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A PRIORITY SETTING FOR RURAL WATER SUPPLY PROGRAM IN INDONESIA

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A PRIORITY SETTING FOR RURAL WATER SUPPLY PROGRAM

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PREFACE & ACKNOWLEDGEMENT

This dissertation is adressed to a study of the application of a system approach to the problem of selecting project localities for the Indonesian Rural Water Supply Program based on the Indonesian Government strategies. Thus the development of a village water supply prioritizing model. The author was personally involved for some years with the activaties of the Indonesian Rural Water Supply Program, such as the training and upgrading of health controllers and sanitarians, design, survey and construction supervision, and participation in the Project System Analysis Group consisting of the World Health Organization experts who formulated a priority ranking for the West Java Rural Water Supply Program in 1973. Therefore, the author is technically familiar with the Indonesian Rural Water Supply Program.

Several contacts were made between the Indonesian Government and the Bureau of Water and Environmental Resources Research at the University of Oklahoma through Mr. Martin G. Beyer, Adviser, Drinking Water Programs, the United Nations Children's Fund, New York, in an effort to establish cooperation leading to the processing mass data (56,000 villages) collected from the Indonesian rural areas for the Indonesian

Rural Water Supply Program using the Reid and Discenza model; however, there have been no positive results. With this in mind, Prof. George W. Reid, the Chairman of my dissertation committee and the Director of the Bureau of Water and Environmental Resources Research at the University of Oklahoma, suggested that I choose the topic "A Priority Setting for Rural Water Supply Program in Indonesia" for my dissertation. This wise idea reflects the great concern of Reid for Indonesia as he has been doing for developing countries. This work will be a companion piece to Process Selection Model (Reid).

The priority model for the Indonesian Rural Water Supply Program was developed in Chapter III, Methodology and an example of practical utilization was presented in Chapter IV, Test of the Model. The Delphi method, as suggested by Reid, was used for assigning the weight of the ten parameters used as criteria for a priority setting. For this approach which was discussed in Chapter III, a panel consisting of 28 experts from various countries was formed as a result of his broad personnal connections. Some of the panel members are his ex-students from developing countries who are now playing important roles in building their nations.

I wish to take this opportunity to express my deepest appreciation to Professor Reid for his wise idea, his guidance, supplying references and correcting carefully my dissertation concept chapter by chapter. A special note of appreciation is also due to my dissertation committee members,

Dr. Leale Streebin, Dr. James M. Robertson, and Dr. Arthur Bernhart, all of whom supplied me with invaluable professional advice and ideas.

The data required for this dissertation was provided by the Directorate of Hygiene & Sanitation, Directorate General of Communicable Diseases, Ministry of Health, Jakarta, Indonesia, who will utilize this dissertation. In regard to this I would like to thank: Mr. Wahyu Widodo, the Director of the Directorate of Hygiene & Sanitation; Mr. Soebeno Hadiwidjojo, Chief of the Drinking Water Sub-Directorate of Hygiene & Sanitation; Mr. Henning Darpinto, Health Controller, a staff member of the Drinking Water Sub-Directorate and the administration personnel of the Drinking Water Sub-Directorate who spent about two weeks preparing the selected data.

My study was sponsored by the World Health Organization Regional Office for South-East Asia, New Delhi, India, through the Pan American Health Organization, Washington D.C. In this respect I would like to express my sincere appreciation, especially to Ms. Nancy J. Berinstein, Training Officer, Fellowships Division of Human Resources and Research, who contributed much the financing of my study, I am indebted to her. I would also like to express my gratitude to Dr. Welfredo L. Reyes, an expert of World Health Organization Regional Office for South-East Asia, for his encouragement and invaluable assistance.

I must also thank the 23 distinguished panel members of the Delphi for contributing their opinions and experience to this dissertation. Many others deserve thanks, including Dr. H.J. Thung, District Engineer of Water Quality Service for the Oklahoma State Health Department and Mr. T.K. Tjiook, an expert of the World Health Organization Reference Center for Community Water Supply, The Hague, The Netherlands, who contributed much to this dissertation by supplying materials as well as professional advice and ideas; and Maude Grace Ebbink who corrected the structure of my dissertation concept, I am indebted to her.

Finally, to my wife, children and parents, I must convey my most affectionate appreciation for their patience and moral support through the difficult times of my study.

Soetiman
May 1, 1977

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CHAPTER I

INTRODUCTION

General

This dissertation deals with the present need of the Indonesian Rural Water Supply Program, that is, a priority setting for selecting which villages should receive the water supply system first. The scope of the Indonesian Rural Water Supply Program is very broad; it covers more than 100 million Indonesian people who live in about 56,000 villages. The sources, especially money and manpower, are very limited and there is a time limit as well. Most of the villages want to receive their water supply system first and in order to overcome this complex situation, it is felt that a priority model is strongly needed to ensure that the government money is spent more wisely and the people feel that the program is being implemented fairly

This dissertation consists of four chapters: Chapter I, Introduction; Chapter II, Literature Review; Chapter III, Methodology; Chapter IV, Test of the Model.

Indonesian Governmental Hierarchy

This dissertation will frequently use the names of the Indonesian Government Level which are Indonesian in nature and difficult to translate in English or to compare with the American Governmental Hierarchy. For this purpose, the basic Indonesian Governmental Hierarchy was illustrated in Figure 1.

The Central (Federal) Government consists of a president, a vice-president and about 21 ministers; there is no prime minister.

The Province (State) is also called the First-Level of Government headed by a governor. There are 26 provinces in all of Indonesia.

The Kabupaten is also called the Second-Level of Government headed by a bupati. There are 234 kabupatens in all of Indonesia. Besides the Kabupatens, there are 54 Municipal Areas each of which is headed by a city mayor.

The Kecamatan is headed by a camat and there are 3,138 kecamatans in all of Indonesia.

The Desa (Village Unit) is also called the Lowest-Level of Government headed by a lurah. Some desas consist of only one village, but some desas consist of two or more villages. There are 48,575 desas consisting of about 56,000 villages in all of Indonesia.

The names of the 26 Provinces and the number of Municipal Areas, Kabupatens, Kecamatans and Desas, together with

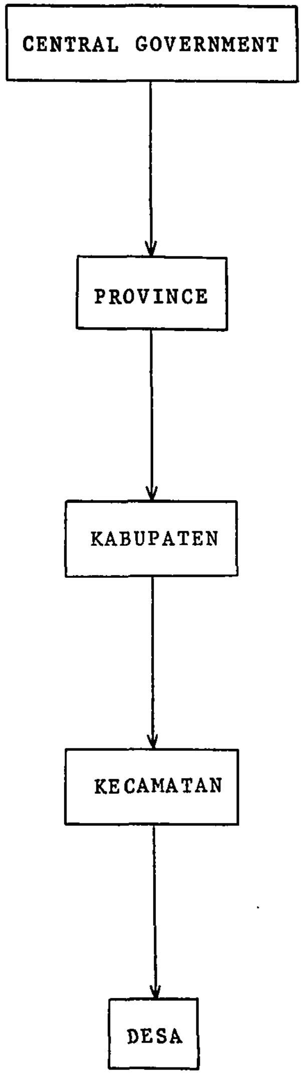

Figure 1. A sketch of the Indonesian Governmental Hierarchy.

urban and rural populations quoted from the census in 1971 are shown in Table 1. This table indicates that the Indonesian population in 1971 was 119.2 million, which was much lower than what observers predicted (1) and for planning purposes the higher figure was generally used.

Population

At the present time, the Indonesian population is approximately 151 million consisting of 122 million who live in rural areas and 29 million who live in urban areas according to the projected population which is shown in Table 2. These figures indicate that more than 80 per cent of the Indonesian population lives in rural areas which is common characteristic of Less Developed Countries in general. The present annual growth rate is 2.3 per cent and it is expected that by an intensive family planning program which is currently being implemented in the country, the annual growth rate will be reduced to 1.2 per cent in 2001 (1).

The problem with population in Indonesia is its uneven distribution. With respect to distribution among rural and urban areas it has been cited that more than 80 per cent of the Indonesian population lives in rural areas and less than 20 per cent lives in urban areas. This means that Indonesians depend upon agriculture for living, the low income bracket is dominant, industry is not yet developed, there is a high unemployment rate and the national economic growth rate is low.

The distribution among the various islands of Indonesia

TABLE 1

THE PROVINCES AND THE NUMBER OF MUNICIPAL AREAS, KABUPATENS, KECAMATANS AND DESAS TOGETHER WITH URBAN AND RURAL POPULATION

	Province	Mun. Areas	Kabu-patens	Keca-matans	Desas	Population x 1,000		
						Urban	Rural	Total
1.	D.I. Aceh	2	8	129	601	198	1,811	2,009
2.	North Sumatra	6	11	167	5,303	1,174	5,448	6,622
3.	West Sumatra	6	8	80	559	480	2,313	2,793
4.	Riau	1	5	67	721	218	1,423	1,641
5.	Jambi	1	5	37	918	293	713	1,006
6.	Bengkulu	1	3	23	71	61	458	519
7.	South Sumatra	1	9	85	1,692	1,001	2,442	3,443
8.	Lampung	1	3	58	1,124	274	2,503	2,777
9.	D.K.I. Jakarta	5	-	27	220	4,576	-	4,576
10.	West Java	4	20	387	3,927	2,686	18,946	21,632
11.	Central Java	6	29	492	8,485	2,356	19,521	21,877
12.	Yogyakarta	1	4	74	556	-	-	2,490
13.	East Java	8	29	554	8,865	3,702	21,824	25,526
14.	Bali	-	8	50	560	208	1,921	2,120

TABLE 1-Continued

	Province	Mun. Areas	Kabu-patens	Keca-matans	Desas	Population x 1,000		
						Urban	Rural	Total
15.	West Nusa Tenggara	-	6	56	553	179	2,023	2,202
16.	East Nusa Tenggara	-	12	98	1,714	129	2,165	2,294
17.	West Kalimantan	1	6	106	3,584	258	1,761	2,019
18.	Central Kalimantan	1	9	82	1,183	110	589	699
19.	South Kalimantan	2	9	94	674	453	1,246	1,699
20.	East Kalimantan	2	4	69	915	301	432	733
21.	North Sulawesi	2	4	81	1,142	335	1,383	1,718
22.	Central Sulawesi	-	4	61	1,149	73	840	913
23.	South Sulawesi	2	21	169	1,163	941	4,248	5,189
24.	South-East Sulawesi	-	4	43	394	52	662	714
25.	Maluku	1	4	51	1,605	144	944	1,088
26.	Irian Jaya	-	9	35	892	151	772	923
	Total	54	234	3,138	48,575	20,353	96,379	119,222

Source: Report of A UNICEF/WHO Group on Rural Water Supply in Indonesia, April 1975(2)

TABLE 2

PROJECTED POPULATION FOR INDONESIAN RURAL WATER SUPPLY PLANNING BASED ON CENSUS1971

Y e a r s	Population x 1,000		
	R u r a l	U r b a n	T o t a l
1969 - 1970	102,467	21,420	123,887
1970 - 1971	105,148	22,409	127,557[1]
1971 - 1972	107,899	23,443	131,342
1972 - 1973	110,721	24,525	135,246
1973 - 1974	113,618	25,657	139,275
1974 - 1975	116,494	26,820	143,314
1975 - 1976	119,343	28,012	147,355
1976 - 1977	122,261	29,258	151,519
1977 - 1978	125,251	30,559	155,810
1978 - 1979	128,315	31,917	160,232
1979 - 1980	131, 453	33,336	164,789

[1] This figure is supposed to be the same as shown in Table 1 which is 119.22 million. As mentioned previously, 119.22 million is much lower than many observers predicted and for planning purposes, most Indonesian planners use the higher figure as does the Directorate of Hygiene & Sanitation.

Source: The Directorate of Hygiene & Sanitation, Directorate General of Communicable Diseases, Ministry of Health, Jakarta, Indonesia.

is very uneven. The islands of Java and Madura which account for only 6.7 per cent (about 134,000 square kilometers or about 52,340 square miles) of the total land area (about 2,000,000 square kilometers or about 781,250 square miles) have 63.8 per cent (about 96.3 million people) of the total population, which is about 151 million according to the projected population (see Table 2), living on them; while Kalimantan, which accounts for 27.3 per cent of the total land area (about 546,000 square kilometers or about 213,280 square miles) has only 4.3 per cent (about 6.5 million people) of the total population (1). This means that Java and Madura are very densely populated and there is no more land for agricultural extension; on the other hand, Kalimantan and other big islands are scarcely populated and they have a lack of manpower to develop their lands and natural resources. The location of islands and the 26 Provinces is shown in Figure 2.

Finally, the distribution of population with respect to age groups, 44.1 per cent of the population is under 15 years of age and only 2.5 per cent is over 65 years (1). This reflects that the consumptive group is high and requires a high investment in education. In 1973 (1) there was only 57 per cent of the children between the ages of 7 and 12 were able to attend the primary school because there was a lack of facilities to accomodate the total population of school-age children.

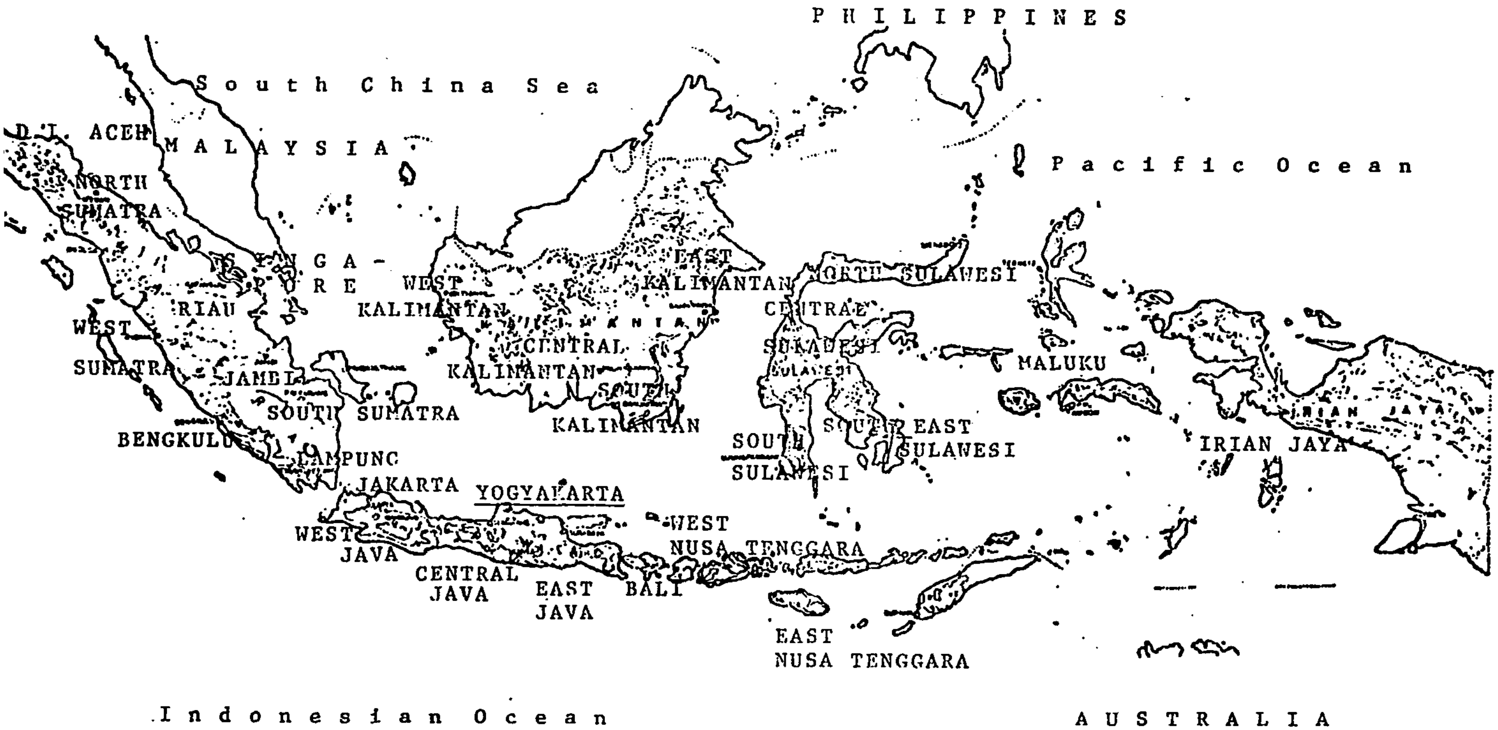

Figure 2. A Map of Republic of Indonesia
Denoting the 26 Provinces

Source: A Report of UNICEF/WHO Group on "Rural Water Supply in Indonesia" (2).

