Sanitary Engineering, and every possible effort should be made to complete all the questions included in the data forms. In short, careful attention should be given to completing and supplying the information requested on the data forms, since successful use of the model depends on this information.

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APPENDIX A

TRANSLATION OF INDONESIAN GOVERNMENT REGULATION ON WATER POLLUTION

TRANSLATION OF GOVERNMENT REGULATION ON CONTROL OF WATER POLLUTION

The control of water pollution for several uses related to Public Health (the Regulation of the Minister of Health of the Republic of Indonesia No. 173/Men.Kes/Per/VIII/77, dated 3-8-1977)

The Minister of Health of the Republic of Indonesia

Considered: a That the quality control of raw water which is used has an important role in the maintenance, the protection and the promotion of public health.

b that regulations are required to present the possible pollution of water and the use of water which does not meet adequate standards to safeguard public health.

Recognised 1 The Law No. 9 year 1960 on the Basic Health (State Journal No. 131 year 1960, Added State Journal No. 2068):

2 the Law No. 11 year 1962 (S.G. No. 826/9A) on Hygiene for the Public Shared Enterprises (State Journal No. 48 year 1962, Additional State Journal No. 2475):

3 the Law No. 2 year 1966 (S.G. No. 1371/7A-9A) on Hygiene (State Journal No. 22 year 1966, Additional State Journal No. 2804).

4 the Law No. 11 year 1974 (S.G. No. 2654 LB-9B) on irrigation (State Journal No. 65 year 1974, Additional State Journal No. 3046).

5 The Regulation of the Minister of Health of the Republic of Indonesia No. 01/BIRHUKMAS/I/1975 year 1975 (S.G. No. 2693/2B-4B) on the requirements and the Supervision of Drinking Water Quality.

Decided:

Defined: The Regulation of the Minister of the Republic of Indonesia on the control of Water Pollution in Water bodies for several uses relating to Public Health.

CHAPTER I

General Regulations

Article 1

Definitions of terms used in this regulation

a "Air baku" (raw water) is water from a water body which by coagulation, precipitation, filtration and purification, may be made potable.

b "Drinking Water" is water with a quality fulfilling the requirements of drinking water stated by the Regulation of the Ministry of Health of the Republic of Indonesia No. 01/BIRHUKMAS/I/1975 year 1975 on the requirements and control of drinking water quality.

c Natural Bath Water is water in its natural condition which is used for public baths.

d Water for several uses in relation with health comprises raw water and water for natural baths land fisheries, agriculture, where the crop is eaten before cooking, for sport, picnic and recreation.

e "Water body" is a place or catchment on the land surface which contains water, i.e., swamp, lake, dam and water channel.

f "Water body of class A" is a water body where the water is used as raw water for drinking purposes.

g "Water body of class B" is a water body where the water is used for public baths and agriculture where the crop is eaten without cooking.

h "Water body of class C" is a water body where the water is used for land fisheries, (sport/except swimming, water skiing, surf gliding) picnic and recreation.

i "Industrial Waste" is waste coming from an industry as a consequence of a production process.

j Household waste is waste coming not from an industry but from a household, an office, a hotel, a restaurant, a house of worship, an entertainment house, a market, a shopping centre/bazar, a harbour and a hospital.

k "Health Service" is a Health Service of a Regency/ Municipality, level II or similar to.

l "Special Case: is a case different/deviated from the defined regulations, because of an unavoidable natural situation.

m "Water pollution" is a situation where some elements are introduced into the water that decreases the quality of the water, so that it could endanger public health.

CHAPTER II

The Requirements for Water Quality in Water Bodies

Class A,B, & C

Article 2

Water which is used and comes from Water Bodies of class A,B, and C has for health reasons to fulfill the conditions of physical, chemical microbiological and radioactivity as shown in table 1 and 2.

Article 3

Deviations from the conditions described in article 2 of this regulation are not allowed, except in special cases and under the supervision of the Health Service.

CHAPTER III

The Use of Water from Water Body

Article 4

The use of water from a class A,B, or C water body is not permitted if its water quality falls below the permitted level.

Article 5

1 The use of a class A,B, or C water body is not permitted for the disposal of solid waste from households, mining or industry.

2 The use of a class A,B, or C water body is not permitted for the discharge of waste water from households, mining, or industry unless it has been treated to the appropriate standard.

CHAPTER IV

Quality control for waste water, discharges and overflows.

Article 6

Waste water which has undergone treatment as required in article 5 point (2) in this regulation and has been discharged or overflowed from an agricultural undertaking, an industry, a mining-industry or a household and is discharged into a class A,B, or C water body has to fulfill the following requirements:

1 Physically and Chemically as shown in table 3 and,

2 Must not cuase the pollution of the water body, so that it cannot meet the requirements of article 2.

Article 7

Deviations from the requirements of article 6 of this regulation are not allowed, except in special cases and under the supervision of the Health Service.

CHAPTER V

Maintenance

Article 8

1 The maintenance of the water quality of a water body as required in article 2 of this regulation must be carried out regularly throughout the year.

2 The treatment plant as described in article 6 must be well maintained at all times.

CHAPTER VI

Supervision

Article 9

The Health Service will be responsible for the supervision of water quality of a water body as required in article 2 and for the quality of an effluent discharge as described in article 6 of this regulation.

Article 10

The supervision as required in article 9 will encompass:

a The periodic inspection in the field and associated laboratory testing.

b The analysis of the laboratory tests.

c To report on problems which become apparent from the analysis.

d To resolve the solution of the problem outlined in the report.

Article 11

The type of inspection outlined in article 9 and duties of the inspectors will be set out by the Directorate General of the Health Service.

CHAPTER VII

Budget

Article 12

The budget for the supervision as described in article 9 of this regulation will be charged to the Department of Health of the Republic of Indonesia.

CHAPTER VIII

Corrective Actions

Article 13

Offenses against the articles 2,3,4,5,6,7, and 8 of this regulation which may harm or endanger public health or cause a public nuisance may be acted upon and may be tried in accordance with the relevant regulations.

CHAPTER IX

Conclusions

Article 14

This regulation is called the Regulation of the Minister of Health for the control of Pollution in a Water Body.

Article 15

Cases which are not specifically covered by this Ministry Regulation, will be the subject of further legislature.

Article 16

This regulation will come in force from the date of publication. In order to make the public aware of this Ministry Regulation it is ordered that it be published in the State Gazette of the Republic of Indonesia.

Decided at Jakarta
on 3 August 1977

The Minister of Health of the Republic
of Indonesia

signed by

(G.A. SIWABESSY)

Enclosure, as meant in article 2 of the Regulation of the Minister of Health of the Republic of Indonesia No. 173/Men.Kes/Per/VIII/77 year 1977 on the Supervision on the Water Pollution of a Water Body for several uses in relation with health.

Table 1
WATER QUALITY REQUIREMENTS OF A WATER BODY OF CLASS A, B AND C

No	Parameter	Unit	Minimum allowed	Maximum Suggested	Maximum Allowed	Explanation
	I CHEMISTRY					
	A Inorganic chemistry					
1	Arsenic	mg/l		nil	0.05	As
2	Barium	mg/l		nil	0.05	Ba
3	Total Iron	mg/l		nil	1.0	Fe
4	Boron	mg/l		nil	1.0	B
5	Chromium Cr^6	mg/l		nil	0.05	Cr^6
6	Chromium Cr^3	mg/l		nil	0.5	Cr^3
7	Cadmium	mg/l		nil	0.01	Cd
8	Cobalt	mg/l			0.01	Co
9	Magnesium	mg/l		nil	0.5	Mn
10	Nickle	mg/l			0.1	Ni
11	Silver	mg/l		nil	0.05	Ag
12	Mercury	mg/l			0.005	Hg
13	Selenium	mg/l		nil	0.01	Se
14	Zinc	mg/l		nil	1.0	Zn
15	Copper	mg/l		nil	1.0	Cu
16	Lead	mg/l		nil	0.05	Pb
17	Ammonia	mg/l		0.01	0.5	N
18	Chloride	mg/l		25	600	ion Cl
19	Free Chloride	mg/l			nil	Cl_2
20	Fluoride	mg/l			1.5	ion Fl
21	Hardness	°D	5	10		
22	Nitrate & Nitrite	mg/l		nil	10	N
23	Sulphate	mg/l		50	400	ion SO_4
24	Sulphide	mg/l			nil	ion S
25	Uranium	mg/l		nil	5	ion uranium
	B. Organic Chemistry					
1	Chloriform Product	mg/l		0.04	0.5	

Table 1 continued

No	Parameter	Unit	Minimum allowed	Maximum Suggested	Maximum Allowed	Explanation
2	Herbicides	mg/l		nil	0.1	
3	Oil & Fats	mg/l		nil	nil	
4	Phenols	mg/l		nil	0.002	
5	Pesticides					
	a Aldrin	mg/l		nil	1.017	
	b Chlordane	mg/l		nil	0.003	
	c D.D.T.	mg/l		nil	0.042	
	d Dieldrin	mg/l		nil	0.017	
	e Endrine	mg/l		nil	0.001	
	f Heptachlor	mg/l		nil	0.018	
	g Heptachlor Epoxide	mg/l		nil	0.018	
	h Lindane	mg/l		nil	0.056	
	i Methoxy chloride	mg/l		nil	0.035	
	j Organophos-phate and carbonate	mg/l		nil	0.100	
	k Toxaphene	mg/l		nil	0.005	
6	Cyanide	mg/l		nil	0.1	ion CN
7	Matter which will react with Methylene Blue	mg/l		nil	0.5	
	II RADIOACTIVITY					
1	Gross Beta	pCi/l		100	1,000	
2	Radium - 226	pCi/l		1	3	
3	Strontium 90	pCi/l		2	10	

Table 2
WATER QUALITY REQUIREMENTS OF A WATER BODY

No	Parameter	Unit	Class A		Class B		Class C		Expl.
			Minimum Allowed	Maximum Allowed	Minimum Allowed	Maximum Allowed	Minimum Allowed	Maximum Allowed	
	I PHYSICS								
1	Temperature	°C		Air temp		Air temp		Air temp	
	II CHEMISTRY								
1	B.O.D.	mg/1		3		3		3	O_2
2	D.O.	mg/1	6		4		6		O_2
3	pH		6.5	8.5	6.5	8.5	6	9	
4	T.D.S.	mg/1		1,000		2,000		2,000	
	III MICROBIOLOGY								
1	Total Coliforn	per 100 ml		10,000		1,000		20,000	
2	Faecal Coliforn	per 100 ml		2,000		400		4,000	

Enclosure as meant in article 6 (sub 1) of the Regulation of the Minister of Health of the Republic of Indonesia No. 173/Men.Kes/Per/VIII/77 year 1977 on the Supervision on the Water Pollution of a Water Body for several uses in relation with health.