Last, but not least, is the uneven income distribution. The gap between the rich and the poor is too wide and, unfortunately, the greater portion of the Indonesian population, especially in rural areas, belongs to the low income bracket. This condition tends to create some social problems.

Water Situation

Indonesia is a tropical country characterized by heavy rainfall. The average rainfall for the whole country is approximately 2,000 mm (about 80 inches) per year. Unfortunately, the distribution of rainfall throughout the country is uneven; some areas get a very high rainfall, for instance, Batu Raden, Central Java, receives about 7,000 mm (about 280 inches) per year, while Palu, Central Sulawesi, receives only about 700 mm (about 28 inches) per year. The distribution of rainfall throughout the year is also uneven. During the wet months, between December and March, some areas get heavy flooding routinely which destroys property and takes lives. During the dry months, on the other hand, between July and September, some areas have no water, not even a drop to drink. There is a saying in Central and East Java along the Bengawan Solo river basin, that "there is no place to sit during the wet season and no water to drink during the dry season" which means there is always a flood or a drought in this area.

Water supply facilities are still scarce in most part of Indonesia, particularly in rural areas. Before the

Indonesian Government ran the First Five-Year Development Plan, April 1, 1969 to March 31, 1974, only less than 20 per cent of the urban population had been served by piped water system from the Municipal Drinking Water Services, and only about one per cent of the rural population had reasonable access to safe water. By the end of the First Five-Year Development Plan, approximately 25 per cent of the urban population was served by piped water systems and about 1.6 per cent of the rural population had reasonable access to safe water. Today, about 45 per cent of the urban population is served by piped water systems and about 5.4 per cent of the rural population is served by safe water supply systems.

The majority of Indonesian people depend on unsafe water from wells, rivers, irrigation canals, ponds, lakes, unprotected springs and rainwater collections which subject to pollution. In certain islands and coastal areas where potable water is not available, water has to be brought by boats or trucks from nearby producers of safe water. Villages in the mountainous areas use bamboo pipes to carry water from natural springs, where the major portion of water leaks on the way and only a very small portion reaches the villages due to very long distances.

The situation is drastic during the dry season, the period from July to September, when wells, rivers, irrigation canals and ponds run dry and the villagers have to travel a few kilometers or even more than seven kilometers to get get a bucket of water from the big rivers or springs.

Women and children are responsible for getting the water, while men go to work to earn a living. They spend all day long getting water; therefore, many children do not go to school and lose their opportunity for an education provided by the government. Also, women lose valuable time that could be devoted to economic activities and educating their children.

Excreta Disposal

At present, not more than 5 per cent of the Indonesian rural population have or use facilities for safe disposal of excreta (2). Most of rural population disposes their human waste through rivers, irrigation canals, ponds, farms or back yards, which creates the major source of pollution in rural areas. This condition is, of course, very dangerous to public health and aesthetically unpleasant.

In the First Five-Year Development Plan, the Provincial and Kabupaten Health Offices initiated the introduction of the simplest method for safe excreta disposal by means of latrines that is just a plain hole covered by a concrete slab with a water seal. Now latrines, as excreta disposal facilities, are one of the most important objectives of INPRES[1] Program in Health Improvement along with the Rural Water Supply and Sanitation Programs.

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[1]Presidential Instruction.

Public Health

Public health conditions in Indonesia, especially in rural areas, are very bad due to a lack of safe water and excreta disposal facilities as discussed previously. This causes many waterborne diseases[1], particularly cholera, which is contracted by the people and takes many lives. Cholera is said to be an endemic in Indonesia, a disease which occurs every year and spreads from one place to another, especially during the dry season when water is extremely difficult to find or during the wet season after heavy flooding.

The World Health Organization Regional Office for South East Asia (9) reported that there were numerous cholera cases in Indonesia: 6,525 in 1970, 23,555 in 1971, and 43,423 in 1972 with deaths number 1,379, 3,335 and 6,863 respectively; this indicates a marked increase within a two-year period. Children under six years of age are prone to cholera and other waterborne diseases such as gastroenteric disease and typhoid. Diseases which are also considered waterborne and are often contracted by the people are trachoma and skin diseases. A water-related disease[2] which is often contracted by the people is malaria. Finally, other diseases which are related to poor sanitation and are often contracted by the people are hookworms (ancylostomiasis), roundworms (trichuriasis) and ascariasis.

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[1] diseases which are transmitted through water.

[2] a disease where a necessary part of the life cycle of the infecting agent takes place in aquatic animals (7).

In the past, the Indonesian Government controlled cholera and other waterborne diseases (gastroenteric and typhoid) through vaccination campaigns which had not been successful due to a lack of understanding by the villagers and the difficulty in communication. Many villagers were reluctant to get vaccinations and some times the vaccination campaign team had to travel to the remote areas on foot or ride on bicycles, but when the team reached the community to be vaccinated, many villagers were gone. The most effective way to vaccinate is through schools where the children are urged by teachers to be vaccinated. The immunization against cholera and typhoid is only good two weeks to six months after vaccination.

Indonesian Rural Water Supply Program

Learning from past experience, the Indonesian Government is aware that the best way to control cholera and other waterborne diseases is to provide safe water in adequate quantity. This is in accordance with the recent statement of the Director General of the World Health Organization that if a single activaty were to be undertaken which would have the greatest impact on the health of people living in the developing countries, it would probably be the provision of safe water supply (5).

The Indonesian Rural Water Supply Program began in the first year of the First Five-Year Development Plan, April 1, 1969, but only as a "Pilot Project". At the end of the First Five-Year Development Plan, March 31, 1974, it had served only 721,250 people or about 0.6 per cent of the total rural population. In April 1, 1974, the beginning of the Second Five-Year Development Plan, the Indonesian Rural Water Supply Program was integrated with the INPRES Program in Rural Development, and it is called the INPRES Program in Rural Water Supply.

The objective of the INPRES Program is to improve the living conditions of the Indonesian rural population and consists of:

1. INPRES Schools; the construction of primary schools in every Desa to improve the educational level of the rural population.

2. INPRES Health Centers; the construction of health centers in every Kecamatan to improve health care for the villagers.

3. INPRES Infrastructures; the building of roads, irrigation canals, farming centers, village growth center units, religious centers, and so on to promote the economic growth and mental well-being of the villagers.

4. INPRES Rural Water Supply and Sanitation; the provision of safe water and latrines to the villages to improve public health conditions in the villages.

5. Family Planning Program to reduce the population growth rate to two per cent by the end of the Second Five-Year Development Plan (March 31, 1979) for the short-term target, and to 1.2 per cent by 2001 for the long-term target.

Since the Indonesian Rural Water Supply Program has been financed by INPRES funds, a remarkable progress has been achieved; within three years, 1974 to 1977, it served about 5.7 million people or about 4.7 per cent of the total Indonesian rural population. The target of the INPRES Program in rural water supply is to supply safe water to 10 per cent of the Indonesian rural population by the end of the Second Five-Year Development Plan (March 31, 1979) with a water consumption rate of 60 liters per capita per day using public taps (hydrants) as a distribution system. This target is too low compared with the Second United Nations Development Decade (1971 - 1980) goals which are to supply safe water to all of the urban population and 25 per cent of the rural population living in the developing countries (5). However, the target of the Indonesian Rural Water Supply Program is more realistic because it is very hard to serve 25 per cent of 131 million based on the projected population, or about 33 million in six years, because the INPRES Program just started in 1974.

To compare the designed water consumption rate of the Indonesian Rural Water Supply Program with the world figures, the World Health Organiztion data for average daily consumption in rural areas is presented in Table 3.

The target of the urban water supply program in Indonesia is in line with the Second United Nations Development Decade goals, that is, to supply piped water systems to all Municipal Areas and Kabupaten Capital Cities with a water consumption rate of 150 liters per capita per day and a house connection distribution system by the end of the Second Five-Year Development Plan, March 31, 1979.

The Second United Nations Development Decade goals were based on the estimate that in 1970, about 15 per cent of

TABLE 3

AVERAGE DAILY WATER CONSUMPTION IN RURAL AREAS

Region	Liters per capita per day	
	Minimum	Maximum
Africa	15	35
South East Asia	30	70
Western Pasific	30	95
Eastern Mediterranean	40	85
Europe (Algeria, Morocco, Turkey)	20	65
Latin America and the Caribbean	70	190
World average	35	90

Source: A World Bank Paper, Village Water Supply page 33.

the rural population in developing countries had reasonable access to safe water, but in fact, in Indonesia it was only 1 per cent, and about 70 per cent of the urban population in developing countries had access to a piped water supply, but in fact, in Indonesia it was only about 20 per cent.

In order to meet the Second United Nations Development Decade goals, the Indonesian Government should spend US$13.1 million for an annual average rural water supply investment for the period 1971 - 1980 based on the per capita cost US$4 (5), which is too low compared with actual per capita cost US$8 (3). In the last three years, the Indonesian Government has spent a considerable amount of money for a rural water supply program, US$6.35 million in 1974-1975, US$10.79 million in 1975-1976 and US$14.88 million in 1976-1977, respectively, while during the five years of the First Five-Year Development Plan the Indonesian Government spent only US$1.7 million.

The necessary rural water supply investment and assumed per capita cost in some developing countries of South East Asia according to the Second United Nations Development Decade (UNDD) goals is presented in Table 4.

TABLE 4

NECESSARY RURAL WATER SUPPLY INVESTMENTS
TO MEET THE UNDD GOALS

Country	Annual average invesments US$[1] million	Assumed per capita cost of rural water supply US$[1] million
India	US$90.0	US$ 8
Indonesia	13.1	4
Pakistan	13.3	9
Philippines	1.7	5
Thailand	7.4	10
Sri Lanka	6.3	21

[1]Basis in 1970 US dollar.

Source: A World Bank Paper, Village Water Supply page 80.

In implementing the rural water supply program, the Indonesian Government is receiving assistance from WHO[1] in terms of experts in planning and supervision; from UNICEF[2] in terms of materials and equipment susch as pipes, fittings, water pumps, pre-fabricated steel water tanks, survey and drilling tools; and from UNDP[3] and USAID[4] in terms of manpower development such as the upgrading of health controllers, sanitarians and assistant sanitarians.

The progress of the Indonesian Rural Water Supply Program by funds, by population served, and by systems are presented in Table 5, 6 and 7 respectively.

TABLE 5

PROGRESS REPORT BY FUNDS

Y e a r s	Amount in US$
1969 - 1974	US$ 1,70 million
1974 - 1975	6,35 million
1975 - 1976	10,79 million
1976 - 1977	14,88 million
T o t a l	US$29,62 million

Source: Directorate of Hygiene & Sanitation, Ministry of Health.

[1] World Health Organization.
[2] United Nations Children's Fund.
[3] United Nations Development Program.
[4] United States Agency for International Development.

TABLE 6

PROGRESS REPORT BY POPULATION SERVED

Y e a r s	Population Served	% Rural Population
1969 - 1970	78,700	0.077
1970 - 1971	28,500	0.027
1971 - 1972	82,850	0.077
1972 - 1973	242,950	0.219
1973 - 1974	287,800	0.253
1974 - 1975	1,452,982	1.247
1975 - 1976	2,130,400	1.785
1976 - 1977	2,107,500	1.724
T o t a l	6,411,582	5.409%

Source: The Directorate of Hygiene & Sanitation, Ministry of Health.

TABLE 7

PROGRESS REPORT BY SYSTEMS

Y e a r s	Piped Systems	Rain water collections	Spring Protections	Artetion Wells	Hand Pumps
1969 - 1970	3	0	1	0	0
1970 - 1971	5	0	1	0	0
1971 - 1972	14	0	0	1	0
1972 - 1973	35	0	7	0	0
1973 - 1974	51	0	15	16	3
1974 - 1975	96	163	81	33	10,127
1975 - 1976	146	445	180	50	14,199
1976 - 1977	150	500	150	25	14,175
T o t a l	500	1,108	435	125	38,504

Source: The Directorate of Hygiene & Sanitation, Ministry of Health.

The Administrative Procedure for the Indonesian Rural Water Supply Project Proposal is illustrated in Figure 3 and described by the following steps:

1. Community complains.

2. Health Center Officer discusses this complaint with the Camat.

3. Sanitarian from the Health Center explores complaint.

4. Health Center Officer reports to HS[1] Section at Kabupaten Level.

5. HS[1] personnel and Kecamatan sanitarian go to area of complaint.

6. HS[1] Section Officer reports information collected from area to the Bupati.

7. Bupati sends agreement of need to HS[1] Section.

8. HS[1] Section Officer proposes need of safe water system to Sub-Directorate of HS[1] at Provincial Level.

9. HS[1] Section Officer approaches Bupati for his support in construction and maintenance costs.

10. Bupati instructs the Camat and Lurah to approach community for contribution to construction and maintenance costs.

11. Staff of Sub-Directorate of HS[1] visits area to review preliminary proposal.

12. Staff of Sub-Directorate of HS[1] discusses revised preliminary proposal with the Governor to get financial contribution from provincial level.

13. Proposal is sent to Directorate of HS[1] for approval.

14. Directorate of HS[1] formulates program and refers to the BAPPENAS[2].

15. BAPPENAS[2] discusses the program with the Meeting

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[1] Hygiene & Sanitation.
[2] National Development Planning Board.

Board consisting of BAPPENAS, BAPERDA[1], Ministry of Health, Ministry of Public Works and Ministry of Home Affairs to determine ceiling budget provided for rural water supply projects.