Table 3
QUALITY REQUIREMENTS FOR WASTE WATER/DISCHARGES AND OVERFLOWS FROM AN INDUSTRY A MINING-INDUSTRY OR A HOUSEHOLD

No	Parameter	Unit	Minimum allowed	Average over 24 hours	Maximum allowed	Explanation
	I PHYSICS					
1	Temperature	°C			30	
2	Floating material	mg/1			nil	Left by a filter with a grate opening of 3 mm
3	Settled matter	mg/1			1.0	
	II CHEMISTRY					
	A Inorganic chemistry					
1	Total Aluminium	mg/1			10	Al
2	Total Arsenic	mg/1			1	As
3	Barium	mg/1			1	Ba
4	Total Iron	mg/1			1	Fe
5	Chromium	mg/1			0.1	Cr
6	Total Cadmium	mg/1			1	Cd
7	Total Nickle	mg/1			2	Ni
8	Total silver	mg/1			0.1	Ag
9	Total Mercury	mg/1			0.1	Hg
10	Zinc total	mg/1			1	Zn
11	Total copper	mg/1			1	Cu
12	Total lead	mg/1			1	Pb
13	Free ammonia	mg/1			0.1	NH_3
14	Free chlorides	mg/1			0.05	Cl_2
15	Fluoride	mg/1			2	ion F
16	Nitrite	mg/1			1	ion NO_2
17	Phosphate	mg/1		2		ion PO_4
18	Sulphide	mg/1			0.1	ion S
19	B.O.D.	mg/1		20	30	O_2
20	C.O.D.	mg/1		50	80	O_2
21	pH		6.5		8.5	

Table 3 continued

No	Parameter	Unit	Minimum allowed	Average over 24 hours	Maximum allowed	Explanation
22	Methylene blue					negative
23	Permanganate Value	mg/l		60	90	O_2
24	Suspended solid	mg/l		20		
	B Organic Chemistry					
1	Chloroform	mg/l			10	
2	Oil and Fats	mg/l			10	
3	Total Phenols	mg/l			0.1	Phenols
4	CN	mg/l			0.1	ion CN

APPENDIX B

WESSEX WATER AUTHORITY, ENGLAND
PRIORITY RATING SYSTEM FOR SEWAGE TREATMENT

WESSEX WATER AUTHORITY

PRIORITY RATING SYSTEM - EXPLANATORY NOTES

HOW THE PRIORITY RATING SYSTEM WORKS

1. The government and Water Authorities have agreed that there are 14 broad purposes for capital expenditure in the Water Industry. These purposes are set out in the table shown in the Appendix which also defines the 14 purposes in greater detail.

2. Each scheme must be wholly allocated on a percentage cost basis under whichever of the purposes it fulfills. Wherever possible a proportional flow basis of apportionment should be adopted and allocation should be made to the nearest 5%. These percentages by cost are entered at the head of the priority rating form. (Priority rating sheets for the service of sewage treatment is appended.)

3. For convenience when filling in the detailed part of the form it is recommended that, under each purpose served by the scheme, the actual cost should be entered together with the 'existing population served' (or this equivalent).

4. The detailed part of the form entails the answering of a set of questions under each of the purposes served by the scheme. Predetermined points are given on the form against most questions and it is generally only necessary to circle the appropriate points score against each of the questions.

5. The final points score under each purpose served by the scheme is entered in the final block. The maximum points score on the detailed part of the form is 100 under each of the purpose headings.

6. The questions are numbered 1, 2, 3, etc., and further subdivided la, lb, lc, etc. Only one score can be made against each question, i.e., whereas questions la and lc may both be applicable to the scheme a score can only be made against either la or lc whichever gives the highest points.

7. The final points score under each of the purpose headings is transferred from the detailed part of the form to the head of the form where they are multiplied by the percentage cost allocated to that purpose and by the weighting factor given to the purpose.

8. After multiplication the points scored under each purpose are summated and the total points score is entered at the top right hand side of the form. The highest weighting factor is 1.0 (allocated to the purpose of 'public health & safety') so that, assuming the scheme served no other purpose, the maximum total points score on any scheme is 100.

Wessex Water Authority
Priority Rating System For Capital Works of
Sewage Treatment

.... DIVISION   NAME OF SCHEME .... ESTIMATED COST £..................... AT 1976 SURVEY PRICES

This scheme cannot be started or is not required to be started until the financial year 19 ....   i.e. November 1975 Average out-turn

PURPOSE HEADINGS (percentages by Cost)														
1 = %	2 = %	3 = %	4 = %	5 = %	6 = %	7 = %	8 = %	9 = %	10 = %	11 = %	12 = %	13 = %	14 = %	
MAINTENANCE OF SYSTEM	GROWTH IN DEMAND	IMPROVE LEVEL OF SERVICE	NEW HOUSING	NEW INDUSTRY OR COMMERCE	PUBLIC HEALTH & SAFETY	IMPROVEMENTS TO WATER QUALITY				INCREASED OPERATING EFFICIENCY	FIRST TIME SERVICES	IMPROVE RECREATION & AMENITY	ACHIEVE OTHER PURPOSES	
						RIVER USED FOR DRINKING	OTHER RIVERS	ESTUARIES	COAST					
Cost £000's =	Cost £000's =	NOT APPLICABLE	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	Cost £000's =	
Existing Population Served =	Existing Population Served =		Future Population Served =	Future Area Served (ha) =	Existing Population Affected =	Existing Population Served =	Existing Population Served =	Existing Population Served =	Existing Population Served =		Existing Population Served =			
Weighting Factor=0.9	Weighting Factor=0.8		Weighting Factor=0.9	Weighting Factor=0.9	Weighting Factor=1.0	Weighting Factor=0.7	Weighting Factor =0.4	Weighting Factor=0.2	Weighting Factor=0.4	Weighting Factor=0.9	Weighting Factor=0.4	Weighting Factor=0.3	Weighting Factor=0.1	
Pts =	Pts =		Pts =	Pts =	Pts =	Pts =	Pts =	Pts =	Pts =	Pts =	Pts =	Pts =	Pts =	
Pts x0.9x % =	Pts x0.8x % =		Pts x0.9x % =	Pts x0.9x % =	Pts x1.0x % =	Pts x0.7x % =	Pts x0.4x % =	Pts x0.2x % =	Pts x0.4x % =	Pts x0.9x % =	Pts x0.4x % =	Pts x0.3x % =	Pts x0.1x % =	Total Pts = (items) =

Source : Wessex Water Authority, Priority Rating System, England 1979.

1 REPLACEMENT OR MAINTENANCE OF SYSTEM

1. Replacement of obsolete treatment works or of defective or obsolete plant or treatment units:

	No of breakdowns in last 5 years			
	1	2 to 4	5 to 10	10
a) where breakdown causes extremely serious operational problems <u>at the works</u> eg. extensive flooding of site.	12	23	34	40
b) where breakdown merely causes operational difficulties <u>at the works</u> eg. use of portable pumps, difficulty in settling, treating and disposing of sludge.	0	5	10	16

2. Running Costs

$$\frac{\text{*Annual savings in running costs x 400}}{\text{Scheme cost attributable to this purpose}} \quad \_\_40$$

*Include compensation payments; emergency call-out payments; savings in no. of full or part-time employees, electricity costs; transport costs.

(Max score = 40 points) [ ]

3. Cost

a. housing $\frac{300}{\text{Cost per person}}$ * [ ]

b. industry and commerce $\frac{30,000}{\text{Cost per hectare}}$ * [ ]

If the STW is to be abandoned multiply the points scored under these headings by 2.
Where scheme serves both 'housing' and 'industry and commerce' score under both headings.
(Max total score = 20 points)
*Use existing population or area served.

Totals 1 to 3 [ ]

2. GROWTH IN DEMAND

1. Overloading (use BOD or SS whichever is worst condition) where discharge is to: -

	likely overload on works or part of works in five year's time			
	25 to 49%	50 to 74%	75 to 100%	100%
a) river used for water supply (Upstream of intake).	30	36	43	50
b) river earmarked for water supply	29	35	42	50
c) Class 1A river or estuary	28	34	42	50
d) Class 1B river or estuary	27	33	41	49
e) Class 2 river or estuary	24	30	39	48
f) Class 3 river or estuary	20	29	37	46
g) Class 4 river or estuary	15	24	32	40
h) Class X(5) river or estuary	4	11	19	26
i) Coastal waters where tourism is an important industry and where no treatment or maceration is carried out.	24	27	30	34
j) ditto where partial treatment or maceration is carried out	10	14	19	23
k) Coastal waters where tourism is of little importance and where no treatment or maceration is carried out	8	12	17	21
l) ditto where partial treatment or maceration is carried out	5	8	11	15

2. Cost - use existing population or area served by STW

a. housing	$\frac{15 \times \%age\ overload^{*}}{Cost\ per\ person}$	
b. industry or commerce	$\frac{1{,}500 \times \%age\ overload^{*}}{Cost\ per\ hectare}$	

Where scheme serves both 'housing and 'industry or commerce' score under both headings.
(Max total score = 50 points)
* Use %age overload in 5 years time

Totals 1 and 2	

3. IMPROVE LEVEL OF SERVICE

Not Applicable

4. NEW HOUSING (including redevelopment)

1. Has outline planning permission been granted for this housing development?	YES	6
	NO	0
2. Location - Does the housing development lie within an area covered by either a regional, structure or local plan?	YES	8
	NO	0

3. Most realistic estimate of when house construction is likely to commence assuming adequate sewage treatment facilities will be made available.

a. Within next 18 months	8
b. 18 months to 3 years	4
c. More than 3 years	0

4. Importance placed upon this housing development by the District Council

a. High priority	8
b. Intermediate priority	4
c. Low priority	0

---

5. Need - Is there an existing sewage treatment works or sea outfall which could serve the new housing (assuming that the sewage works or outfall has an unlimited capacity even if this is not the case)?

YES	0
NO	6

---

6. Capital Contribution

$$\frac{\text{Contribution}}{\text{Total cost of scheme}} \times 20$$

[ ]

---

7. Cost

$$\frac{1{,}300}{\text{cost per person}} *$$

(maximum score = 44 points)

*use future population to be served

[ ]

Totals 1 to 7 [ ]

5. NEW INDUSTRY AND COMMERCE (including extensions to existing premises or change of use)

1. Has outline planning permission been granted for this development?

YES	6
NO	0

---

2. Location - does the development lie within an area covered by either a regional, structure or local plan?

YES	8
NO	0

---

3. Most realistic estimate as to when development is likely to commence, assuming adequate sewage treatment facilities will be made available.

a. Within next 18 months	8
b. 18 months to 3 years	4
c. More than 3 years	0

4. Importance placed upon this development by the District Council

a. High priority	8
b. Intermediate priority	4
c. Low priority	0

5. Need. Is there an existing sewage treatment works or sea outfall which could serve the new industry (assuming that the sewage works or outfall has an unlimited capacity even if this is not the case)?

YES	0
NO	8

6. Capital Contribution

$$\frac{\text{Contribution}}{\text{Total cost of scheme}} \times 20$$

7. Cost

$$\frac{13{,}000}{\text{Cost per hectare}}*$$

(maximum score = 44 points)
*use future area to be served

Totals 1 to 7

6. PUBLIC HEALTH AND SAFETY

1. Nuisance or risk to public health and safety at present time.

	Population affected			
	0 to 50	50 to 200	200 to 500	500
a. serious risk to public health where effluent is discharged upstream of water supply intake.	54	56	58	60

b. Slight risk to public health where effluent is discharged upstream of water supply intake.	22	28	34	40
c. Effluent from works or sewage discharged from sea outfall is offensive to bathers (i.e. visual or smell nuisance) or bacterial count is in excess of proposed EEC Standards.	20	25	30	35
d. Effluent or sludge causes smell or fly nuisance or fishing is adversely affected.	18	22	26	30
e. Serious risk or injury or unacceptable hazard to public or employees.	45	49	53	57
f. Slight risk of injury or unacceptable hazard to public or employees.	18	22	26	30

2. Cost

$$\frac{1200}{\text{*Cost per person}}$$

(maximum socre = 40 points)

*use existing population served by STW

Totals 1 + 2

7. IMPROVE QUALITY OF POTABLE WATER SUPPLY RIVERS

1. Improve existing river quality by meeting higher discharge standards or by meeting existing discharge standards (95 percentile)	Existing river classification					
	1A	1B	2	3	4	X(5)
a. more than 100% improvement in the specific quality aspect requiring improvement	44	43	42	36	18	8
b. 50% to 100% ditto	40	39	38	32	15	4
c. 25% to 50% ditto	26	25	24	19	7	0

2. No. of consumers supplied with water who are likely to benefit from this improvement. If none, length of river which will benefit from this improvement (1 person = 5 meters of river)

0 to 50	50 to 100	200 to 500	500
0	2	4	6

3. Cost

$$\frac{300}{\text{*Cost per person}}$$

(maximum score = 50 points)

*use existing population served by STW

Totals 1 to 3

8. IMPROVE QUALITY OF NON-TIDAL RIVERS (excluding those currently used for water supply)

1. Improve existing river water quality by meeting higher discharge standards or by meeting existing discharge standards (95 percentile).

	Existing river classification					
	1A	1B	2	3	4	X(5)
a. up to Class 1A upstream of likely future water supply intake.	16	28	41	44	44	44
b. up to Class 1A	-	20	35	42	44	44
c. up to Class 1B	-	-	26	40	43	44
d. up to Class 2	-	-	-	20	30	40
e. up to Class 3	-	-	-	-	6	20
f. up to Class 4	-	-	-	-	-	1

2. Length of river which will benefit from this improvement. (metres)

0 to 250	250 to 1000	1000 to 2500	2500
0	2	4	6

3. Cost

$$\frac{300}{\text{*Cost per person}}$$

(maximum socre = 50 points)

*use existing population served by STW

Totals 1 to 3

9. IMPROVE QUALITY OF ESTUARIAL WATERS AND BEACHES

	Upstream river classification					
1. Improve existing water quality by meeting higher discharge standards or by meeting existing discharge standards (95 percentile)	1A	1B	2	3	4	X(5)
a) more than 100% improvement in the specific quality aspect requiring improvement	44	43	42	36	18	8
b) 50% to 100% ditto	40	39	38	32	15	4
c) 25% to 50% ditto	26	25	24	19	7	0

2. Length of estuary (measured both sides if appropriate) or beach which will benefit from this improvement metres)	0 to 250	250 to 1000	1000 to 2500	2500
	0	2	4	6

3. Cost

$$\frac{300}{\text{*Cost per person}}$$

(maximum socre = 50 points)

*use existing population served by STW

Totals 1 to 3

10. IMPROVE QUALITY OF COASTAL WATERS OR BEACHES

	Improvement in the specific quality aspect requiring improvement		
1. Improve existing water quality by meeting higher discharge standards (95 percentile) at STW. For sea outfalls score 44 points for long sea outfalls and 20 points for short outfalls	25 to 50%	50 to 100%	100%
	20	32	44

2. Length of coast which will benefit from this improvement (metres)	0 to 250	250 to 1000	1000 to 2500	2500
	0	2	4	6

3. Cost

$$\frac{300}{\text{*Cost per person}}$$

(maximum score - 50 points

*use existing population served by STW

Totals 1 to 3

11. INCREASED OPERATING EFFICIENCY

1. Reducation in number of employees	1	2 to 4	5 to 10	10
	1	3	7	10

2. Cost

$$\frac{\text{Annual savings in running cost x 900}}{\text{Scheme cost attributable to this purpose}} - 90$$

(maximum score = 90)

Totals 1 and 2

12. FIRST TIME SERVICES (to existing properties)

1. Existing sewerage and sewerage treatment facilities are: -	Existing population to be served			
	0 to 50	50 to 200	200 to 500	500
a) reasonably satisfactory e.g. septic tanks with no nuisance	0	5	11	17
b) not very satisfactory e.g. more than 25% of septic tanks causing a slight nuisance	10	15	22	30
c) grossly unsatisfactory e.g. more than 25% of septic tanks causing severe pollution or nuisance, or more than 25% of properties without flush toilets	28	34	39	41

2. Cost

$$\frac{700}{\text{Cost per person}}\ *$$

(maximum score = 59 points)

*use existing population

Totals 1 + 2

NOTES FOR GUIDANCE

1. Complete this form for each scheme of 25,000 and above scoring under any one or more purpose heading.

2. Each scheme must be allocated under each purpose heading on a percentage cost basis and these percentages should be entered at the top of the form.

3. Circle or enter the appropriate points within each category (1 to 7 max.) of the purpose headings applicable to the scheme; enter the total points score under each purpose heading, (Max. = 100) and transfer this to the summary at the top of the form; multiply the points score under each purpose heading by the weighting shown and the percentage cost to give a final score under each purpose heading (max. score = 100); summate the final points score under each purpose heading and enter this under 'Total Points' (max. = 100).

APPENDIX C

SOUTH WEST WATER AUTHORITY, ENGLAND
PRIORITY RATING ASSESSMENT

SOUTH WEST WATER AUTHORITY

REVIEW OF CAPITAL PROGRAMME

POINTS RATING SYSTEM

1. BENEFIT OF SCHEME

		POINTS
	Will the scheme enable a drainage or water supply embargo to be lifted in:-	
1.1	An area identified for development in the Structure/Development Plans	12
1.2	An area outside the Structure/Development Plan proposals	6
1.3	Not enable an embargo to be lifted	0

2. AREA TO BE SERVICED

Will the scheme service:-

2.1	A classified development area	5
2.2	A classified intermediate development area	3
2.3	An area not falling within 2.1 or 2.2	0

3. SCALE OF DEVELOPMENT

Will the scheme provide new or improved services for:-

3.1	A peak population of more than 10,000 or industry employing over 1,000 people	18
3.2	Ditto between 2,000 and 10,000 or industry employing between 400 and 1,000 people	13
3.3	Ditto between 500 and 2,000 or industry employing between 100 and 400 people	9
3.4	Ditto between 100 and 500 or industry employing less than 100 people	4
3.5	Less than 100 peak population	0

Contd. . . .

	POINTS
4. URGENCY OF IMPLEMENTATION	
Is the scheme necessary to enable development essential to meet the aims of the country structure and local development plans OR due to natural increase in demand for services will existing facilities be unsatisfactory:-	
4.1 In less than 3 years	25
4.2 Within 3 to 5 years	19
4.3 Within 5 to 10 years	6
4.4 In more than 10 years	0
5. MEETING STATUTORY OBLIGATIONS	
If the scheme is not implemented, will the Authority be in breach of one of its statutory obligations, in the present situation, because:-	
5.1 For water supply schemes only	
5.1.1 Abstraction licence provisions are regularly exceeded by 20% or more OR for more than 20% of the time there is concern about the reliability of supplies OR more than 20% of all samples give unacceptable water quality	25
5.1.2 Ditto between 10% and 20% ditto OR between 10% and 20% ditto OR between 10% and 20% ditto	13
5.1.3 Abstraction licence provisions are regularly exceeded by less than 10% OR for less than 10% of the time there is concern about the reliability of supplies OR less than 10% of all samples give unacceptable water quality	0
5.2 For sewage schemes	
5.2.1 Greater than 50% of all samples are outside the actual, or likely, discharge consent conditions OR there is regular flooding or discharge of sewage at storm water overflows at 4 times D.W.F. or less	25

		POINTS
5.2.2	Between 25% and 50% ditto OR ditto 7 times D.W.F. ditto	13
5.2.3	Less than 25% of all samples are outside the actual, or likely, discharge consent conditions OR there is a regular flooding or discharge of sewage at storm water overflows at 10 times D.W.F. or less	0

6. FINANCIAL IMPLICATIONS

6.1	Will savings in operating costs (excluding loan charges) exceed 2% of capital cost OR is there a capital contribution of 50% or more OR will on completion the annual income generated exceed 20% of capital cost	10
6.2	Will savings in running costs (excluding loan charges) exceed 1% OR is there a capital contribution of 25% to 50% OR will on completion the annual income generated exceed 15% of capital costs	7
6.3	Will running costs not exceed present running costs OR is there a capital contribution of up to 25% OR will on completion the annual income generated exceed 10% of capital cost	3
6.4	Will running costs exceed present running costs OR is there no capital contribution OR will, on completion, the annual income generated be less than 10% of capital cost	0

7. OPTIMIZATION OF RESOURCES

Will the scheme help towards maximizing the use of a previously constructed regional scheme

7.1	Yes	5
7.2	No	0

APPENDIX D

SOUTHERN WATER AUTHORITY, ENGLAND
PRIORITY RATING ASSESSMENT

1. Standard and Factors
2. Special considerations

NOTES

1. It is important to relate the frequency of occurrence of rainfall-induced flooding to the severity of the storms causing it. Combined and surface water drainage systems are commonly designed for 2 or 5 year storm frequencies, so that a more severe storm might very well cause flooding without the situation being sub-standard. A sub-standard situation exists when a storm equal to or less severe than the design storm causes flooding.