16. BAPPENAS sends final decision to Directorate of HS through Ministry of Health and to Ministry of Home Affairs.

17. Based on ceiling budget, Directorate of HS makes final decision about the projects which are found to be urgent and notifies HS Section at Kabupaten Level through Sub-Directorate of HS concerning this final decision.

18. At the same time, Ministry of Home Affairs notifies Bupati through the Governor about final decision of BAPPENAS.

19. Directorate of HS sends standard designs of selected systems to Bupati through HS Section.

20. Bupati, as project manager, forms tender committee consisting of technical and administrative officials from Kabupaten Public Works, HS Section, Sub-Directorate of HS and, for systems using artesian wells, Directorate of Geology, Ministry of Mining to perform a tender. Based on evaluation of tender committee, Bupati assigns selected contractor and notifies Camat and Lurah for their support in implementing the projects.

There are two ministries that are responsible for the implementation of the Indonesian Rural Water Supply Program; the Ministry of Health through the Directorate of Hygiene & Sanitation which is responsible for technical problems such as surveys, designs and supervision of the construction as well as operation and maintenance, and Ministry of Home Affairs through the Bupati who is responsible for administrative and financial problems such as the selection of project localities and collection of funds from INPRES, Province and local resources.

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[1] Provincial Development Planning Board.

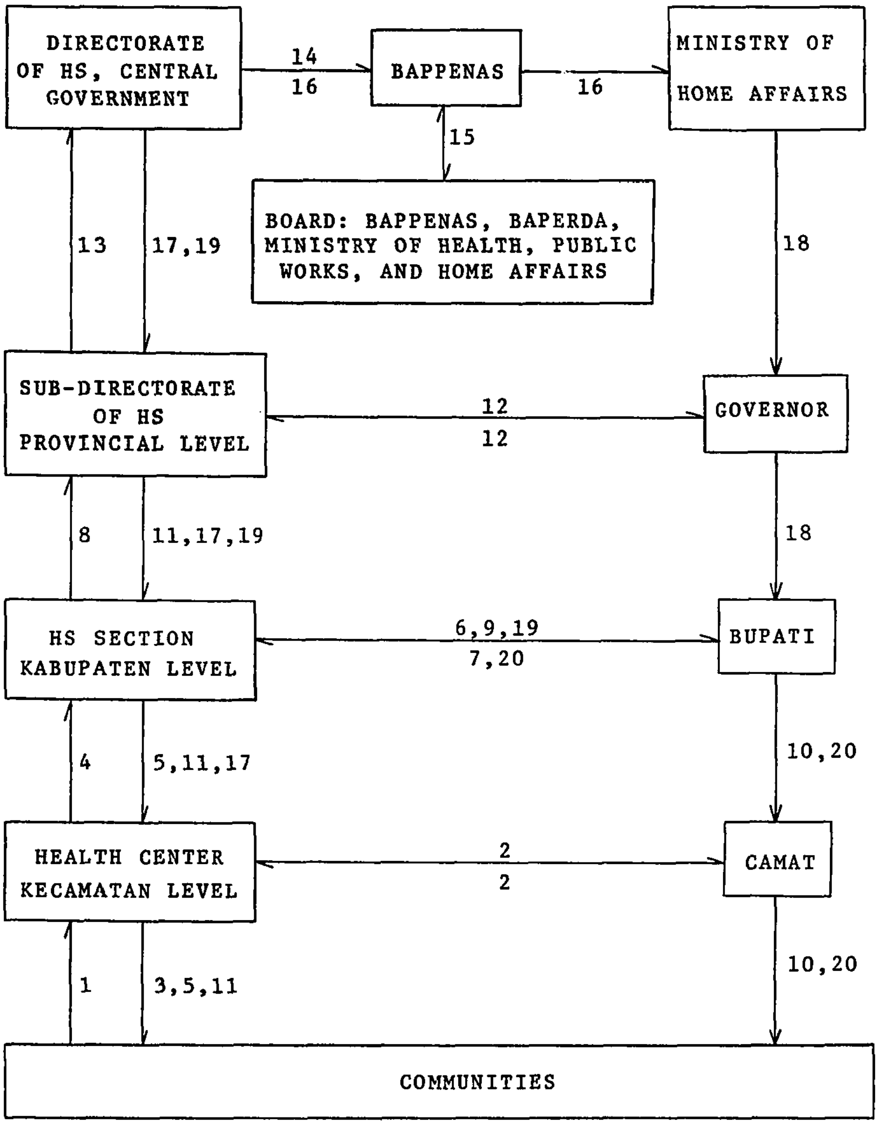

Figure 3. Administrative Procedure for the Indonesian Rural Water Supply Project Proposals.

Source : Directorate of Hygiene & Sanitation, Ministry of Health.

Constraints

There are three major constraints in executing the Indonesian Rural Water Supply Program, namely, money, time and manpower.

Money

With respect to money, it was estimated by the PSA[1] Group of WHO experts in 1973 by taking samples in the West Java Province, that based on the water consumption rate of 60 liters per capita per day with a public tap distribution system, the average construction cost was US$8 per capita ranging from US$3 to US$30 depending on the type of system to be installed. This figure is more realistic than US$4 as assumed by the Second United Nations Development Decade (5). Assuming that this figure does not change, the Indonesian Rural Water Supply Program, which is to serve about 131 million people according to the projected population in 1980 (see Table 2), will need at least US$1 billion, which is a substantial amount of money for the Indonesian Government at present because many other projects are being implemented simultaneously under the Second Five-Year Development Plan.

From an economic point of view, the rural water supply investment is not attractive to investors since the benefit is not easy to assess and the rates of return are low. The other investments such as irrigation, roads, harbours, airports, telecomunications, power plants, industry and so on are more

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[1] Project System Analysis.

attractive to investors because of the higher rates of return and because the benefits are easily quantified. However, the Indonesian Rural Water Supply Program receives a high priority since it is financed by INPRES funds. As mentioned earlier, in the fiscal year 1976-1977 the Indonesian Government spent spent US$14.88 million which is higher than average annual investment of US$13.1 million to meet the Second United Nations (see Table 4), although it is still small compared with the estimated total investment of US$1 billion.

Time

The Indonesian Rural Water Supply Program consists of short-term and long-term targets. The short-term target is to supply ten per cent of the Indonesian rural population, or about 13 million people, with safe water systems by the end of the Second Five-Year Development Plan, March 31, 1979 (11). The long-term target is to supply all of the Indonesian rural population with safe water systems.

Concerning the short-term target, the Indonesian Government would have to serve about 5.5 million people within two fiscal years, 1977-1978 and 1978-1979; this requires a total of about US$44 million or US$22 million each fiscal year which is difficult undertaking. With regard to the long-term target, as mentioned before, investment of about US$1 billion is needed. In the fiscal year 1976-1977, the Indonesian Government spent US$14.88 million. Assuming that the Indonesian Government will spend at least the same amount for each successive year, it will take about 70 years to supply the projected rural population of 131 million with safe water systems; but during this period of time, the population will, at least, double. Therefore, it is difficult to predict how much time is needed to implement the Indonesian Rural Water Supply Program.

However, since the Indonesian Government is now running a national development program across the country with emphasis on rural areas, the progress in the economic growth of rural areas, as well as in the nation, will be achieved in the near future, so the government together with the rural communities will be able to invest a greater amount of money in rural water supply projects. As village incomes increase and a better level of education is attained, the villagers will perceive the need for a safe water system and they will contribute a greater portion to the installation of a safe water system or even finance such an installation themselves. Nevertheless, the Indonesian Rural Water Supply Program will take some decades to complete.

Manpower

The scope of the Indonesian Rural Water Supply Program is broad. It requires a lot of money and a large number of competent personnel, appropriately organized for planning, design, execution, supervision, operation, maintenance and the development of the rural water supply systems.

In 1975 (2), at the Central Directorate of Hygiene &

Sanitation, there were 15 health controllers and 13 sanitarians. There is a sanitary engineer in each of the two Departments of Communicable Diseases in the Central and East Java Provinces. In all, 32 health controllers and 54 sanitarians are engaged in rural water supply schemes in the 26 Provincial Office. For the 234 Kabupatens there are 33 health controllers and 198 sanitarians in the Health Offices who are engaged in rural water supply and sanitation programs. A staff of 17 health controllers, 169 sanitarians and 368 assistant sanitarians is engaged in rural water supply and sanitation programs in some of the 3,138 Kecamatans.

These personnel figures are far below the needs of the water supply program and most of them do not have enough background in engineering. A UNICEF/WHO Group (2) stated that the absence of trained engineering staffs at the national, provincial and kabupaten levels is serious drawback. This is true, but it must be kept in mind that at present, it is very difficult to find an engineer who is willing to work on rural water supply projects because the production of engineers by universities in Indonesia, particularly sanitary engineers, is very low, while the demand is high, especially from private firms which offer better conditions and higher salaries.

On the other hand, there is not much interest in construction works of rural water supply projects by large and experienced contracting firms because the expected profit is not attractive to them. Therefore, only the small and unexperienced contracting firms are willing to work on rural water supply projects; consequently the use of small contracting firms will require more qualified and experienced supervising teams who are very difficult to find at this time. Some sub-projects are located in very remote areas, especially projects using spring protections with piped systems, and they are quite difficult to reach; this is another reason why the large contracting firms are reluctant to work on rural water supply projects.

Probably, the best way to overcome this complex situation is to install the simplest systems first, such as dug wells or tube wells with handpumps, rainwater collections, and simple spring protections without piped systems which do not require sophisticated engineering designs, careful supervision and skilled operators; if not, the program will never be implemented. This should be accompanied by an extensive training of engineering staffs, supervising teams, operation and maintenance personnel, as is presently being conducted and planned by the Ministry of Health with the cooperation and assistance of some engineering institutions and international agencies such as WHO, UNICEF, UNDP and USAID, as discussed earlier.

Objective

There are, as described previously, three major constraints in the implementation of the Indonesian Rural Water

Supply Program, namely, money, time and manpower. Most of the communities want to receive their safe water system first and this is difficult to accomplish. It is felt that there is a need of a criteria for selecting which villages should receive a safe water system first. Therefore, the objective of this dissertation is to establish a priority model which is suitable to the Indonesian rural conditions, characteristics, and the strategies of the Indonesian Rural Water Supply Program.

Justification

Although some priority models for rural water supply programs have been introduced and have been successfully practiced in some developing countries, none of them are suitable to the Rural Water Supply Program in Indonesia due to a difference in strategies, a lack of well-trained engineering staffs, different local conditions and community characteristics. Therefore, this dissertation is concerned with establishing a suitable priority model for the Indonesian Rural Water Supply Program taking into consideration the particular characteristics and conditions of the Indonesian rural areas as well as the strategies of the Indonesian Government at present.

CHAPTER II

LITERATURE REVIEW

Introduction

References on priority setting for rural water supply programs are still limited at this time because there is little attention from the governments, especially in the developing countries, due to a lack of funds and manpower. Since the United Nations has set goals for the improvement of water supplies in the Second Development Decade, 1971-1980, many governments from developing countries are becoming increasingly concerned with improved water supply programs for rural areas as part of the rural development programs to improve the living conditions of the rural populations.

The Second United Nations Development Decade goals (5) are to supply safe water to all urban populations and one-quarter of the rural populations. To achieve these goals would mean, in round terms, increasing the numbers served in urban areas by 390 million, from 320 million to 710 million, or by 120 per cent. In rural areas, even this modest goal means extending service to a further 273 million people, increasing coverage from 140 million to 413 million, or nearly 200 per cent (5). Although these goals are commendable, they are very hard to achieve. For the same period, for instance, the Indonesian Rural Water Supply Program target is only to supply safe water to 10 per cent of the Indonesian rural population covering about 13 million people living in some of the 56,000 villages, which is much lower than the Second United Nations Development Decade goals. However, this is difficult to achieve because the Indonesian Government just started to implement extensively the rural water supply program three years ago.

International agencies which are very much concerned with rural water supply programs are WHO, UNICEF, UNDP, USAID, and Others. WHO is conducting survey to collect data, publishing standars, manuals, papers and statistics, and providing experts to governments. UNICEF is supplying materials and equipment such as pipes, fittings, water pumps, pre-fabricated steel water tanks, survey and drilling tools, and so on. UNDP and USAID are more concerned with manpower development by providing experts and funds for staffs and personnel training. Other agencies include the European Development Fund, Food and Agriculture Organization, the Inter-American Development Bank, the Canadian International Development Agency, the Organization for Economic Co-operation and Development, the Cooperative for American Relief Everywhere, the Kreditanstalt fuer Wiederaufbau (Federal Republic of Germany), the Overseas Development Ministry (United Kingdom), the Rockefeller Foundation, and Swedish International Development Agency; they are providing short-term technical advice to projects which have provided supplies and equipment, and technical assistance extending over several years (5).

Basic Consepts of Priority Criteria

Three different approaches for assigning priority of rural water supply projects will be presented in this chapter. These three approaches are under the following headings: Village Need, Village Potential and System Costs; Economic and Policy; and Criteria Adopted by Countries for Assigning Priority.

Village Need, Village Potential ang System Costs

A World Bank Paper (5) discussed general criteria for selecting individual sub-projects which will be executed first based on village need, village potential and system costs since it is impossible to make rigorous cost/benefit analysis of the effects of village water supply programs.

Village Need

Village need is broken down into three components: village interest; adequacy of existing supply which covers not only quantity but also convenience, reliability during drought and quality; and prevalence of waterborne diseases.

Village Potential

This includes growth potential of the community and village institutions. With respect to growth potential, it was mentioned that a lack of adequate water supplies may prevent the development of the village's economic potential, for example, markets, food or fish processing centers, and local health or education centers. The villages may also be unable to obtain sufficient water for productive non-domestic use, for example, agriculture, livestock, vegetable cultivation, preparing produce for market, or cottage industries such as cloth dying. With respect to village institutions, it was stated that villages with strong, competent institutions and good educational levels would be able to participate in drawing up a program, to collect water charges, and to find operating and maintenance staffs from among the villagers than villages where such conditions do not exist.