   However, it will often be difficult to determine the precise severity of the storm causing a particular flooding occurrence. In cases of doubt, an occurrence should always be counted in the assessment, only those which are clearly exceptional should be ignored.

2. In order to justify capital expenditure, the failures must be due to the inadequacy of the sewer. Blockages will be dealt with as maintenance, unless they are frequent, in which case their revenue cost wi-l justify the capital expenditure (see Para I.4)

3. The design standard will normally accord with the recommendations of the Technical Committee on Storm Overflows and the Disposal of Storm Sewage 1970- but using current population and discharge.

4. The minimum acceptable standard is conformity with all these requirements, or as many as are specified in the consent. If, however, they are not all infringed, the possibility of trade-off (e.g. higher quality compensating for excessive discharge) should be investigated with Resource Planning before capital expenditure is contemplated.

   Consent standards used will be ultimate standards: any interim standard set solely to ensure temporary compliance with the Control of Pollution Act should be ignored.

5. The appearance of sewage solids on the beach may be taken as failure of the standard.

6. The standard for residual chlorine concentration is proposed as a substitute for measures of bacterial contamination as being more easily and reliably measured.

7. Quality Ratio is defined as:-

$$\frac{1}{2}\left(\frac{\text{Average BOD}}{\text{Consent BOD}} + \frac{\text{Average Ammonia}}{\text{Consent Ammonia}}\right)$$

with:

(a) averages taken over the failed samples only and

(b) each fraction being assigned a value of 1 if it is actually less than 1, or is not specified in the consent.

8. An actual % conformity of zero will result in an overriding priority.

I. STANDARDS AND FACTORS

I.1 Minimum Acceptable Standards for Service

These are given below and are where possible derived from standards approved by the Authority. It should be emphasized that they are not the same as the Authority-approved standards, which are design standards, but are simply a criterion by which to decide whether or not work needs to be done. If it does, then the scheme will be executed to design standards which will in general be higher than minimum acceptable standards. Clearly it would not be logical to design schemes so as to raise the standard to only just above minimum acceptable.

1. Operation of a Sewage Treatment Works — SEE NOTE 4

   Dry weather flow to be not more than 20% above consent DWF

   and

   BOD to be not more than 20% above consent

   and

   Ammonia to be no more than 20% above consent, all at the 95 percentile.

2. Storm Water Capacity at a STW — SEE NOTE 3

   Storage capacity to be not less than 80% of design standard.

3. Pollution of Bathing Beaches — SEE NOTE 5

   Not less than 80% of samples tested conform to the EEC standard of:-

   not more than 10,000 coliforms/100 ml and
   not more than 2,000 e coli/100 ml

I.2 Multiplying Factors for Extent

The extent of a sub-standard situation can most easily be determined by answering the question "How many people are affected?", and it is intended that this basis should be used as far as possible. However, in many cases the number of people affected is not obvious, or the effect on an individual is much less serious (e.g. from a polluted beach) than when his house or garden is flooded. A series of equivalent extents is therefore proposed.

Note that for simplicity, extents may be averaged over a number of occurrences.

	NORMALLY APPLIES TO STANDARDS:-
1 resident (situations affecting domestic property including private gardens and residential accommodation).	1,3,8,9 & 10
is equivalent to:	
1 employee (situations affecting industrial or commercial property).	1,3,8,9 & 10
or 0.1 hectare (situations affecting areas of land other than private gardens and agricultural land).	1
or 1 hectare agricultural land	1
or 1 m^3/day DWF or shortfall of capacity downstream of a storm overflow.	4 & 5
or 0.25 m^3 shortfall of storm tank capacity at a STW.	6
or 5 lin. m bathing beach	7
or 0.25 m^3/day estimated overall water supply deficiency <u>or</u> minimum reliable yield of proposed scheme, whichever is the less.	11

The multiplying factor in each case is derived by dividing the number of people, hectares, metres, etc., by the values given, e.g.

A situation affecting 5 residents: multiplying factor = 5

A situation affecting 1200 m of beach: multiplying factor = 1200/5 = 240

Where not otherwise known, the occupancy rate may be assumed to be 3 residents/household.

In addition, for flooding of carriageways and footpaths the following constant factors are to be used:-

"A" roads	20
Other roads or footpaths	5

1.3 Multiplying Factors for Frequency

The multiplying factors for frequency are based on the minimum standards and are generally the ratio of actual to minimum standards, where the latter is expressed in frequency terms.

SEWAGE DISPOSAL SEE NOTE 7

1. Operation of a Sewage Treatment Works

(i) actual - Quality Ratio
(ii) potential - $\frac{\text{Projected DWF}}{\text{Existing DWF}}$ x Quality Ratio

2. Storm Water Capacity at a STW

Average number of occurrences of overflow per month.

3. Pollution of Bathing Beaches SEE NOTE 8

$$\frac{80}{\text{Actual \% conformity}}$$

1.4 Dividing Factor For Cost

The cost to be used in priority assessment is the net present cost. An estimate is made of the annual operating costs of the new installation and those of the installations (if any) superseded, counting a net additional cost as positive, a net saving as negative. These are discounted over the expected life of the new installation at the rate recommended by HQ Finance (currently 5%) and added to the capital cost to give a net present cost which is used instead of capital cost as divisor. (If this becomes zero or less, an over-riding priority will be assigned).

To avoid unnecessary effort, this refinement will be optional if the annual revenue effect is likely to be less than 2½% of capital cost.

Capital cost may be taken as the total capital cost on form CP11 or CP11A: price level is unlikely to make any material difference to assessments.

II. SPECIAL CONSIDERATIONS

II.1 Priority Assessment in Special Cases

II.1.1 Public Health Hazards and Accident Risks

In view of the difficulty of clear definition of a hazard, schemes proposed to remove a health hazard or accident risk should be dealt with as follows:-

a) Where the SWA has a statutory obligation, where a notice has been served, or where a Zone 1 aquifer is at risk, the scheme will be programmed as early as technically feasible.

b) In other cases which are an SWA responsibility, e.g. inadequate sewer capacity causing foul flooding, the priority assessment system should be applied in the usual way.

c) Cases of pollution due to the poor functioning of cesspools and other private installations are not the responsibility of the SWA to remedy.

II.1.2 New Development

The actual connection of new property will almost certainly be a statutory or contractual obligation; the question of priority only arises when considering work done to provide for the new connection at the STW or in the water distribution system. The concept required in assessing such schemes is that of a potential sub-standard situation. The result of making the connections but not providing the supporting facilities is projected and this potential situation is then analyzed in exactly the same way as an actual situation to arrive at a priority ranking. It is recognized that considerably more judgement is required to estimate the flooding frequencies etc., which would result under certain conditions in the future but it is felt that this is the most logical way of incorporating schemes to serve new development into the system.

When making projections in order to follow this approach, the populations, flows etc., to be used in priority assessment are those expected to be reached at the time the priority becomes operative i.e., when the scheme is commissioned. Planning horizon values are only valid for design purposes.

II.1.3 Contributions

The value of any contributions should not be deducted from the cost used in priority assessment, since priority is concerned with the proper direction of resources as a whole. However, in most cases the receipt of a contribution will involve an agreement making the scheme in effect a contractual obligation.

II.1.4 Contamination by Nitrates and Chlorides

Water supply divisions should take account of constraints imposed because of these in assessing the minimum reliable yield for Standard 11, Overall Water Source Reliability.

II.2 Cases Where Priority Assessment is Inapplicable

II.2.1 Land Drainage

This service is excluded from Priority Assessment.

II.2.2 Requisitioning of Schemes

Schemes which are requisitionable under Section 16 of the Water Act 1973 or Section 37 of the Water Act 1945 will not in general come within the scope of priority assessment. If requisitioned, they will become statutory obligations; if not, they will not be carried out. Priority Assessment may however, be applied separately to any non-obligatory part of a scheme. In this case only the additional problems to be solved and the marginal cost would be used in the assessment.

II.2.3 Mutually Exclusive Schemes (Economic and Technical Appraisal)

The priority assessment system is not intended to select between alternative schemes to solve the same problem. This should be done by means of economic and technical appraisal and the cost of the preferred scheme used in the priority assessment.

II.2.4 Aquifer Pollution

Refer to para. II.1.1

II.2.5 Sludge Treatment and Disposal

For new treatment works, sludge treatment and disposal will be an integral part of the overall scheme and should be assessed as such. The provision of new or additional sludge capacity at an existing works will normally be an obligation, and Priority Assessment is not appropriate.

II.2.6 Imminent Failure of Installations

These cases arise most often with sewers, but can occur with any type of installation. The essential feature is that no failure has taken place, therefore no standards are infringed and priority cannot be assessed, but it is considered that serious failure (e.g. sewer collapse, total breakdown of machinery) is imminent. The consequences of such failure are not easily predictable, but if it is considered that they would not be acceptable and would lead to emergency remedial action, then an over-riding priority will be assigned. Note that failures which take place and are readily repaired can be assessed, either by taking account of the shortfalls of service caused and/or the revenue costs of the repairs.

APPENDIX E

OKLAHOMA STATE HEALTH DEPARTMENT, U.S.A.
SEWAGE PRIORITY RATING SYSTEM

Formula for sewage priority rating system, Oklahoma State Health Department.

Formula

The project priority number (P) is derived from the formula:

$$P = \frac{S(Pa)}{T} + U + Q, + H \text{ where,}$$

S = Segment ranking factor

Pa = Population factor

T = Project type factor

U = Water use factor

Q = Effluent quality factor

H = Health hazards factor

Each of these factors is described below.

Segment Ranking Factor (S)

This factor is based on the statewide segment ranking contained in the annual State Water Quality Management Program. The S factor for each segment is listed below.

Segment No.	Stream	Segment Ranking Factor
5A(2)	North Canadian (El Reno to L. Eufaula)	5.766
1D(1)	Bird Creek	5.268
1C	Grand Neosho & Tributaries	5.175
1D	Verdigris & Caney River	5.100
6A(1,2,3)	Upper Arkansas River (above Keystone Dam)	5.076
6B	Cimarron River & Tributaries	4.335
2A	Lower Arkansas	3.603
1A	Middle Arkansas	3.465
3B(3,4)	Cache & West Cache Creeks	3.363
4B	Kiamichi River	3.006
4D	Blue River	2.862
4C	Muddy Boggy & Boggy	2.862
3A	Washita River & Lake Texoma	2.652
5A(1)	Deep Fork	2.550

3C	Elm & North Forks, and Red River	2.439
5B(1)	Little River below Lake Thunderbird	2.253
5B(2)	Little River (Thunderbird Watershed)	2.013
6A	Salt Fork Arkansas	1.842
3B(2)	Red River, L. Texoma to 4 mi. West of Texas Line	1.782
7	Panhandle	1.749
2A(1)	Poteau	1.722
5B(4)	Upper South Canadian	1.716
3D	Salt Fork Red	1.713
5A(3)	Upper North Canadian	1.566
6B(2)	Cottonwood	1.239
3B(1)	Beaver Creek	1.050
2A(2)	Sallisaw Creek	1.050
2A(3)	Lee Creek	1.050
5B(3)	Canadian River (Union City to L. Eufaula)	0.849
2B(1)	Gaines Creek (McAlester)	0.825
1B	Illinois River	0.795
4A	Little River to Arkansas Border	0.780
2B	Canadian River (L. Eufaula to Arkansas R.)	0.762
4C(1)	Boggy Creek (Lake Atoka Watershed)	0.750
6B(1)	Skeleton Creek	0.381

Tributaries to the above stream segments carry the same numerical designation as the identified segments.

Population Factor (Pa)

The Pa is based on the 1970 census population of the service area or an approved more recent estimate. The applicant will furnish the latest estimate of population and describe the method utilized in arriving at that estimate. If the estimate results in a different Pa than the census population, the OSDH staff will verify the estimate with the Regional Planning Agency and/or the Oklahoma Employment Security Commission. If the estimate is realistic, it can be used in place of the 1970 census figure. The Pa will come from the table below:

Population	Pa
100,000 to 1,000,000	1.8
50,000 to 100,000	1.7
25,000 to 50,000	1.6
10,000 to 25,000	1.5
5,000 to 10,000	1.4
1,000 to 5,000	1.3
Under 1,000	1.2

Project Type Factor (T)

The T is based on the general type of project as follows:

Type of Project	T
Complete system, no collection	.25
Treatment plant	.33
Interceptor lines and/or lift stations	.5
Stormwater Retention Basin	1.0
Complete system with collection	1.25
Interceptors & collection lines	1.50
Collection system only	2.0

Water Use Factor (U)

U is based upon the two highest water uses of the receiving stream. The U factor is the sum of the values for the two numberically highest uses of the receiving stream (see the table below).

CODE	VALUE	
A	7	Public and private water supplies
B	4	Emergency public and private water supplies
C_1	2	Fish and wildlife propagation
G_1	3	Recreation, primary body contact (includes recreational uses where the human body may come in direct contact with the water to the point of complete body submergence)
G_2	2	Recreation, secondary body contact (includes recreational uses, such as fishing, wading and boating, where ingestion of water is not probable)
J	5	Small-mouth bass fishery excluding lake waters
K	7	Trout fishery (put-and-take)
	0	All other uses

Tributaries to the stream segments with no water use designation carry same numerical designations as the identified segments.

Effluent Quality Factor (Q)

EQF is based upon whether the applicant is currently meeting NPDES permit requirements.

Present Discharge Status	EQF
Fully Compliant	0
Not monitoring adequately to ascertain	1
Non-Compliant with regard to:	
Flow	5
BOD	5
TSS	5
Fecal Coliform	5
Two or more	10
Groundwater contamination by existing facility demonstrated to exist	5
No system, but community experiences significant septic tank problems	5
No system, nuisance problems	2

Severe Health Hazard (H)

Severe health hazards exist as evidenced by an official notification from the State Commissioner of Health or designated representative(s)	25

APPENDIX F

REID AND DISCENZA PRIORITY RATING MODEL

a) Description of the characteristics of the 18 socioeconomic and sociocultural variables used in the model.

b) Description of the data input variables related to the local resources and materials.

a) Description of the characteristics of the 18 socio-economic and socio-cultural variables used in the model:

1. The level of education is a broad measurement designed to provide a rough estimate of the level of education of the people in a community. Five broad levels are specified: none, primary, high school, technical institute, and college. The high-level communities generally have higher levels of educational attainment.

2. Distribution of the labor force is expressed in terms of the percentage of professional, skilled, and unskilled workers in the employed labor force. The employed labor force means those persons who are in some way connected with the market economy. In a subsistence economy, only a very small portion of the total population is engaged in market activities. At the advanced level of development, a large percentage of the total population is active in the market, and these workers have expertise levels equivalent to the professional and skilled categories.

3. Income characteristics generally reflect the level of development. A larger per-capita income generally denotes high levels of development.

4. The percentage of non-indigenous workers in government and in industry is also used as an indicator of development. Low levels generally require that the majority of skilled and professional jobs are held by non-indigenous workers.

5-8. These variables relate to the investment that a community has in the education of its youth. When schools are operated by voluntary agencies or missionary organizations, the level of development tends to be at a low level. Increases in the standard of living tend to bring compulsory education to at least the primary level. The general accessibility of schools to a community indicates the level of development. Generally, the higher the grade offered, the higher the level of development.

9. The availability of in-service training programs reflects the level of development. These programs are not generally available in less developed areas. These programs often become more available as the need for higher skills and more expertise in technical areas is required in the community. These in-service programs may be offered through agricultural extension and community development programs.

10-11. These variables relate to the more sophisticated educational opportunities within the community itself. The availability of a college chemistry department gives some indication of the technical expertise available in the community. It also provides a potential place for the testing of water quality characteristics. In short, the availability of higher education indicates a high level of development.

12. The community fiscal level relates to the ability of a community to meet the needs of improved water and sewage treatment by providing for some, if not all, of the funds required for these improvements.

13. Rampant unemployment is characteristic of communities at a low level of development. The bulk of those unemployed in an area of low development are unskilled workers. Generally, the unemployment problem decreases as the level of development increases.

14. Agricultural extension services tend to improve as the level of development increases. At low levels of development, agricultural extension services and demonstration projects are scarce. In addition, there is a tremendous need for advisory services to farmers and other programs to upgrade the skills and enlist the participation of the rural masses. The main hurdle at low levels is that the appropriate organizational and institutional structures lack the means to implement and administer extension services.

15. The universities or colleges that local students attend give an indication of the level of development. If most or all of the college students receive their higher (third) education in neighboring communities or abroad, then the community is at a low level of development.

16. The level of technology available is a generalized data variable that calls on the experience of the planner. It simply asks what level of development is available as signified by four general categories of technology: hand tools, mechanical tools (e.g., gasoline-powered equipment), chemical products (e.g., use of fertilizers and/or chlorine), and electronic technology.

17. The government's role in the labor market also gives an indication of the level of development. At low levels of development, the local government tends to

be the major employer. As development increases, employment in private or non-governmental-related activities tends to increase.

18. The availability of public employment services indicates the level of development. These services are generally only available at high levels of development. Public employment services in less developed countries tend to be service blue-collar workers rather than professionals.

b) Data input variables related to the local resources and materials include:

1. Operation Equipment:

    a. Water meters.
    b. Soldering equipment.
    c. Acetylene torches.
    d. Recording devices (e.g., thermostats).
    e. Laboratory equipment (e.g., test tubes).
    f. Protable power plants (e.g., portable gasoline-powered electric generators).
    g. Motors (e.g., 1-3 horsepower electric motors).
    h. Water pumps.

2. Process Materials:

    a. Pipe (clay, steel, cement, plastic, copper, etc.).
    b. Pipe fittings.
    c. Paint.
    d. Valves.
    e. Tanks.
    f. Vacuum gauges.
    g. Heat exchangers.

3. Maintenance Supplies:

    a. Silica sand.
    b. Graded gravel.
    c. Clean water.
    d. Gasoline.

4. Chemical Supplies:

    a. $Al_2(SO_4)_3$ (Aluminum sulphate).
    b. $FeCl_3$ (Ferric chloride).
    c. Char (Activated charcoal).
    d. CaO (Lime).
    e. Na_2CO_3

f. Cl_2 (Chlorine).
g. O_3 (Ozone).
h. Laboratory chemicals (e.g., litmus paper).

5. Water Source:

a. River or stream.
b. Lake or impoundment.
c. Wells (is groundwater available?).
d. Sea or brackish source.

APPENDIX G

ALGORITHM WHICH CAN BE USED AS A GUIDE TO THE SELECTION OF THE MOST APPROPRIATE SANITATION TECHNOLOGY FOR ANY GIVEN COMMUNITY IN DEVELOPING COUNTRIES

Technology Selection[1]

Once different sanitation technologies have been compared (and excluded) on a technical basis, the sanitation program planner must select from those available the ones most appropriate to the needs and resources of the community. This selection should be based on a combination of economic, technical and social criteria, which often reduces to the question: which is the cheapest, technically feasible technology which the users will accept and can maintain and which the local authority is institutionally capable of operating? However in communities (or areas of cities) with higher income levels, consumers may prefer and be willing to pay for higher service standards, so that the cheapest technology is not always the one that should be chosen.