System Costs

The objective of system costs is to make sure that it represents the least-cost means of providing the required service. Factors affecting this objective are: population distribution, the nature of the water source and its accessibility. With respect to population distribution, it was mentioned that other things being equal, the larger, the more densely populated villages will need lower investment costs per capita. One system for a group of villages that are close together may be lower in capital cost and more economical to operate and administer than those for scattered villages. The relationship between per capita costs and population is illustrated in Figure 4. The systems selected should also be compatible with the in country, village capability, manpower capability, and so on (4). Finally, with respect to accessibility, it was stated that a system for villages

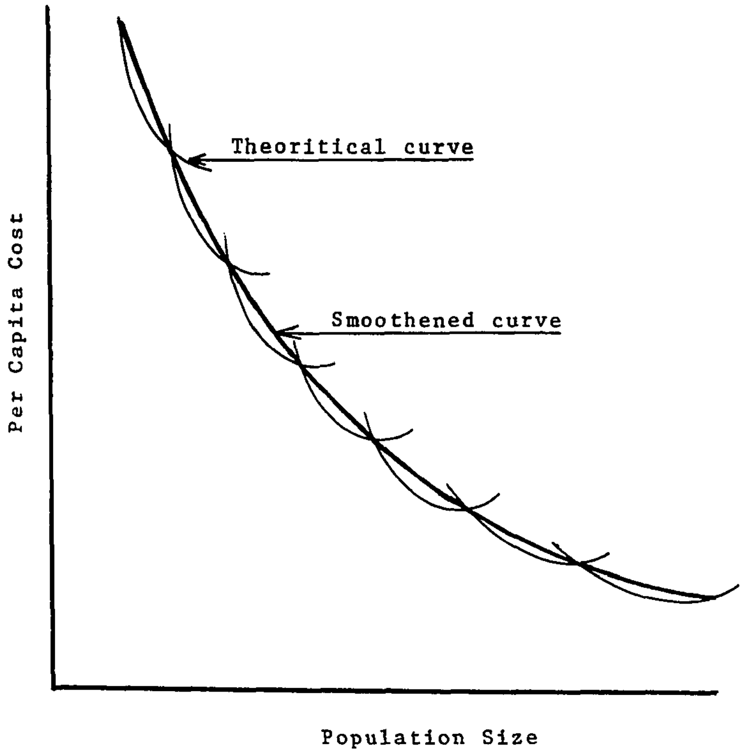

Figure 4. Relationship between Population Size in the Community and Per Capita Cost

without good roads will be difficult and expensive to construct and maintain.

Economic and Policy

Saunders and Warford (7) described the criteria normally used to determine investment priorities in rural water supplies in Less Developed Countries based on economics and policy of the government. It was stated that one of most important questions which must be considered early in planning stage relates to which areas or villages should receive priority. This question was examined under the following four headings: Costs, Economies of Scale, and Service Quality; Growth Point Strategies; Income Redistribution and "Worst First" Strategies; Financial Viability and Community Enthusiasm. It was further stated that these considerations are always cited, and no doubt, frequently used as criteria by which countries choose which particular towns or villages should receive water first. In practice, of course, political considerations or response to the most vociferous demands for service are often major determinants.

Costs, Economies of Scale, and Service Quality

Saunders and Warford (7) assume that, generally, there are economies of large scale production in the provision of water supplies. If this assumption is valid and if the objective of the rural water supply program is to serve the most people at the least cost, this criterion will lead to construct the water supply systems in the largest villages first. Eligible villages could simply be ranked by population size and and provided with water supplies in turn as resources become available.

Regarding the service quality, it was stated that two of the more important factors are transmission costs and source works. For instance, distribution through public hydrants is more economical than through house connections, and using dug wells with handpumps is more economical than river treatment facilities.

Growth Point Strategies

It was stated by Saunders and Warford (7) that economic growth and development does not take place at the same rate in all localities; at any point in time, some areas are growing rapidly, some areas are stagnant, and some others are declining. The urban areas attract people, capital, and firms. People move from rural to urban areas for better jobs and higher earnings, better educational opportunities for their children, and better public facilities and services. Capital flows to urban areas because of the greater demand and higher rates of return. Business firms tend to locate in urban areas because there is a better trained labor force, better transportation facilities, locally manufactured inputs and legal, technical, and governmental services.

It was further stated that it is difficult for villages to compete with urban areas for skilled labor, innovative entrepreneurs and financial resources. One suggestion for helping the rural population is to stem the out-flow of people in rural areas so that they can more effectively compete with the better established urban areas. Once the potential growth point has been selected, government investment in educational facilities, roads, sanitary facilities including water supplies, market places, and so on would be necessary. The objective of the investment would be to create centers which would hold populations and attract and hold economic activities.

Finally, it was stated that probably, the village safe water supply investment which is spread randomly among villages in rural areas of developing countries, will not directly or indirectly generate a significant quantity of economic activity. While a safe water supply may be necessary for development, it is not sufficient in itself to induce development. Therefore, if economic development is an objective, then the limited water supply investment must be directed into selected high potential areas or regions, with a relatively concentrated population and it should be accompanied by complementary investment in other public services.

Income Redistribution and "Worst First" Strategies

It was also stated by Saunders and Warford (7) that the goal of redistributing income from higher to lower groups could also be a consideration when selecting which villages should have a high priority for receiving a water supply system. Any investment emphasis on rural areas will on an overall basis result in a high to low income redistribution since rural populations are generally poorer than urban populations and since the major portion of national revenue (on a per person basis), which is usually generated primarily from output and income-based taxes, comes from the higher income urban areas.

It was further stated that the methods which countries currently use for selecting which areas should have a high priority for water service are somewhat diverse and are not generally well-defined. An exeption to this is the well-defined selection used in Thailand (Accelerated Rural Development Manual, 1971). There, villages are ranked according to their need for water and those villages with "very extreme need" or "extreme need" are given the highest priority. At present, the Indonesian Rural Water Supply Program (10) is close to this strategy since the highest priority is given to "critical areas"[1], although village contributions are expected.

Financial Viability and Community Enthusiasm

It was stated by Saunders and Warford (7) that a financial viability condition is probably not consistent with a worst-first strategy. On the other hand, it could be consistent with a growth point or growth area strategy, and if the national government partially subsidizes the program there would still be a redistribution of income in the country. It is also frequently noted in rural water supply literature

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[1] Where water is extremely difficult to find and a high cholera incidence is present.

that the probability of project failure is much greater in cases where the recipient village is not outwardly enthusiastic about the project. No matter how badly a village needs a better water supply system, if the population does not perceive the need for, or value of, the system the usage rate will be low, system maintenance and local administration will be inadequate, and vandalism could be a problem.

It was further stated that this strategy results in only those villages which are actively enthusiastic about obtaining water supply systems being considered eligible. An example of this is found in the criteria for selecting target villages for participation in the rural water supply program in Peru. There, villages which have expressed interest, have requested the system, and have offered assistance in construction and operation are designated as high priority (Acurio, 1969).

Finally, it was stated that another strategy for selecting villages would be to choose villages which can be served most economically. This would essentially be an attempt to serve the maximum number of either villages or people with a given amount of financial resources. The PAHO[1] formula which will be discussed later in this chapter, has a selection bias which fits well under this strategy. Generally, while there is nothing wrong with a strategy of minimizing costs and maximizing the number of localities served,

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[1] Pan American Health Organization.

many countries, given their objectives, would probably be better off constraining such a strategy to include some considerations of financial viability, growth points and/or enthusiasm.

Criteria Adopted by Countries for Assigning Priorities

Pineo and Subrahmanyam (WHO 1975) in Community Water Supply and Excreta Disposal Situation in Developing Countries presented seven criteria adopted by countries for assigning priorities in providing new community water supplies as shown in Table 8 which indicates the various weights allocated by governments which differ according to regions and strategies. The seven criteria consist of: scarcity such as acute need, and so on; population such as size of community, density of population, growth rate, and so on; health such as poor quality of available water, high incidence of waterborne diseases, and so on; development such as agricultural, industrial and other development in an area; social reason such as uplift of section of population or area, and so on; cost such as unit costs of new projects in one area compared with another; willingness such as community readiness, demand, and so on.

Table 8 indicates that population receives the highest weight of 30 followed by scarcity and development which receive 23 each. Health occupies the third place receiving 21 followed by social reason and willingness which receive 18 each. Cost receives only 9 representing the lowest weight.

TABLE 8

CRITERIA ADOPTED BY COUNTRIES FOR ASSIGNING PRIORITY IN PROVIDING NEW COMMUNITY WATER SUPPLY

	Frequency of mention of the following priority criteria						
	Scarcity	Population	Health	Development	Social reasons	Cost	Willingness
Africa south of the Sahara	9	10	4	9	6	3	2
Latin America and the Caribbean	2	11	3	6	6	4	8
West Asia and North-East Africa	1	0	0	0	0	0	0
Algeria and Morocco	8	4	6	3	4	1	4
South-East Asia	2	1	5	2	0	1	3
East Asia and Western Pacific	1	4	3	3	2	0	1
Total	23	30	21	23	18	9	18

Source: Mr. T.K. Tjiook, WHO International Reference Center, The Hague, The Netherlands.

Priority Models

For priority models, namely, linear programming approach (3), pragmatic approach (3), PAHO formula (7), and Reid and Discenza model (4) will be presented in the following

Linear Programming Approach

This model was developed by the PSA Group of WHO experts (3) in 1973 for assigning priority for the rural water supply program in the West Java Province in Indonesia. In mathematical terms, this formula is expressed as follows:

Maximize: $U_d.Pc.Wms$

subject to:

1. $E(B) = p(fi).FI + p(di).DI$

2. $E(T) = 1/n \sum_{i=1..} p(ta)_i.CC_i$

3. $E(M) = p(m_c).L_c + p(m_{om}).L_{om}$

4. $W_d \neq W_i$

5. $E(P) = \prod_{i=1.2.3.} p(p)_i.OC$

where

U_d = the fraction of the population covered with drinking water of minimum standard, who utilizes water,

Pc = population coverage,

Wms = water of minimum standard in liters per capita per day with quality of minimum standard for health care,

W = $Q_n^a . Q_m^b$ where (Q_n) represents quantity of water, (Q_m) represents quality of water, (a) represents the quantity elasticity of water, and (b) represents the quality elasticity of water. (a) and (b) correspond to accepted minimum standard,

E(B) = expected budget,

p(fi) = the probability of foreign investment,

FI = the level of foreign investment,

p(di) = the probability of domestic investment,

DI = the level of domestic investment,

E(T) = expected technology

$p(ta)_i$ = the probability of the i-th technological alternative based on the hydrological and hydrogeological conditions in the area under consideration,

CC_i = the construction or capital costs for the i-th alternative,

n = number of technological alternatives,

E(M) = expected manpower availability,

$p(m_c)$ = the probability of manpower or availibility of manpower for construction,

$p(m_{om})$ = the probability of manpower for operation and maintenance,

L_c = labor cost for construction,

L_{om} = labor cost for operation and maintenance,

W_d = water for drinking purposes,

W_i = water for irrigation purposes,

E(P) = expected population, health, and socio-economic development problems,

$p(p)_i$ = probability of population (i=1), health (i=2) and socio-economic development (i=3) as a result of a lack of safe water supply, OC = the opportunity cost of these problems.

Pragmatic Approach

This model was also developed by the PSA Group (3) as an alternative model for the linear programming approach which was described above. The basic characteristics of this adopted method is a systematic integration of hydrological, hydrogeological, technological, demographic, health and socioeconomic information for the definition of a water supply problem and subsequent setting of objectives for a water supply action program. The quantification of most of the above variables follows an iterative process consisting of the following 12 steps:

1. Determine from a review of the water situation, hydrological and hydrogeological information, and the technology analysis, the technological alternatives for construction of a new and/or rehabilitation of the existing water supply system per area.

2. Determine from a review of the manpower constraints, the probability of community contribution for maintenance of the water supply systems per area.

3. Rank order (as a result of steps 1 and 2) the areas on the basis of highest alternatives for construction and/or rehabilitation and highest probability for maintenance of the water supply systems.

4. Select relevant demographic dimensions, for instance projected population and population density, for water supply systems and indicate these demographic factors per area.

5. Rank order (as a result of step 4) the areas on the basis of the highest demographic dimensions.

6. Select relevant health dimensions (for instance, incidence, prevalence, and case fatality ratio) for selected health problems which relate to water supplies. Indicate per area the level of these health dimensions for the selected health problems.

7. Rank order (as a result of step 5) the areas on the basis of highest probability of health problems.

8. Determine from a review of on-going and planned socio-economic development in the country, province or district under consideration, the growth potential of selected socio-economic sectors.

9. Rank order (on the basis of step 8) the areas on the basis of lowest development potential.

10. On the basis of the rankings provided by steps 3, 5, 7 and 9, the areas can next be rank ordered such that the result shows in descending order:
    - the areas with lower probability of population problems related to water supplies.
    - the areas with lower technological alternatives for construction and probability of maintenance of water supply systems.
    - the areas with lower probability of health problems related to water supplies.
    - the areas with lower probability of socio-economic development potential.

11. From a review of the manpower and financial resources, an attempt should be made to indicate the level of existing available resources per area. In addition, a number of alternative financing levels should be generated where each alternative shows the level of foreign and domestic investment for the water supply project.

12. This step allows for objective setting within the range of the remaining possibilities. This range has been narrowed by step 1, the technological alternatives and step 10 which integrated demographic, health and socio-economic information for determination of priority areas. Given the highest ranked priority area in step 10, an objective (in terms of population coverage with water of minimum standard) can be set by selecting among the technological alternatives for this area (step 3) on the basis of maximum utilization of existing manpower and local financial resources and minimum requirement for foreign investment (step 11). Next, Objectives can be set for the second, third, and so on, highest ranked priority areas. After setting objectives for all areas on the basis of one combination of levels of foreign and domestic investment, the process could be repeated for other alternative combinations of investment levels.

PAHO Formula

This model is called a priority index formula developed by PAHO (7) in Mexico which is expressed in mathematical terms as follows:

$$I = 100.\frac{P}{C-A}.r.k$$

where

I = an index of project selection priority in which higher value of (I) indicates a higher priority for early water supply system installation,

$\frac{P}{A-C}$ = the inverse of the cost per capita of the system, excluding the distribution net work costs (or cost of public faucets), (C) the total cost less household connections, if any), and (A) is the counterpart contribution supplied by the community,

r = an index of the physical availability of water derived as a ratio between the existing water flow at the point of capture and the requirement foreseen in the 20-th of operation of the system,

k = an index of the concentration of houses in the community to be served, measured as that proportion of the total number located within 50 meters of the proposed main conduit.

Reid and Discenza Model

This model was intended to select the compatible water and wastewater treatment processes (4), however, this model is flexible; it can be also used, with a slight modification in raw data inputs and data processing, for assigning priority for rural water supply and urban water supply as well since a priority assignment is nothing more than selecting project localities. Particularly for technological alternatives, one of the most important 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 5 uses 18 inputs that describe socio-economic conditions, 31 inputs that describe the indigenous resources, 2 inputs that describe the demographic profile, and 3 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, had been successfully tested in the community of Nakuru, Kenya, one of the developing countries for which this model was developed in 1975. 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 Rural Water Supply Program.