Figures G.1-G.3 present an algorithm which can be used as a guide to the selection of the most appropriate sanitation technology for any given community in developing countries. It should be stressed that the algorithm is meant only as a guide to the decision-making process. Its main virtue is that it prompts engineers and planners to ask the right sort of questions, which perhaps they would not otherwise ask; some answers can only be obtained from the intended beneficiaries. Although it is believed that the algorithm is directly applicable to most situations encountered in developing countries, there will always be the occasional combination of circumstances for which the most appropriate option is not that suggested for it. The algorithm therefore should not be used blindly in place of engineering judgment, but as a tool to facilitate the critical appraisal of the various sanitation options, especially those for the urban and rural poor. The algorithm is most useful when there are no existing sanitation systems, other than communal facilities, in the community under consideration. In general the type of any existing household sanitation systems, except perhaps unimproved pit and bucket latrines, will influence the technology chosen to improve excreta and sullage disposal. Additionally it is important to consider the existing or planned sanitation facilities in neighboring areas as they may enable the community to reduce its costs to the level at which it becomes affordable. In this context, and in the algorithm, affordability is taken to embrace both economic and financial affordability at the household, municipal and national levels including the question of subsidies, as discussed in Chapter 4.

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[1]Source: The World Bank, Appropriate Sanitation Alternatives: A Technical and Economic Appraisal, Energy, Water and Telecommunications Department, Final Draft, Vol. 1, October 1978.

The selection process starts on Figure G.1 by asking if there is or soon will be water supply service to the houses under consideration. This is a key question as its answer immediately determines whether conventional sewerage is a possible option or not. If the water supply service is through house connections, if there are no social or environmental reasons for excluding sewerage, and if it can be afforded, conventional sewerage is chosen unless there is land enough and the cost is less for septic tanks with soakaways. Septic tanks with drain fields would be the technology of preference where water saving appliances, such as cistern flush toilets using less than one gallon of water, can be installed to make them feasible.

If a community does not have, and is not likely to have, house water connections, then cistern-flush toilets and conventional sewerage cannot be used. If sullage generated on site is sufficient (50 lcd) to enable a sewered pour-flush system to function satisfactorily, a sewered PF system can be used provided that: (1) it is cheaper than alternative systems with separate sullage disposal facilities, or if the users or the municipality are willing to pay the extra cost; and (2) there is no over-riding social preference for nightsoil to be collected separately for subsequent use.

If the sewered PF system is not appropriate, the choice lies between the various on-site excreta disposal technologies with appropriate facilities for the disposal of sullage, for which the selection process is shown in Figure G.2.

If DVC toilets and three stage septic tanks system cannot be used, the choice lies between VIP latrines, ROECs, PF toilets, vault toilets and communal sanitation blocks as determined by the algorithm in Figure G.3.

Once the most appropriate technology has been selected from the algorithm, several questions should be asked as checks. These are:

1. Can the existing sanitation system (if any) be upgraded in any better way than that suggested by the algorithm?

2. Is the proposed technology socially acceptable? Is it compatible with cultural and religious requirements? Can it be maintained by the user and, if appropriate, by the municipality? Are municipal support services (e.g., educational, inspectional) required? Can they be made available?

3. Is the technology politically acceptable?

4. Are the consumers willing to pay the full cost of the proposed technology? If not, are user subsidies (direct grants or "soft" loans) available? Is foreign exchange required?

5. What is the expected upgrading sequence? What time frame is involved? Is it compatible with current housing and water development plans? Are more costly technologies in the upgrading sequence affordable and desired now?

6. What facilities exist to produce the hardware required for the technology? If lacking, can they be developed? Are the necessary raw materials locally available? Can self-help labor be used? Are training programs required?

7. If the technology cannot deal with sullage, can adequate facilities for sullage disposal be installed? Is the amount of sullage water so low (or could it be reduced) so as to preclude the need for sullage disposal facilities?