The characteristics of the 18 socio-economic and socio-cultural variables used in this methodology are briefly described below:

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 inmarket activaties. At the advanced level of development,

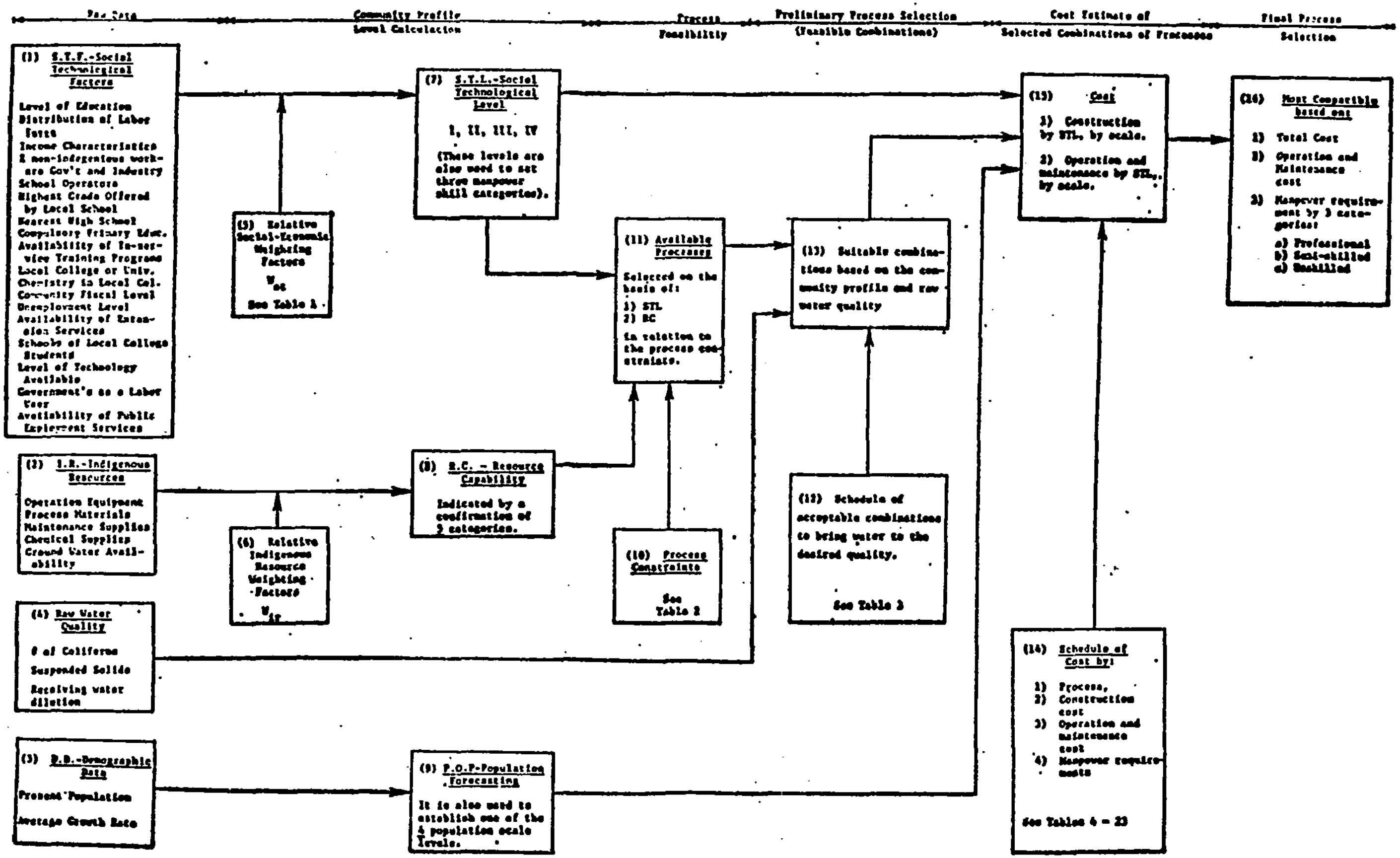

Figure 5. The Complete Imformation Flow for Water & Waste Water Treatment Processes Selection Model

Source: Reid and Discenza, "Prediction Methodology for Suitable Water & Waste Water Processes" p. 6.

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 a school 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 are often become 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 itsef. 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 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 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 (for example, gasoline-powered equipment), chemical products (for example, 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 level of development. Public employment services in less developed countries tend to be service blue-collar workers rather than professionals.

The second group of raw data inputs is concerned with the indigenous resources available within the 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 wastewater treatment systems. The availability of these items is matched, within the model, against the requirements of the various processes. The 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 include:

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

2. Process Materials:
   a. Pipes (clay, steel, cement, plastic, copper, and so on).
   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. Aluminum sulphate.
   b. Ferric chloride.
   c. Activated charcoal.

d. Lime.
e. Soda ash.
f. Chlorine.
g. Ozone.
h. Laboratory chemicals (for instance, litmus paper).

5. Water Sources:
   a. Rivers or streams.
   b. Lakes or impoundments.
   c. Wells (is groundwater available?).
   d. Rainwater collection.
   e. Sea or brackish sources.

The third group of raw data inputs consists of demographic inputs which include: present population and annual population growth rate.

The fourth and final group of raw data inputs consists of three different measurements:

1. The number of coliform groups of bacteria as an indicator of pollution in terms of the number of coliform groups per 100 mililiters of water.

2. The degree of suspended solids in the water in terms of parts per million or miligrams per liter.

3. The receiving water dilutions as specified by the Biochemical Oxygen Demand (BOD-5 day, $20^{o}C$) content of the water, or sewage.

For the purpose of this study, this fourth group of raw data can be replaced by water situation data, such as the methods by which the communities get their water which reflects the difficulty in obtaining water, one of the second-highest weights of the criteria used for the Indonesian Rural Water Supply Program's priority setting.

CHAPTER III

METHODOLOGY

Several priority models for the rural water supply program were presented in the previous chapter. However, none of them are suitable for the Indonesian Rural Water Supply Program at the present time because of different strategies, rural conditions and characteristics, and the lack of well trained engineering personnel, especially at the Kabupaten levels where the selection of the project localities are made. The following is a brief discussion of the reasons why those priority models are not suitable.

Linear Programming Approach

This model in mathematical terms is expressed as follows:

Maximize: $U_d.Pc.Wms$

subject to:

1. $E(B) = p(fi).FI + p(di).DI$

2. $E(T) = 1/n \sum_{i=1..n} p(ta)_i.CC_i$

3. $E(M) = p(m_c).L_c + p(m_{om}).L_{om}$

4. $W_i \neq W_d$

5. $E(P) = \prod_{i=1.2.3.} p(p)_i . OC$

This model is very sophisticated because every constraint requires a separate analysis. It also requires that the personnel involved have a background in economics, mathematical statistics, demography and engineering as the PSA Group who developed this model. Such personnel, however, is not available at the Kabupaten level at this time. The lack of conceptual definitions, quantifiable relationships and data prohibited a mathematical solution to the above problem (3).

Pragmatic Approach

The basic characteristic of this approach is a systematic integration of hydrological, technological, demographic, health and socio-economic information. The quantification of most of these variables follows an iterative process with is illustrated in the following steps:

1. Hydrological, Hydrogeological, Technological Alternatives for Construction (TAC).
2. Probability of Maintenance (PoM).
3. Ranking on the basis of TAC & PoM.
4. Demographic Dimension, for instance, Population Concentration (PC).
5. Ranking on the basis of PC.
6. Health Dimension (HD) Incidence, Prevalence of Cholera and Other Health Problems.
7. Ranking on the basis of HD
8. Socio-Economic Dimension, for instance Growth of

Agriculture, Industry and Services (S/ED).

9. Ranking on the basis of Lowest Socio-Economic Potential.

10. Ranking on the basis of Steps 3, 5, 7 and 9.

11. Resources, for instance Manpower, Domestic Investment and Foreign Investment.

12. Objecttive Setting based on Steps 10 and 11.

This method also requires the same background for its personnel as does the Linear Programming Approach and there is no basic formula for ranking every variable; it requires practical experience and to some extent personnel judgment.

Priority Index Formula (6)

This formula is expressed in mathematical terms as follows:

$$I = 100 \cdot \frac{P}{C - A} \cdot r \cdot k$$

This model is much simpler and more realistic than the previous two; every variable is easy to quantify. It fits the strategies of the Economies of Scale and the Financial Viability introduced by Saunders and Warford (7). However, this model does not fit the Indonesian Rural Water Supply Program Strategies which is closer to Income Redistribution and "Worst First" Strategies (7). This model implies that the communities with the larger population, the higher village contributions, the higher house density and abundance of water sources receive the safe water system first; it reflects the "Best First" Strategies because, in general, a larger population indicates better economic development, better educational levels and better sanitation conditions in the community. In other words, this type of community does not need very much help.

This model also benefits the community having an abundance of water sources and larger population because the larger the population, the lower the per capita cost. The Indonesian Rural Water Supply Program Strategies, however, emphasize critical areas as indicated earlier. The author thinks that this formula will be useful to the Indonesian Rural Water Supply Program in the near future after critical areas have been served.

Reid and Discenza Model (4)

This model uses four inputs as raw data, namely, socio-economic conditions, indigenous resources, demographic profile and raw water quality, which were originally intended to select a suitable combination of water and wastewater treatment processes, however with some modifications, it can also be used to select the project localities of the rural water supply 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 wastewater treatment processes in Indonesia because the questionnaire used to collect data is also applicable to the urban areas in Indonesia. However, it is not suitable for the rural water supply program in Indonesia at this time because some of the inputs of socio-technological factors and indigenous resources are not yet available in the rural areas in Indonesia. However, this model inspired the author to develop a suitable model for a priority setting of the Indonesian Rural Water Supply Program. Although the model developed in this study is different from the Reid and Discenza model, the process of utilization is similar.

Model Development

The objective of this study is to develop a priority model suitable for the Indonesian Rural Water Supply Program at this time, taking into consideration the strategy of the Indonesian Rural Water Supply Program, the Indonesian rural conditions and characteristics, the qualifications of the personnel at the Kabupaten Offices who are to use the proposed developed model, and the practical experience of the author.

Based on the above criteria, the model developed in this study will be very simple and unique as illustrated in Figure 6. It is a matrix system and in mathematical terms is expressed as follows:

$$PI = \sum_{j=1}^{n} \sum_{i=1}^{10} W_i \cdot S_{ij}$$

where: PI = Priority Index

W = weight of each parameter

S = score of each parameter

i = a subscript denoting the i-th parameter

j = a subscript denoting the j-th village

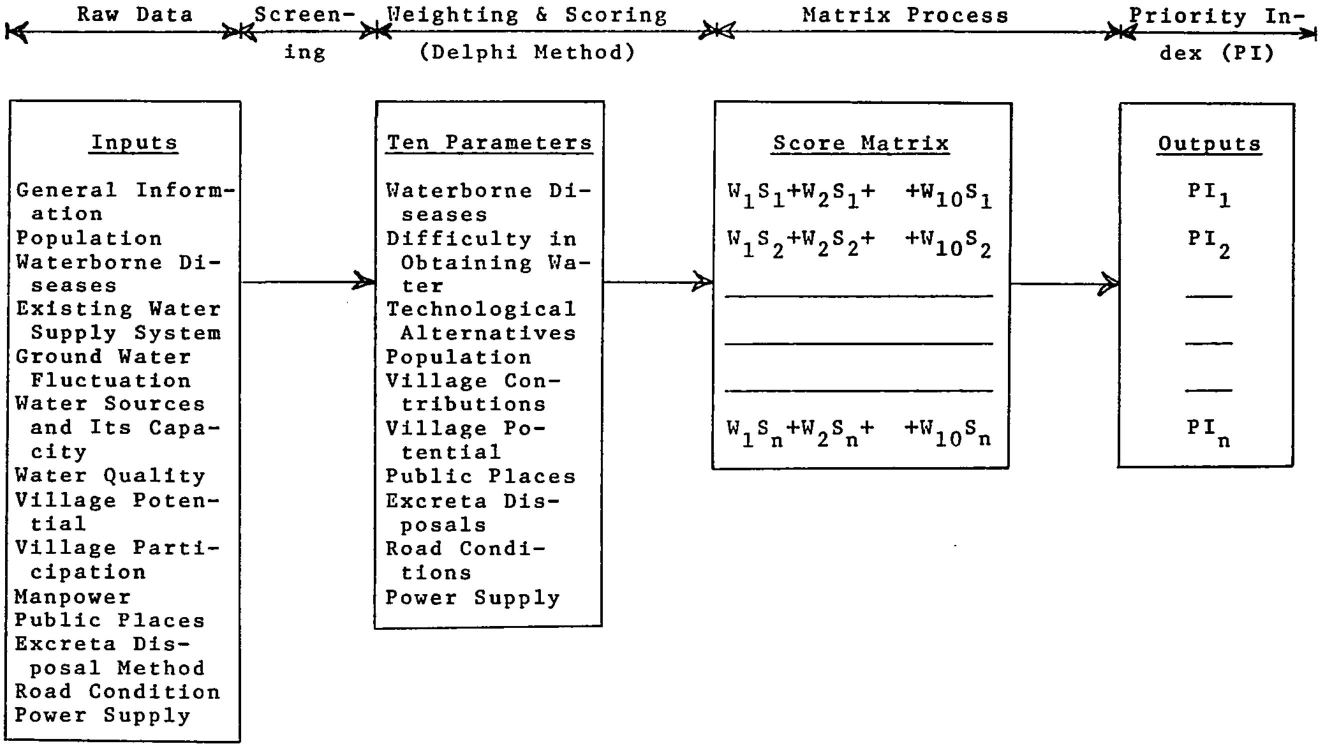

Figure 6. A Flow Diagram of Priority Setting Model for the Indonesian Rural Water Supply Program.

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 ten elements derived from Questionnaire Part I (see Appendix D) which was obtained from Indonesia through UNICEF New York, and it was to be used in collecting data from the villages. These ten parameters are waterborne diseases, difficulty in obtaining water, technological alternatives, population, village contributions, village potential, public places, excreta disposals, road conditions, and power supply.

The selected ten parameters are based on the strategy of the Indonesian Rural Water Supply Program, its relevance to the program, suitability to the Indonesian rural conditions and characteristics, and feasibility in applying them to the data available. Six of these ten parameters are the same as the criteria adopted by countries for assigning priority in providing new community water supplies presented by Pineo and Subrahmanyam as shown in Table 8.

The following is the discussion of the relevance of each parameter to the above mentioned criteria.

<u>Waterborne Diseases</u>

It was expressed in the INPRES Program (10) regarding the provision of safe water systems per province was based on the following considerations:

a. The number of cholera incidences and other waterborne diseases such as gastroenteric, typhoid, trachoma and skin diseases.

b. The areas which have difficulty in obtaining water.

c. The availability of Hygiene & Sanitation personnel.

d. The availability of data from pre-surveys.

Water plays important role in transmitting waterborne diseases; therefore, this parameter should be rated at the highest weight.

Difficulty in Obtaining Water

This parameter was also expressed in the INPRES Program as mentioned above. The Indonesian Government intends to alleviate the suffering of the rural population from the difficulty in obtaining water by running a rural water supply program. During the dry season, in some areas, water is extremely difficult to obtain; the villagers have to travel a few kilometers, and in some places more than seven kilometers, to get a bucket of water. Also, they must to climb or descend to get the water source. The women and chidren are responsible for obtaining water while men go to work to earn a living. They spend all day obtaining the water, therefore, some children do not go to school and women lose valuable time which could be devoted to economic activities that could increase family earnings. Difficulty in obtaining water could affect the health, education, economic welfare and mental well-being of the villagers.

Technological Alternatives

This parameter represent the type of water technology to be installed based on the availability of water sources and the capability of the community to operate and maintain the system. The concern of this parameter is to choose the simplest and most economical systems, such as dug or tube wells with handpumps, spring protection without piped systems, free-flowing artesian wells, and, if there is no other water source in the area, rainwater collections. Reid and Discenza (4) stated that the selected system should be compatible with the capability and ability of the local people and indigenous resources.

Population

This parameter is associated with the economy of the project as described by Saunders and Warford (7) who assumed that there are economies of large production scale in the provision of water supplies which means that the larger the population size, the lower the per capita cost (see Fig. 4).

More important in this respect is the distribution of population wether it is nucleated or dispersed. It must be understood that the Indonesian Government is trying to serve the population; therefore, population is also an important parameter along with the above-mentioned parameters. As shown in Table 8, criteria adopted by countries for assigning priority in providing new community water supplies, Population receives the highest weight.

The problem with the population in Indonesian rural areas is that the distribution is uneven. Some villages in the West Java Province have a population of more than 10,000 per village; on the other hand, some villages in the Maluku

Province and some other provinces in Kalimantan have populations of less than 500 per village. Therefore, care must be taken in considering this parameter to get a fair result.

Village Contributions

This parameter reflects the village interest and involvement in the water supply program. A World Bank Paper (5) stated that the experience of many countries indicate that water supply systems are better maintained if the villages to be served are selected because they expressed a real interest in having a new or improved system. The best evidence of such interest is village willingness to contribute to construction costs and to pay an adequate fee for water use in order to operate and maintain the system that is to be installed. Village contributions include money, labor and local materials. This parameter also reflects the sense of community responsibility for the system.

Village Potential

This parameter is related to the availability of village resources in terms of economic growth potential such as land productivities, mineral resources, industrial development, and manpower. The higher the village potential, the higher the capability of the village to operate and maintain the system. A World Bank Paper (5) stated that villages with higher incomes and higher educational levels will be better able to collect water charges and find operating and maintenance staffs from among the villagers than villages where such conditions do not exist.

Public Places

Public places include health centers, schools, markets, Desa institution buildings, and religious centers such as mosques, churches, and temples, where people come and go. These public places play an important role in spreading and controlling waterborne diseases and, especially health centers and schools, in teaching people about personel hygiene, grooming and how to appreciate safe water system. School is the best place to teach children about hygienic habit and the role of safe water in controlling waterborne diseases since they have just begun the learning process are easily taught and influened by their teacher; children follow their teacher rather than their parents.

PSA Group (3) received information that men tend to get cholera first and then transmit it to their families. The reason is that men often travel to other villages to visit public places to do business, while most women stay at home preparing meals and taking care of their children. Therefore, in planning a rural water supply, public places must be taken into consideration; for instance, public taps (hydrants) should be located near public places, or preferably on public place grounds.

In case, water is not sufficient to supply the community, public places are served first since these places accomodate many people; this reflects the characteristics of the Indonesian people who are cooperative and willing to work together. They like to get together at public places for praying, economic activities, and discussing community problems such as security, education, culture, and politics.

Excreta Disposals

To improve the public health conditions in rural areas, along with the water supply program, the Indonesian Government is also running a household latrine program by providing one latrine for every house. If many houses in the community have latrines or other sanitary excreta disposal facilities, it will reduce the number of latrines to be built in the community and the budget for latrines could be applied later to the water supply project; this will increase the number of project localities.

Road Conditions

If there is an accessible road to the community, it will be helpful in the transportation of equipment and materials during construction and later maintenance as well, particularly for systems using artesian wells and surface water treatments, where construction requires drilling rigs, concrete mixers, water pumps, pipes, pre-fabricated steel water tanks, and so on. An accessible road, therefore, will reduce the construction cost and save time.

Concerning this parameter, A World Bank Paper (5) stated that village without a good road will be difficult and expensive to construct and maintain the system. And Donaldson (6) rated this parameter at the second order among five criteria used to select target communities under the heading "Community with Access by Road for Truck".

Power Supply

Some systems such as non-free flowing artesian wells, surface water treatments and spring protections with low elevation require motorized pumps; therefore, the availability of electric power will be very helpful because it will reduce the costs of operation and maintenance as well. An electric pump is easier to operate and maintain than a diesel pump.

Delphi Method

The Delphi method has been developed extensively by Olaf Helmer (1966) and others at the RAND Corporation (8). In this technique, the experts doing forecasting form a panel and then deal with a specific question. Rather than meeting physically to debate the question however, these experts, the panel members, are kept apart so that their judgment will not be influenced by social pressure or by other aspects of small group behavior. The question was sent in a letter to the experts on the panel and each expert was asked to send his opinion in writing to the coodinator of the panel. The experts were asked not to approach any other members of the panel. The process was repeated until a reasonable conclusion could be made.

This method is applied in this study to determine the weight of each parameter. The weight should be based on the relevance and importance of each parameter in relation to the water supply program. A panel of 28 distinguished experts was formed; the experts were selected from various countries who are very much involved in rural water supply program. The list of the panel members is presented in Table 9. A questionnaire listing ten parameters as shown in Table 10 was sent to every expert on the panel and each expert was requested his or her opinion how to distribute 100 points among the ten parameters. Twenty-three completed questionnaires (see Appendix E) were received and summerized in Table 11. Following is a brief discussion about the results of the Delphi method and weight determination for each parameter using the average values.

<u>Waterborne Diseases</u>

The figures varied markedly ranging from 0 to 35. Mr. Donaldson commented that data for this parameter is usually non-existent while Dr. Ballance stated that waterborne diseases may be overrated reason for installing an improved water supply. Dr. Ballance also assumed if all communities to be served suffer from waterborne diseases, then this parameter should have equal weight for all communities. Concerning the comment of Mr. Donaldson, it was cited in Chapter I that there were 6,525 cholera cases in 1970, 23,555 in 1971 and 43,423 in 1972 respectively in Indonesia (9). With respect to Dr. Ballance statement, the data collected from the Phase I Survey indicated that most villages in the same Kecamatan had the same figures for waterborne diseases.

The average value of this parameter is 14.9.

<u>Difficulty in Obtaining water</u>

There was no comment concerning this parameter. The

TABLE 9

LIST OF THE PANEL MEMBERS FOR DELPHI METHOD

No.	Name	Title
1.	Ayoub, Dr. G.M.	Associate Professor of Civil Engineering (Environmental Engineering), American University of Beirut, Lebanon
2.	Arboleda, J.	Manager Hidrosan Ltd., Consulting Engineering, Bogota, Colombia
3.	Ballance, Dr. R.C.	Sanitary Engineer, Community Water Supply and Sanitation, Division of Environmental Health WHO, Geneva, Switzerland
4.	Bartone, Dr. C.	System Analyst, CEPIS - PAHO/WHO Lima, Peru
5.	Beyer, M.G.	Adviser, Drinking Water Programmes, UNICEF, United Nations, New York, USA
6.	Donaldson, D	Sanitary Engineer, PAHO/WHO, Washington, USA
7.	Hadiwidjojo, S.	Chief, Drinking Water Sub-Directorate of Hygiene & Sanitation, Directorate General of Communicable Diseases, Ministry of Health Jakarta, Indonesia
8.	Howard, Dr. L.	United State Agency for International Development, Washington, USA
9.	Huisman, Prof.Ir.[1] L.	Professor of Sanitary Engineering, University of Technology, Delft, The Netherland
10.	Malina, Prof.Dr. J.F.	Professor of Civil Engineering, The University of Texas at Austin, Texas, USA

[1] Engineer.

TABLE 9
(Continued)

No.	Name	Title
11.	Mills, W.T.	United Nations, New York, USA
12.	Nguyen, Dr. C.T.	Associate Professor and Acting Chairman, Environmental Engineering Division, Asian Institute of of Technology, Bangkok, Thailand
13.	Piot, Dr. M.	UNICEF, United Nations, New York, USA
14.	Rafei, Dr.MPH.[1] U.M.	Chief of Health Officer in West Java Province, Bandung, Indonesia
15.	Reyes, Dr. W.L.	WHO Regional Office for South East Asia, New Delhi, India
16.	Sanchez, H.	WHO Engineer in Jakarta, Indonesia
17.	Soemarto, Dr.Ir. S.	Rector Secretary of Student Affairs and Ex-Chairman of Sanitary Engineering Department, Institute of Technology Bandung, Indonesia
18.	Soesanto, Ir.MPH.[1] Mrs. S.S.	Chief Division of Physical Environment, Health Ecology Research Center, National Institute of Health Research & Development, Ministry of Health, Jakarta, Indonesia
19.	Spangler, Dr. C.D.	International Bank for Reconstruction and Development, Washington, USA
20.	Talboys, Dr.Eng. A.P.	Project Manager, UNDP/PAHO Training Center, Trinidad
21.	Thung, DR.Ir. H.J.	District Engineer, Water Quality Services, Oklahoma State Health Department, Oklahoma City, USA
22.	Tjiook, Ir. T.K.	International Imformation Center, The Hague, The Netherlads

[1] Master of Public Health.

TABLE 9
(Continued)

No.	Name	Title
23.	Unakul, S.	Regional Adviser in Environmental Health for Regional Director, WHO,New Delhi, India
24.	Van Damme, Dr. J.M.G.	Manager International Reference Center for Community Water Supply The Hague, The Netherlands
25.	Warford, Dr. J.J.	Economic Adviser, Energy, Water and Telecommunications Department, International Bank for Reconstruction and Development, Washington, USA
26.	Widodo, W.	Director of the Directorate of Hygiene & Sanitation, Directorate General of Communicable Diseases, Ministry of Health, Jakarta, Indonesia
27.	Yanes, Dr. F.	Adviser in Wastewater Treatment, CEPIS - PAHO/WHO, Lima, Peru
28.	Yunis, S	United Nations Expert in Economic Comission for Western Asia, Amman, Jordan

TABLE 10

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	______
2.	Difficulty in Obtaining Water	______
3.	Technological Alternatives	______
4.	Population	______
5.	Village Contributions	______
6.	Village Potential	______
7.	Public Places	______
8.	Excreta Disposals	______
9.	Road Conditions	______
10.	Power Supply	______
	Total	100.00

Date ______________________________

Name ______________________________

Title______________________________

____

____

TABLE 11

DISTRIBUTION OF PARAMETER WEIGHTS BY THE PANEL MEMBERS

Name	Parameter									
	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	Village Potential	Public Places	Excreta Disposal	Road Conditions	Power Supply
1. Mr. Arboleda	20	20	0	20	20	10	5	0	5	0
2. Dr. Ballance	0	20	20	20	38	0	2	0	0	0
3. Dr. Bartone	15	10	15	5	25	15	0	5	5	5
4. Mr. Beyer	20	20	10	5	15	3	10	10	5	2
5. Mr. Donaldson	0	15	20	5	20	15	0	5	10	10
6. Mr. Hadiwidjojo	30	20	10	10	5	4	5	10	3	3
7. Professor Huisman	15	18	12	10	20	8	3	4	3	7
8. Professor Malina	5	10	15	20	10	10	20	3	2	5
9. Mr. Mills	35	15	5	5	10	10	10	5	0	5
10. Dr. Nguyen	10	11	13	15	19	9	6	4	4	9

TABLE 11-Continued

Name	Parameter									
	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alterntives	Population	Village Contributions	Village Potential	Public Places	Excreta Disposals	Road Conditions	Power Supply
11. Dr. Piot	8	15	12	16	14	8	7	10	5	5
12. Dr. Rafei	20	25	10	10	8	8	10	4	2	3
13. Dr. Reyes	15	15	10	15	10	10	10	5	5	10
14. Mr. Sanchez	16	13	8	11	14	10	9	12	4	3
15. Dr. Soemarto	13	12	15	13	15	12	5	5	5	5
16. Mrs. Soesanto	17	17	10	10	10	10	13	5	5	3
17. Dr. Spangler	10	15	25	15	15	10	5	0	0	5
18. Dr. Talboys	15	20	25	5	20	0	10	5	0	0
19. Dr. Thung	25	10	10	15	10	4	10	10	1	5
20. Mr. Tjiook	20	5	10	10	25	10	5	5	5	5

TABLE 11-Continued

Name	Parameter									
	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	Village Potential	Public Places	Excreta Disposals	Road Conditions	Power Supply
21. Dr. Van Damme	20	5	10	10	25	10	5	5	5	5
22. Dr. Yanez	4	5	30	10	15	25	5	1	0	5
23. Mr. Yunis	10	15	25	10	7	6	3	10	7	7
Average Weight	14.9	14.4	13.9	11.5	16.1	9.0	6.9	5.4	3.5	4.4

figures range from 5 to 25 and the average is 14.4.

Technological Alternatives

Dr. Yanez suggested that this parameter be included in Difficulty in Obtaining Water. This can be explained that Difficulty in Obtaining Water reflects the existing condition by which the villagers get their water and Technological Alternatives represents the most compatible system to be installed. The figures range from 0 to 30 and the average is 13.9.

Population

Dr. Bartone and Dr. Spangler suggested that more important in this respect is the distribution of the population, that is, wether it is nucleated or dispersed. This is very good point to be considered. The figures range from 5 to 25 and the average is 11.5.

Village Contributions

There was no comment regarding this parameter. The figures range from 5 to 38 and the average is 16.1.

Village Potential

There was no comment with respect to this parameter. The figures range from 0 to 25 and the average is 9.0.

Public Places

There was also no comment on this parameter. The figures range from 0 to 20 and the average is 6.9.

Excreta Disposals

Dr. Spangler stated that this parameter was not very important. This is true. There is no relevance between excreta disposals and water supply program; both are parallel.

However, as mentioned earlier, the budget for excreta disposals could be applied to the water supply project if most of the houses in the community have latrines or other sanitary excreta disposal facilities; this will increase the number of project localities. The figures range from 0 to 12 and the average is 5.4.

Road Conditions

Dr. Spangler stated that this parameter was not very important because the movement of equipment and materials can be done by man. Dr. Ballance commented that if construction requires heavy equipment such as drilling rigs, it could be mounted on tracked vehicle such as a Nadwell. To a certain extent, these two comments are reasonable, however, it will take more time and more money. As mentioned previously, Donaldson (6) rated this parameter at the second order among five criteria used to assign target communities and A World Bank Paper (5) cited that a system for villages without good road access would be difficult and expensive to construct and maintain. The figures range from 0 to 10 and the average is 3.5.

Power Supply

Dr. Yanez stated that this parameter was not relevant to the project and Dr. Warford suggested to incorporate this parameter into cost heading. Regarding its relevance, it has been mentioned previously that the availability of electric power will be helpful to the systems using motorized pumps because it will make the operation and maintenance of the electric pump is easier and more economical than diesel pump. With respect to Dr. Warford suggestion, it can be mentioned that cost is incorporated into the Technological Alternatives heading. The figures range from 0 to 10 and the average is 4.4.

The average weight of each parameter is summerized in Table 12.