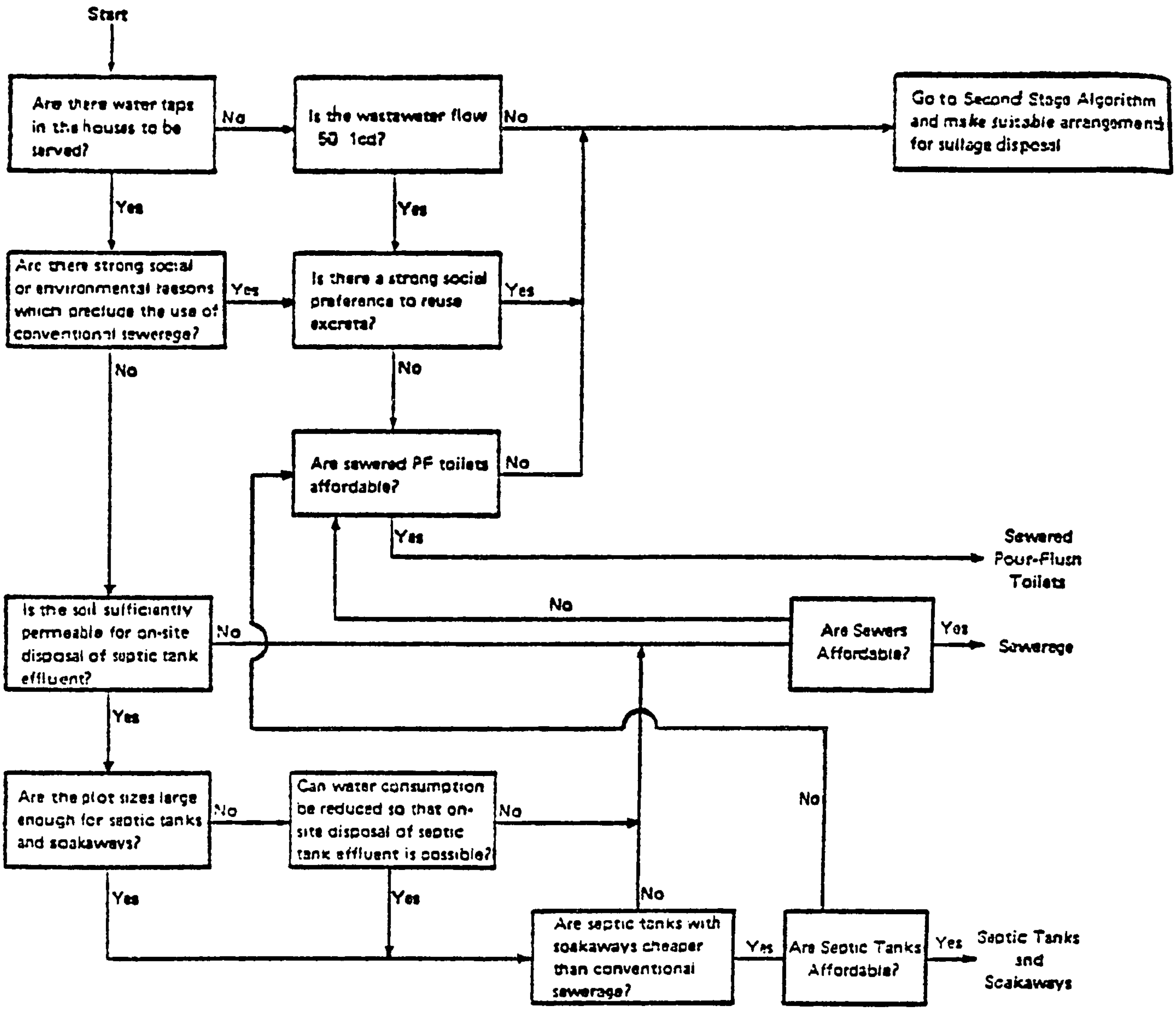

Figure G.1 FIRST STAGE ALGORITHM FOR SANITATION TECHNOLOGY SELECTION

World Bank - 19505

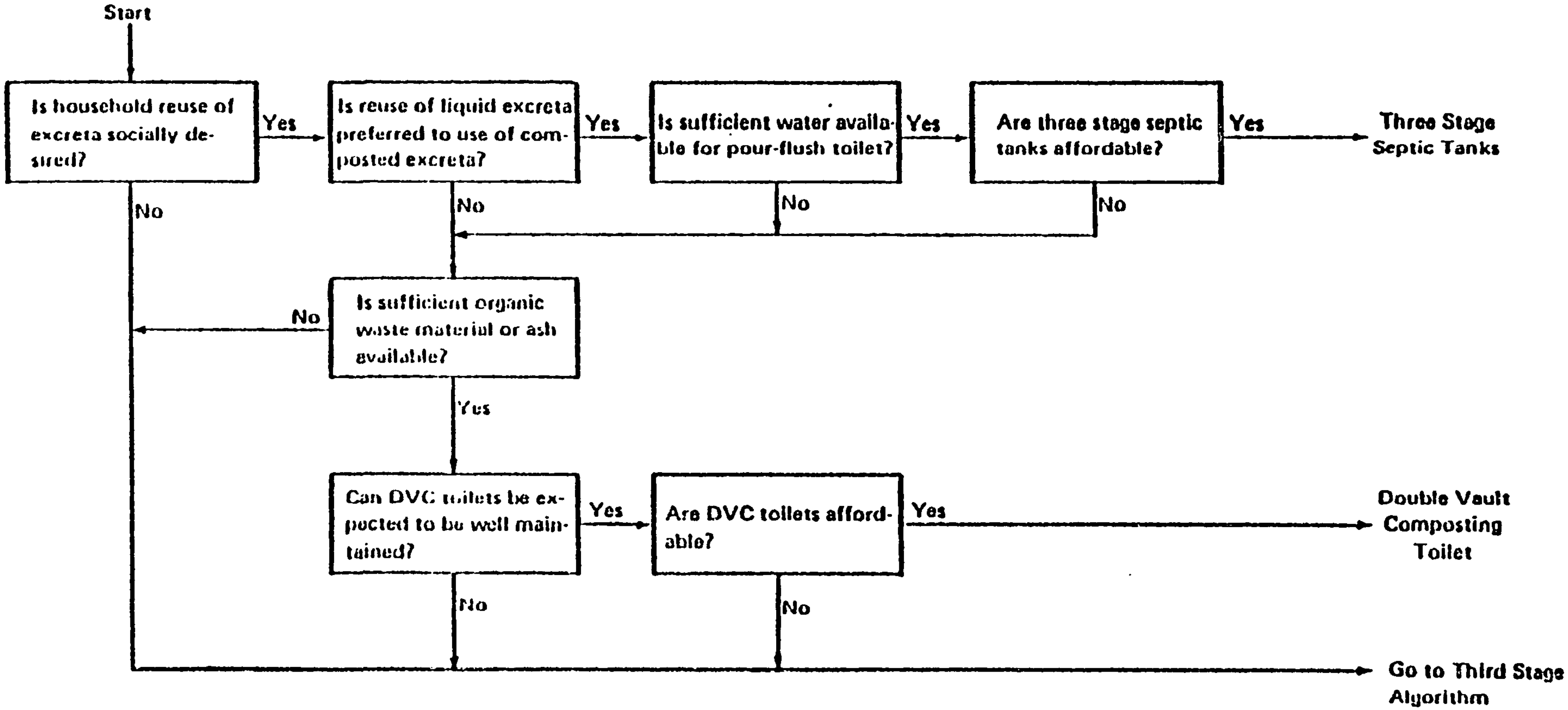

Figure G.2 SECOND STAGE ALGORITHM FOR SANITATION TECHNOLOGY SELECTION

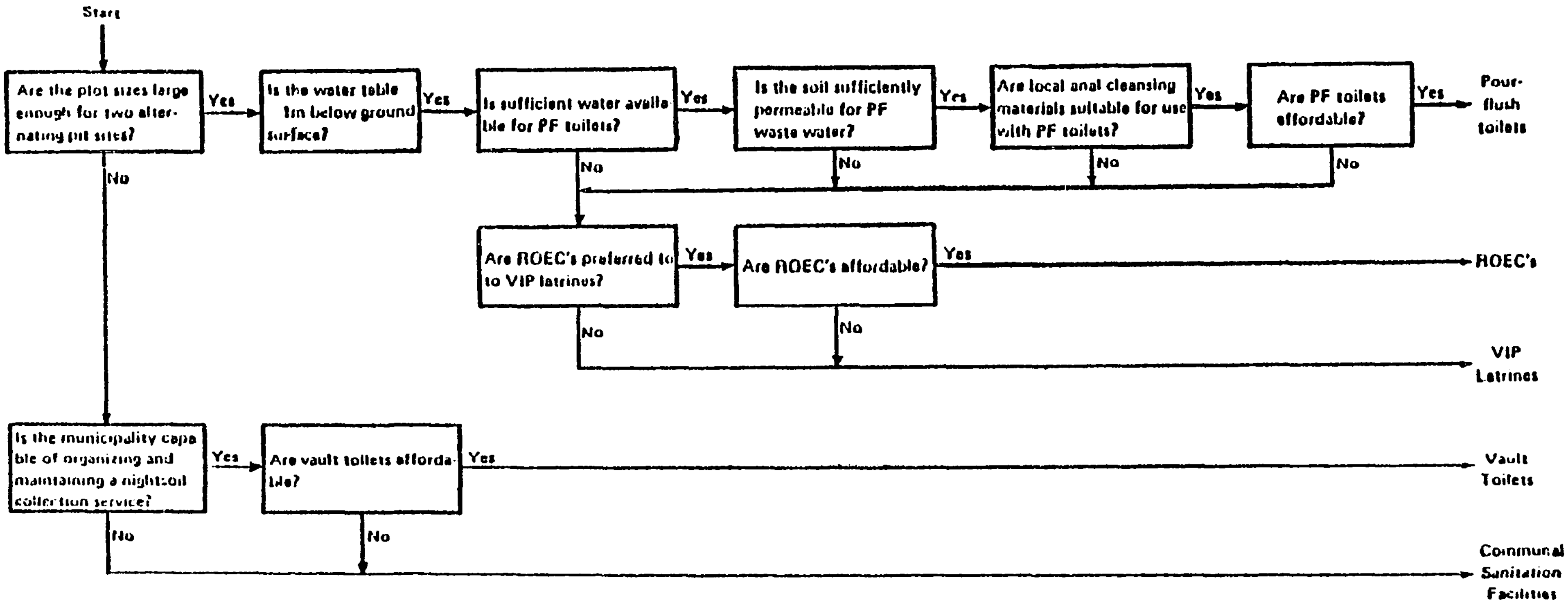

Figure G.3 THIRD STAGE ALGORITHM FOR SANITATION TECHNOLOGY SELECTION

World Bank - 19504

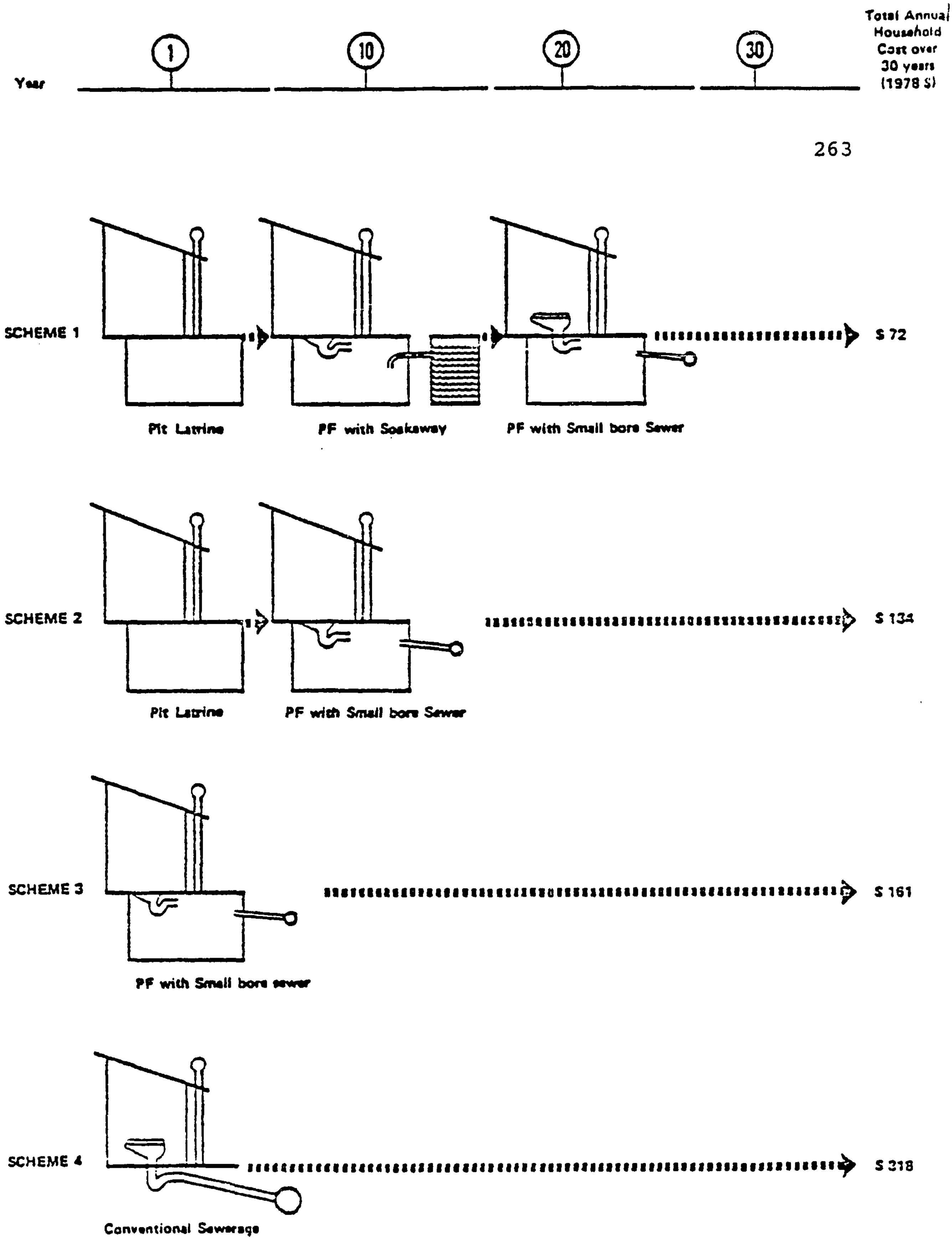

Figure G.4 SAMPLE SANITATION SEQUENCES

World Bank - 19574

APPENDIX H

QUESTIONNAIRE FOR ASSIGNING SCORE OF EACH CATEGORY FOR THE FIVE PARAMETERS

Questionnaire for assigning Score of each Category for Severe Health Hazards

CATEGORY	SCORE
a. Mortality* greater than 75, morbidity* greater than 1000.	____
b. Mortality greater than 75, morbidity less than 1000.	____
c. Mortality between 25 and 75, morbidity greater than 1000.	____
d. Mortality between 25 and 75, morbidity less than or equal to 1000.	____
e. Mortality less than 25, morbidity greater than 1000.	____
f. Mortality less than 25, morbidity less than or equal to 1000	____
TOTAL =	60

*Both mortality and morbidity expressed per 100,000 per year.