TABLE 12

AVERAGE WEIGHT DISTRIBUTION OF THE TEN PARAMETERS

No.	Parameter	Average weight
1.	Waterborne Diseases	14.9
2.	Difficulty in Obtaining Water	14.4
3.	Technological Alternatives	13.9
4.	Population	11.5
5.	Village Contributions	16.1
6.	Village Potential	9.0
7.	Public Places	6.9
8.	Excreta Disposals	5.4
9.	Road Conditions	3.5
10.	Power Supply	4.4
	Total	100.0

This Table was then sent to the 23 panel members who returned the completed questionnaires to obtain their further comments or suggestions. One response was received from Dr. Reyes who agreed with this average weight distribution.

Table 12 indicates that the highest weight is 16.1 for Village Contributions. Three other parameters, Water-borne Diseases, Difficulty in Obtaining Water and Technological Alternatives, received high weights, 14.9, 14.4 and 13.9 respectively. While Population, which was considered the most important parameter by many experts and countries, received only 11.5, just slightly above the mean value or 10, and occupied the fifth rank; as shown in Table 8, Population occupied the top rank among seven adopted criteria by countries for assigning priority in providing new community water supplies. Village Potential received 9.0, below the mean value, occupied the sixth rank, and Public Places received 6.9 occupied the seventh rank. The last three parameters which received the lowest weights are Excreta Disposals, Power Supply and Road Conditions: 5.4, 4.4 and 3.5 respectively. These three parameters were considered by some panel members not very important.

Since there is no panel member who disagrees with the average weight distribution presented in Table 12, it can be concluded that the average weight for each parameter is a reasonable figure to work with. Therefore, the figures presented in Table 12 are workable in assigning priority for the Indonesian Rural Water Supply Program at the present time.

Data Validation

The data was obtained from the Directorate of Hygiene & Sanitation, Directorate General of Communicable Diseases, Ministry of Health, Jakarta, Indonesia, through the Phase I Survey which covered about 21,000 villages.

The original data was collected from the villages using Questionnaire A, instead of Questionnaire Part I which was used to develop the ten parameters as criteria for assigning priority discussed earlier in this chapter. Due to a change in the questionnaires used for collecting the data, some parameters are not available. However, discussions with health officials in Jakarta and Bandung concluded that these ten parameters should be kept because, presently, the Director of the Directorate of Hygiene & Sanitation is still attempting to find the most suitable questionnaire for the Indonesian Rural Water Supply Program and the author was asked to make suggestion in this matter. The Reid and Discenza (4) model data sheet, with some modifications, is suggested.

Data Collection

Data collection was conducted by sanitarians and assistant sanitarians from the Kabupaten and Kecamatan Levels using A Questionnaires (see Appendix A); one Questionnaire A for one village. The completed A Questionnaires were gathered at the Kecamatan Office, where the data was then transferred to B Questionnaires (see Appendix B); this is called Tabulation at the Kecamatan Level. The completed B Questionnaires were then sent to the Kabupaten Office and were transferred to C Questionnaires (see Appendix C), which is called Tabulation at the Kabupaten Level. Finally, C Questionnaires were sent to the Directorate of Hygiene & Sanitation (Central Government). Therefore, the only C Questionnaires were available at the Directorate of Hygiene & Sanitation because the original data, A Questionnaires, were kept at the Kecamatan Office and B Questionnaires, which contained the most complete data for each village, were kept at the Kabupaten Office. C Questionnaires, Tabulation at Kabupaten Level, do not contain detailed data for every village, but rather data and information for the whole Kabupaten area; it cannot be used to establish a priority based on individual villages. To establish a priority, completed B Questionnaires should be used.

Data Selection

Fortunately, there were four Kabupatens who misunderstood the above procedure for handling data and sent all Questionnaires, A, B and c, to the Directorate of Hygiene & Sanitation which eliminate the need to collect this data from individual Kabupatens. Unfortunately, among those four Kabupatens, three Kabupatens were from the same province, the West Java Province, and only one Kabupaten was outside Java, from the Maluku Province. Therefore, C Questionnaires from the 22 surveyed Provinces, A and B Questionnaires from those four Kabupatens were available at the Directorate of

Hygiene & Sanitation.

The necessary data for this study is used to test the priority model developed in this chapter to meet the categories of all parameters which will be discussed later in this chapter. The expected representative data should have consisted of at least one Questionnaire B for every Province, but it was impossible because the author would have had to travel to each of the 22 Provinces surveyed in Phase I.

Finally, to get the most representative data possible based on data available at the Directorate of Hygiene & Sanitation, 22 C Questionnaires representing 22 Kabupatens from 22 Provinces were selected and 35 B Questionnaires were also selected from the following Kabupatens: four from North Maluku; 14 from Tasikmalaya; eight from Cirebon; and nine from Majalengka. For additional information 134 A Questionnaires from Cirebon and Tasikmalaya Kabupatens were also selected.

Total data selected and brought back to Norman consisted of 1,468 pages, and from this raw data the final selection will be made to meet the requirement of testing the model which will be discussed in the following chapter, Test of the Model.

Scoring Process

The scoring process consists of the catagorization of the data and score assignment of each data category which will be discussed separately. As indicated earlier that data for some parameters were not available; in this case, categorization is based on the Questionnaire Part I (see Appendix D) which was used to develop the ten parameters.

Categorization

Efforts have been made in categorization to quantify as many of the parameters as possible in order to facilitate application to the model. The following is the categorization of each parameter.

Waterborne Diseases

There are five diseases that are considered waterborne diseases in the survey data, namely, cholera, gastroenteric disease, typhoid, trachoma and skin disease. According to the Questionnaire A, these five diseases are categorized as follows:

a. Five diseases present.

b. Four diseases present.

c. Three diseases present.

d. Two diseases present.

e. One disease present.

f. Cholera present.

g. No disease present.

Difficulty in Obtaining Water

This parameter is expressed in the distance the villagers have to travel to water source and the distance they to climb or descend to get to the water source. This parameter is categorized as follows:

a. Less than 200 meters away without climbing or descending.

b. Between 200 and 1,000 meters away without climbing or descending.

c. More than 1,000 meters away without climbing or descending.

d. Less than 200 meters away with climbing or descending less than 150 meters.

e. Between 200 and 1,000 meters away with climbing or descending less than 150 meters

f. Between 200 and 1,000 meters away with climbing or descending 150 meters or more.

g. More than 1,000 meters away with climbing or descending less than 150 meters.

h. More than 1,000 meters away with climbing or descending 150 meters or more.

Technological Alternatives

This parameter is categorized as follows:

a. Rainwater collections.

b. Dug wells or tube wells with handpumps.

c. Spring protections without piped systems.

d. Spring protections with piped systems by gravity.

e. Spring protections with pump and piped systems.

f. Free-flowing artesian wells without piped systems.

g. Free-flowing artesian wells with piped systems.

h. Non free-flowing artesian wells with pump and piped systems.

i. Surface water[1] with piped systems by gravity and chlorination.

j. Surface water[1] with piped systems, pump and chlorination.

k. Surface water[1] with complete treatment and piped systems.

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[1]Includes: rivers, irrigation canals, lakes and ponds.

Population

The data shows that the population varies widely, from 100 to more than 36,000 people per village. However, generally, the number of people in the villages within the same Kecamatan do not vary very much; this will ensure a fair result in population scoring because score assignment is made Kecamatan by Kecamatan. Based on the wide range in population size, this parameter is categorized into six groups and each group is further broken down into five sub-groups in accordance with the average number of people per village within the Kecamatan, as presented in Table 13.

Village Contributions

This parameter can be quantified if the village contributions are expressed in terms of how many per cent of the total construction cost and how much the villages are willing to pay the water use for the operation and maintenance of the system to be installed, although their contributions can be money, labor or local materials. However, the data available is only the villages willingness to contribute to the construction and/or maintenance costs without further specification. Based on this data this parameter is categorized as follows:

a. Willing to contribute to the construction and maintenance costs.

b. Willing to contribute to the construction cost only.

c. Willing to contribute to the maintenance cost only.

d. Not willing to contribute at all.

TABLE 13

POPULATION CATEGORY AND SUB-GROUPS
(Population in Thousands)

Average Population per Village within the Kecamatan	Population Sub-Group in each Village				
	1	2	3	4	5
a. up to 0.50	up to 0.15	0.15- 0.25	0.25- 0.50	0.50- 1.00	1.00 and up
b. 0.50- 1.00	up to 0.50	0.50- 0.75	0.75- 1.25	1.25- 2.00	2.00 and up
c. 1.00- 2.50	up to 1.00	1.00- 1.50	1.50- 2.50	2.50- 4.00	4.00 and up
d. 2.00- 5.00	up to 2.00	2.00- 3.00	3.00- 4.50	4.50- 7.00	7.00 and up
e. 5.00-10.00	up to 5.00	5.00- 7.00	7.00-10.00	10.00-15.00	15.00 and up
f. 10.00 and up	up to 10.00	10.00-15.00	15.00-20.00	20.00-25.00	25.00 and up

Village Potential

This parameter consists of economic growth and manpower. Really, it is better to express the economic growth in terms of income per family, but it is difficult to assess because incomes are not stable and do not come from merely one source for most villagers, since the majority of the villagers are farmers. During farming season the villagers work on their farms, but off-season they find other jobs in construction, public transportation, trade, hand craft, fishing, and so on. Therefore, it is better to express village economic growth potential in terms of land use, mineral resources, industrial development, number of infrastructures and utilities as done by PSA Group (3) in 1973 for the West Java Province Rural Water Supply Program using the following factors:

a. Agricultural land used as rice field.

b. Agricultural land used as dry farming.

c. Agricultural land used as fish ponds.

d. Planned industrial development.

e. High growth industry.

f. Medium growth industry.

g. Mineral resources such as oil, coal, tin, bauxite, manganese, gold, copper, nickel, sulphur, lime, and so on.

h. Central Government and/or Provincial roads.

i. Kecamatan road infrastructures.

j. Electricity distribution and/or potential for distribution such as close to tension lines.

k. An urban center in the Kecamatan or in its neighborhood.

Manpower is categorized as follows:

a. Engineers.

b. Bachelor engineers.

c. Health controllers.

d. Technicians.

e. Sanitarians.

f. Assistant sanitarians.

Public Places

Public places include health centers, schools, markets, and religious centers such as mosques, churches and temples. This parameter is quantifiable, so categorization is not necessary because scoring merely follows the number of public places such as the number of health centers, schools, markets, mosques, churches and temples that exist in each village.

Excreta Disposal

This parameter is expressed in terms of the percentage of houses in each village using sanitary excreta disposal methods such as septic tanks, latrines, fish ponds, and so on. Therefore, this parameter is quantifiable, so categorization is not necessary because scoring merely follows the percentage of houses in each village using sanitary excreta disposal facilities.

Road Conditions

This parameter is expressed in terms of its accessibility to carriers and their capacities. The categorization is as follows:

a. Accessible to trucks.

b. Accessible to light trucks.

c. Accessible to carts pulled by horses, cows, and water buffaloes.

d. Accessible to two-wheeled vehicle.

Power Supply

This parameter is based on the capacity of the power output available expressed in terms of kilowatts. The categorization is as follows:

a. Up to 1.5 kilowatts.

b. 1.5 to 3 kilowatts.

c. 3 to 5 kilowatts.

d. More than 5 kilowatts.

Score Assignment

Scoring is somewhat arbitrary because more emphasis has been placed on weighting and categorization. The weight of each parameter is reliable because it represents the opinions of 23 experts from various fields and various countries who are devoting time to the study of rural water supplies in the world, particularly in the developing countries.

Most of the categories are quantifiable but the unquantifiable remainders can be utilized without difficulty. The score of each category will range from 0 to 15 using only the round numbers. The following is the score assignment of each parameter.

Waterborne Diseases

For the five diseases considered waterborne diseases, the scoring is based on how dangerous each disease is and the role of water in transmitting those diseases as presented in role of water in transmitting those diseases as presented in Table 14.

TABLE 14

SCORE ASSIGNMENT FOR WATERBORNE DISEASES

Disease	Score
Cholera	5
Gastroenteric disease	4
Typhoid	3
Trachoma	2
Skin disease	1

It is difficult to assign a score of each category of waterborne diseases because, actually, there are 121 combinations of the five waterborne diseases (5 factorial plus zero disease) instead of seven categories as presented previously. The score of each category is merely the sum of the scores of diseases involved in each category.

Difficulty in Obtaining Water

The scores range from 1 for the smallest distance without climbing or decending to 10 for the farthest distance and the highest climbing or descending distance from the communities to the water sources as presented in Table 15.

Technological Alternatives

The scores range from 1 for the most complicated to 10 for the simplest systems as shown in Table 16.

TABLE 15

SCORE ASSIGNMENT FOR DIFFICULTY IN OBTAINING WATER

Category	Score	Category	Score
a	1	e	6
b	2	f	8
c	4	g	8
d	4	h	10

TABLE 16

SCORE ASSIGNMENT FOR TECHNOLOGICAL ALTERNATIVES

Category	Score	Category	Score
a	10	f	6
b	10	g	4
c	8	h	3
d	7	i	3
e	5	j	1

Population

The scores range from 1 for the smallest number of people to 10 for the largest number of people in each village as shown in Table 17.

TABLE 17

SCORE ASSIGNMENT FOR POPULATION

Category	Population Sub-group				
	1	2	3	4	5
a	1	2	3	4	5
b	2	3	4	5	6
c	3	4	5	6	7
d	4	5	6	7	8
e	5	6	7	8	9
f	6	7	8	9	10

Village Contributions

The scores range from 0 for villages which are not willing to contribute to the construction and maintenance costs to 10 for villages which are willing to contribute to the construction and maintenance costs as shown in Table 18.

TABLE 18

SCORE ASSIGNMENT FOR VILLAGE CONTRIBUTIONS

Category	score
a	10
b	5
c	5
d	0

Village Potential

The score is based on the role of each factor in the economic development of the community and range from 1 to 7. Categorization is not necessary because the score assignment merely follows the number of factors exist in each village. The score of each factor is presented in Table 19.

TABLE 19

SCORE ASSIGNMENT FOR VILLAGE POTENTIAL

Factor	Score	Factor	Score
a	2	g	4
b	1	h	1
c	2	i	1
d	3	j	1
e	7	k	2
f	4		

Public Places

The score of each public place is based on the quantity and frequency of water use and its role in transmitting or controlling the waterborne diseases; the scores range from 1 to 5 as shown in Table 20.

Excreta Disposals

The score is based on the percentage of houses using sanitary excreta disposal methods and range from 1 for ten percent to 10 for 100 percent of houses in the village using sanitary excreta disposal methods as shown in Table 21.

TABLE 20

SCORE ASSIGNMENT FOR PUBLIC PLACES

Public Places	Score
School	5
Health center	4
Market	3
Mosque	3
Church	2
Temple	1

TABLE 21

SCORE ASSIGNMENT FOR EXCRETA DISPOSALS

Houses Using Sanitary Excreta Disposal Facilities	Score	Houses Using Sanitary Excreta Disposal Facilities	Score
Up to 10 per cent	1	51 to 60 per cent	6
11 to 20 per cent	2	61 to 70 per cent	7
21 to 30 per cent	3	71 to 80 per cent	8
31 to 40 per cent	4	81 to 90 per cent	9
41 to 50 per cent	5	91 to 100 per cent	10

Road Conditions

The scores range from 1 for two-wheeled vehicle to 5 for truck as shown in Table 22.