Date:

Name:

Questionnaire for assigning Score of each
Category for Population Density

CATEGORY	SCORE
a. Population density greater than 400 cap/ha.	_____
b. Population density between 325 and less than 400 cap/ha.	_____
c. Population density between 250 and less than 325 cap/ha.	_____
d. Population density between 175 and less than 250 cap/ha.	_____
e. Population density between 100 and less than 175 cap/ha.	_____
f. Population density less than 100 cap/ha.	_____
TOTAL =	60

Date:

Name:

Questionnaire for assigning Score of each Category for City Potential

CATEGORY	SCORE
a. High growth industry, mineral resources and civil or sanitary engineer available.	_____
b. High growth industry, no mineral resources, civil or sanitary engineer available.	_____
c. Low or no growth industry, mineral resources and civil or sanitary engineer available.	_____
d. Low or no growth industry, no mineral resources, civil or sanitary engineer available.	_____
e. Low or no growth industry, mineral resources available, no sanitary or civil engineer.	_____
f. All of industry, mineral resources, sanitary or civil engineer are not available.	_____
TOTAL =	60

Date:

Name:

Questionnaire for assigning Score of each
Category for Water Supply Condition

CATEGORY	SCORE
a. Water consumption greater than 200 l/cap/day, pop.* served by HC** greater than or equal to 35%.	_____
b. Water consumption between 100-200 l/cap/day, pop. served by HC gr[illegible] to 35%.	_____
c. Water consum[illegible] pop. serve[illegible] 35%.	[illegible]
d. Water [illegible] day, p[illegible]	[illegible]
e. Water [illegible] day, [illegible]	[illegible]
f. Wate[illegible] pop.[illegible]	[illegible]

* pop = po[illegible]
** HC = hou[illegible]

Date:

Name:

Questionnaire for assigning Score of each Category for Water Supply Condition

CATEGORY	SCORE
a. Water consumption greater than 200 l/cap/day, pop.* served by HC** greater than or equal to 35%.	_____
b. Water consumption between 100-200 l/cap/day, pop. served by HC greater than or equal to 35%.	_____
c. Water consumption less than 100 l/cap/day, pop. served by HC greater than or equal to 35%.	_____
d. Water consumption greater than 200 l/cap/day, pop. served by HC less than 35%.	_____
e. Water consumption between 100-200 l/cap/day, pop served by HC less than 35%.	_____
f. Water consumption less than 100 l/cap/day, pop. served by HC less than 35%.	_____
TOTAL =	60

* pop = population.
** HC = house connections

Date:

Name:

Questionnaire for assigning Score of each
Category for Technological Alternatives

CATEGORY	SCORE
a. The On-Site Options. pit latrine, pit privy, cesspool, reid's odorless earth closet (ROEC), aqua privy, communal/low cost septic tanks, compost privy, etc.	_____
b. The Cartage Options. night soil collection, house vault and vacuum truck, composting, etc.	_____
c. The Waterborne Options or Septic Tank.* waterborne sewerage with conventional treatment such as stabilization pond, aqua culture, hyacinths pond, marine waste disposal, etc., or septic tank.	_____
d. The Western type. waterborne sewerage with complete treatment.	_____
TOTAL =	40

Date:

Name:

*There are indications that in urban areas septic tanks will often cost more on a per household basis than conventional waterborne sewerage.

Source: -McGarry, M. G. "Waste Collection in Hot Climates: A Technical and Economic Appraisal," Water, Wastes and Health in Hot Climates, edited by Feachem, R. et al., A Wiley-Interscience Publications, 1977 p. 251.

-The World Bank, Appropriate Sanitation Alternatives: A Technical and Economic Appraisal, Final draft, Vol. 1, 1978, p. 50. The category above has been arranged in order from the lowest capital cost (a) to the highest cost (d).

APPENDIX J

DATA REQUIREMENT FORM FOR URBAN EXCRETA AND/OR WASTEWATER PRIORITIZING MODEL

1. Location of community

    City name ____________________

    County ____________________

    Province ____________________

2. Number of city population ________________

3. a. Area of the city ______ ha

    b. Undeveloped land area within the city ______ ha.

    c. Net city area ______ ha = (a - b)

Questions 4-8 relate to availability of city resources and manpower.

4. Industrial growth.

Type of industry	Annual production (ton/year)
(1) ________________	________________
(2) ________________	________________
(3) ________________	________________
(4) ________________	________________

5. Availability of mineral resources

(1) ____________	oil	(9) __________	copper
(2) ____________	natural gas	(10) __________	gold
(3) ____________	tin	(11) __________	silver
(4) ____________	coal	(12) __________	diamond
(5) ____________	bauxite	(13) __________	cement
(6) ____________	nickel	(14) __________	asphalt
(7) ____________	iron ore	(15) __________	caoline
(8) ____________	manganese	(16) __________	others (specify)

6. What is the number of existing staff at the City Public Works?

Civil Engineer __________

Sanitary Engineer __________

Bachelor __________

Technician (High School) __________

Technician (Junior School) __________

7. Is there a college or university in the city?

_____ (1) Yes _____ (2) No

8. Does the university have a chemistry department or laboratory?

_____ (1) Yes _____ (2) No

9. Is government water supply system available in the city?

_____ (1) Yes _____ (2) No

If yes, fill in questions 10-15; if no, continue to question No. 16.

10. Source of water supply

_____ (1) River or stream

_____ (2) Lake or impoundment

_____ (3) Springs

_____ (4) Wells

_____ (5) Others, specify

11. How are the physical and chemical characteristics of raw water supply source?

_____ (1) Good

_____ (2) Contain iron and/or mangan

_____ (3) hard

_____ (4) turbid

_____ (5) salty

_____ (6) others, specify

12. What type of water treatment is used?

_____ (1) No treatment at all

_____ (2) Disinfection only

_____ (3) Slow sand filter with/without[1] disinfection

_____ (4) Primary sedimentation with/without[1] disinfection

_____ (5) Complete treatment

_____ (6) Others, specify

13. Approximate per capita daily water demand

_____ liter/cap./day

14. What percentage of the population in the city have water supply connected to private homes?

_____ (1) None

_____ (2) 1-20%

_____ (3) 20-35%

_____ (4) 35-50%

_____ (5) 50-75%

_____ (6) 75-100%

15. What percentage of the population in the city obtains water supply from street hydrant?

_____ (1) None

_____ (2) 1-25%

_____ (3) 25-50%

_____ (4) 50-75%

_____ (5) 75-100%

[1]Circle the appropriate one.

Questions 16-31 relate to data requirements for technological alternatives parameter.

16. Is sewerage system in existence?

    _____ (1) Yes   _____ (2) No

17. Is this system separated or combined with storm water drainage?

    _____ (1) separated   _____ (2) combined

18. Please distribute the percentage of the population in the city for their excreta removal systems:

    _____ (1) private home connected to sewerage

    _____ (2) private home connected to storm drainage

    _____ (3) septic tank

    _____ (4) pit privy

    _____ (5) cesspool

    _____ (6) dispose of directly to river or irrigation canal

    _____ (7) others, specify

19. Are there any lakes, rivers/streams crossing or adjacent (less than 200 m from city boundary) to the city?

    _____ (1) Yes   _____ (2) No

20. Fill in the blank to denote the characteristics of the river or stream.

(1) Minimum flow	________	m^3/sec.
(2) Maximum flow	________	m^3/sec.
(3) Average flow	________	m^3/sec.
(4) Number of coliforms	________	MPN/100 ml
(5) Turbidity	________	mg/l or JTU
(6) BOD	________	mg/l
(7) Dissolved oxygen	________	mg/l

(8) pH ________ (0 14)

(9) Temperature ________ °C

21. General topography conditions:

______ (1) Mountainous

______ (2) Rocky

______ (3) Flat

______ (4) Steep = ________%

22. General soil characteristics, 3-m:depth from ground level

______ (1) tuffa

______ (2) sand

______ (3) clay

______ (4) limestone

______ (5) quartz

______ (6) others, specify

23. The depth of ground water level to ground level in dry season.

______ (1) less than 1 meters

______ (2) between 1-5 meters

______ (3) between 5-10 meters

______ (4) more than 10 meters

24. The depth of ground water level to ground level in rainy season:

______ (1) less than 1 m

______ (2) between 1-5 m

______ (3) between 5-10 m

______ (4) more than 10 m

25. Is there any objection by the community on the sight and handling of excreta?

_____ (1) Yes _____ (2) No

26. Is there any objection by the community to using flush toilets?

_____ (1) Yes _____ (2) No

27. Are there strong social or environmental reasons which preclude the use of conventional sewerage?

_____ (1) Yes _____ (2) No

28. Is there a strong social preference to reuse excreta?

_____ (1) Yes _____ (2) No

29. Is household reuse of excreta socially desired?

_____ (1) Yes _____ (2) No

30. Is reuse of liquid excreta preferred to use of composted excreta?

_____ (1) Yes _____ (2) No

31. Is the municipality capable of organizing and maintaining a nightsoil collection service?

_____ (1) Yes _____ (2) No

32. Fill in the number of cases and number of deaths per year for the following excreted infectious diseases:

	Number of cases/year	Number of deaths/year
(1) Typhoid	_____	_____
(2) Cholera	_____	_____
(3) Dysentery	_____	_____
(4) Infectious Hepatitis	_____	_____
(5) Gastroenteritis	_____	_____
(6) Ascariasis	_____	_____

	Number of cases/year	Number of deaths/year
(6) Ascariasis	_____	_____
(7) Skin Sepsis	_____	_____
(8) Skin ulcer	_____	_____
(9) Trachoma	_____	_____
(10) Conjunctivitis	_____	_____
(11) Scabies	_____	_____
(12) Yaws	_____	_____
(13) Tinea	_____	_____
(14) Louse-borne Fever	_____	_____
(15) Schistosomiasis	_____	_____
(16) Gunea Worm	_____	_____
(17) Ancylostomiasis (Hook-Worm)	_____	_____
(18) Onchoceriasis	_____	_____
(19) Trypanosomiasis	_____	_____
(20) Enteroviruses	_____	_____
(21) Tularaemia	_____	_____
(22) Leprosy	_____	_____
(23) Diarrhoeal diseases	_____	_____
(24) Yellow fever	_____	_____
(25) Poliomyelitis	_____	_____
(26) Yersinosis	_____	_____
(27) Clonorchiasis	_____	_____
(28) Opisthorchiasis	_____	_____
(29) Diphyllobothriasis	_____	_____
(30) Enterobiasis	_____	_____
(31) Fascioliasis	_____	_____

	Number of cases/year	Number of deaths/year
(32) Gastrodiscoidiasis	_____	_____
(33) Heterophyasis	_____	_____
(34) Hymenolepiasis	_____	_____
(35) Metagonimiasis	_____	_____
(36) Paragonimiasis	_____	_____
(37) Strongyloidiasis	_____	_____
(38) Taeniasis	_____	_____
(39) Trichuriasis	_____	_____