TABLE 22

SCORE ASSIGNMENT FOR
ROAD CONDITIONS

Category	Score
a	5
b	3
c	2
d	1

In some areas in Kalimantan and Sumatra, transportation consists of boats, speed boats and canoes. In this case, a boat is equivalent to truck, a speed boat to a light truck and a canoe to a cart.

Power Supply

The scores are based on its capacity and range from 1 for the lowest to 4 for the highest capacity as shown in Figure 23.

TABLE 23

SCORE ASSIGNMENT FOR
POWER SUPPLY

Category	Score
a	1
b	2
c	3
d	4

CHAPTER IV

TEST OF THE MODEL

Introduction

This chapter is central to this study because it processes directly the data obtained from the Indonesian Government and demonstrates the utilization of the model developed in the previous chapter. It will provide guidelines to the planners who are involved in the Indonesian Rural Water Supply Program at the Kabupaten Levels by giving them some examples of practical use.

As mentioned earlier, the priority setting will be made at the Kabupaten Level because the project manager is the Bupati. The INPRES funds and other funds from local communities directly come to the Bupati account. Additional data and information, if desirable, is easy to obtain at the Kabupaten Office. The Bupati knows much more about the rural conditions and characteristics in his area than the officials from the Directorate of Hygiene & Sanitation. Also the Bupati knows what the communities need and he is responsible for the success of the rural development within the Kabupaten areas. He has to consider the political situation in his territory and keep the communities under control.

At the Kabupaten Level, as indicated earlier, there is a lack of well-trained engineering staffs and personnel experienced in rural water supply projects since the Indonesian Rural Water Supply Program actually just began April 1, 1974. Therefore, the guidelines should be presented in such a way that they are self-explanatory and easy to understand, especially in data analysis, categorization and score assignment.

In data processing, all of the parameter categories are presented in lists and tables, and most of the parameters are quantified, while the unquantifiable remainder are presented in such a manner that it facilitates the use by planners.

Data Selection

As discussed in the previous chapter, to test the model, 1,468 pages consisting of 22 C Questionnaires, 43 B Questionnaires and 133 A Questionnaires were selected and brought back to Norman as the raw data. Technically, it is impossible to work out all this raw data for the purpose of testing the model because it would be very time-consuming and space-consuming as well, since the purpose of the test is to demonstrate the data processing and utilization of the model. Therefore, only essential data will be selected to meet, as much as possible, all parameter categories constructed in the previous chapter, particularly parameters such as population, difficulty in obtaining water, technological alternatives and waterborne diseases which have many categories.

Among the ten parameters, population is the most widely varied and the most reliable data. As mentioned previously, the population varies greatly, ranging from 100 to more than 36,000 people per village; the national average is about 2,200 per village. Population is periodically recorded by the Desa Office then sent to the Kecamtan Office and the figure for the whole Kecamatan is sent to the Census Office at the Kabupaten Level. Therefore, the population data for every village is available at the Desa Office and Kecamatan Office as well. The population parameter was divided into six groups and each group was divided into five sub-groups. Therefore, by taking a sample which meets the requirement for the population categories , it is anticipated that it will also meet the other parameter categories. This will consist of the six population categories, from the smallest average number of people per village to the largest average number of people per village in the Kecamatans.

For the above purpose, six B Questionnaires representing six Kecamatans from four Kabupatens, two of them from the Maluku Province and the remaining four from the West Java Province, were selected; as additional information, when necessary, might be obtained from the available A and C Questionnaires. These six Kecamatan are: Ibu and Jailolo Kecamatans from the North Maluku Kabupaten, Maluku Province; Kadipaten Kecamatan from the Majalengka Kabupaten, West Java Province; South Cirebon Kecamatan from the Cirebon Kabupaten, West Java Province; Manonjaya and Tasikmalaya Kecamatans from the Tasikmalaya Kabupaten, West Java Province.

Score Processing

To provide a clear example, the data from the six above-mentioned Kecamatans will be categorized and scored for each parameter Kecamatan by Kecamatan.

The Ibu Kecamatan

The Ibu Kecamatan, the North Maluku Kabupaten, Maluku Province, represents the lowest average population per village, that is, 336 people per village ranging from 111 to 1,158 people per village; its total population is 10,070 spread out over 30 villages within the Kecamatan areas. One more interesting point is that no waterborne disease is present in this Kecamatan.

Waterborne Diseases

Data concerning waterborne diseases can be seen in Table B. 8 of the Questionnaire B (see Appendix B) and since there is no waterborne disease as indicated by Table B. 8, all villages in this Kecamatan belong to category (f) with a score of 0. From now on, any number of Table B is always related to the Questionnaire B.

Difficulty in Obtaining Water

Table B. 3.2 indicates that the villagers in this Kecamatan take water from wells, springs, rivers or irrigation canals. Table B. 6 indicates that the villagers have to travel from less than 200 to more than 1,000 meters to get to the water sources; while Table B. 7 indicates that the villagers from some villages do not have to climb or descend and others have to climb or descend from less than 150 to more than 150 meters. Thus the Ibu Kecamatan meets most of the categories of this parameter as presented in Table 24.

TABLE 24

CATEGORY AND SCORE FOR DIFFICULTY IN OBTAINING WATER IN THE IBU KECAMATAN

No.	Village	Category	Score
1.	Podal	a	1
2.	Tengwango	e	6
3.	Togowo	e	6
4.	Duno	e	6
5.	Tokowoko	a	1
6.	Goin	a	1
7.	Sangaji Nyeku	a	1
8.	Sangaji Adu	a	1
9.	Toguis	f	8
10.	Togoreba Sungi	a	1
11.	Borona	a	1
12.	Todake	b	2
13.	Sirimahu	e	6
14.	Pasalulu	a	1
15.	Togoreba	f	8
16.	Tobaol	a	1
17.	Tongutette	a	1
18.	Gam Lamo	a	1
19.	Gam Ici	a	1
20.	Tongute Sungu	d	4
21.	Akesibu	h	10
22.	Tongute Goin	a	1
23.	Maritango	a	1
24.	Kei Ici	h	10
25.	Naga	e	6
26.	Tosoa Togower	f	8
27.	Tababal	a	1
28.	Baru	a	1
29.	Aduu	d	4
30.	Ngawet Nanas Jere	d	4

Technological Alternatives

For this parameter the planner must consider Table B. 4, B. 5, B. 6, B. 7, B. 8 and B. 9 to decide the best possible alternative for every village. Based on data indicated in those tables, the best possible alternatives are dug or tube wells with handpumps (category b) for villages numbers 17 and 19 because the ground water is available all year round in those two villages and it is os a good quality with a water depth less than 15 meters which can be drawn out by deep-handpumps.

Spring protections without piped systems (category c) should be used for villages numbers 1, 5, 13, 15, 16, 27, 28, 29 and 30 because there are springs which never dry located in the communities, within 200 meters. Spring protections with piped systems by gravity (category d) should be used for villages numbers 2, 3 and 26 because there are springs which never dry all year round in those three villages and the distances from the communities are between 200 and 1,000 meters and more than 1,000 meters, and their elevation is higher than the communities.

Surface water with piped systems and chlorination (category i) should be used for villages numbers 4, 6, 7, 8, 9, 10, 11, 12, 14, 18, 20, 21, 22, 23, 24 and 25 because only surface water (rivers and irrigation canals) is available during the dry season in those 16 villages and the water quality is good (clear and not salty). The score of this parameter is presented in Table 25.

TABLE 25

CATEGORY AND SCORE FOR TECHNOLOGICAL ALTERNATIVES IN THE IBU KECAMATAN

No.	Village	Category	Score
1.	Podal	c	8
2.	Tengwango	d	7
3.	Togowo	d	7
4.	Duno	i	3
5.	Tokowoko	c	8
6.	Goin	i	3
7.	Sangaji Nyeku	i	3
8.	Sangaji Adu	i	3
9.	Toguis	i	3
10.	Togoreba Sungi	i	3
11.	Borona	i	3
12.	Todake	i	3
13.	Sirimahu	c	8
14.	Pasalulu	i	3
15.	Togoreba	c	8
16.	Tobaol	c	8
17.	Tongutette	b	10
18.	Gam Lamo	i	3
19.	Gam Ici	b	10
20.	Tongute Sungi	i	3
21.	Akesibu	i	3
22.	Tongute Goin	i	3
23.	Maritango	i	3
24.	Kie Ici	i	3
25.	Naga	i	3
26.	Tosoa Togower	d	7
27.	Tababal	c	8
28.	Baru	c	8
29.	Aduu	c	8
30.	Ngawet Nanas Jere	c	8

Population

The number of people per village within the Kecamatan can be seen in Table B. 2. Total population in this Kecamtan is 10,070 consisting of 2,543 families and spread out over 30 villages. The average number of people per family is 4 and the average number of people per village is 336 therefore, this Kecamatan belongs to category (a) with the scores range from 1 to 5. This parameter is easy to apply, so no further explanation is necessary. The score is presented in Table 26.

TABLE 26

CATEGORY AND SCORE FOR POPULATION
IN THE IBU KECAMATAN

No.	Village	Population	Category	Score
1.	Podal	413	a.3	3
2.	Tengwango	184	a.2	2
3.	Togowo	244	a.2	2
4.	Duno	424	a.3	3
5.	Tokowoko	139	a.1	1
6.	Goin	244	a.2	2
7.	Sangaji Nyeku	157	a.2	2
8.	Sangaji Adu	111	a.1	1
9.	Toguis	117	a.1	1
10.	Togoreba Sungi	243	a.2	2
11.	Borona	170	a.2	2
12.	Todake	167	a.2	2
13.	Sirimahu	190	a.2	2
14.	Paslulu	523	a.3	3
15.	Togoreba	339	a.3	3
16.	Tobaol	287	a.3	3
17.	Tongutette	749	a.4	4
18.	Gam Lamo	304	a.3	3
19.	Gam Ici	647	a.4	4
20.	Tongute Sungi	503	a.4	4
21.	Akesibu	261	a.3	3
22.	Tongute Goin	463	a.3	3
23.	Maritango	267	a.3	3
24.	Kie Ici	456	a.3	3
25.	Naga	171	a.2	2
26.	Tosoa Togower	241	a.2	2
27.	Tobabal	198	a.2	2
28.	Baru	1,158	a.5	5
29.	Aduu	202	a.2	2
30.	Ngawet Nanas Jere	497	a.3	3
	Total	10,070		

Village Contributions

The data for this parameter can be seen in Table B. 10. This table indicates that all villages in the Ibu Kecamatan are willing to contribute to the construction costs and 16 villages, numbers 1 to 16 are also willing to contribute to the maintenance costs. Thus 16 villages, numbers 1 to 16, belong to category (a) with a score of 10, and 14 villages, numbers 17 to 30 belong to category (b) with a score of 5; no villages belong to category (c) with a score of 0. Tabulation of scores for this parameter is not necessary because only two catagories are involved.

Village Potential

There is no data available for this important parameter due to the questionnaire change. However, for the next Phase II Survey it has been suggested that this parameter be included. For this study, this parameter is left blank.

Public Places

There is also no data for this parameter which reflects the characteristics of the Indonesian rural population as described previously. Therefore, this parameter is also left blank.

Excreta Disposals

The data for this parameter can be seen in Table B. 16 of the Questionnaire B and Table A. 13 of the Questionnaire A. However, these two tables were blank; probably the surveyor forgot to fill out this table (Table A. 13). Figure for the whole North Maluku Kabupaten which can be seen in Table C. 15

of the Questionnaire C indicated that the percentage of people using latrines or other sanitary excreta disposal facilities was 3.2 per cent which is lower than the national figure, that is 5 per cent, as stated by UNICEF/WHO Group (2). However, this figure can not be used for assigning score for the villages in the Ibu Kecamatan, therefore, it is better to leave this parameter blank. The planners who apply this parameter just look at Table B. 16 where the number of people using latrines or other sanitary excreta disposal facilities is recorded, and convert this number into percentage, so they will know its category and score.

Road Conditions

There is also no data for this parameter due to the questionnaire change, so it is also left blank.

Power Supply

Finally, there is also no data for this last parameter due to the questionnaire change too and it is also left blank.

<u>The Jailolo Kecamatan</u>

The Jailolo Kecamatan is also from the North Maluku Kabupaten, Maluku Province. It represents the second lowest average population per village in the Kecamatan, which is 519. The total population in this Kecamatan is 10,893 spread out over 21 villages. Other interesting points about this Kecamatan are that some villages use rain water collection systems and three waterborne diseases, namely, gastroenteric disease, trachoma, and skin disease are present in all villages within this Kecamatan.

Waterborne Diseases

Table B. 8 indicates that three diseases, namely gastroenteric disease, trachoma and skin disease are present in all villages within this Kecamatan. Therefore, all villages belong to the same category and receive the same score, so this parameter does not affect ranking.

Difficulty in Obtaining Water

The villages in this Kecamatan take water from four sources, such as wells, springs, rivers or irrigation canals and rain water collections as indicated by Table B. 3.2. Table B. 6 and 7 indicate the distances between the communities and water sources which range from less than 200 to more than 1,000 meters, and the different elevations range from zero to more than 150 meters. The score of this parameter is presented in Table 27.

Technological Alternatives

Using the same method as for the Ibu Kecamatan, rain water collection systems shoud be used for villages, numbers 15, 16, 17, 18, 19, 20 and 21 because the ground water is salty in those seven villages and there is no other water source is available. These seven villages belong to category (a) with a score of 10.

Dug wells or tube wells with handpumps should be used for villages, numbers 1, 3, 6, 7, 10, and 13 because the ground water is available all year round in those six villages and its water quality is good. These six villages belong to category (b) with a score of 10.

TABLE 27

CATEGORY AND SCORE FOR DIFFICULTY IN OBTAINING WATER IN THE JAILOLO KECAMATAN

No.	Village	Category	Score
1.	Akediri	a	1
2.	Tedeng	a	1
3.	Acango	a	1
4.	Idamdehe Gamsungi	h	10
5.	Idamdehe Seruni	h	10
6.	Marimbati	b	2
7.	Gamtala	a	1
8.	Lolori	a	1
9.	Taboso	a	1
10.	Hoku-hoku Kie	f	8
11.	Porniti	f	8
12.	Jailolo Seruni	f	8
13.	Gamlamo	a	1
14.	Jalan Baru	f	8
15.	Gofasa	a	1
16.	Guwaemaadu	f	8
17.	Galala	h	10
18.	Rabanehena	a	1
19.	Payo	a	1
20.	Bobo	a	1
21.	Saria	a	1

A spring protection without piped system should be used for village number 12 because there is a spring which is available all year round located less than 1,000 meters from the community with an elevation difference more than 150 meters. This village belongs to category (c) with a score of 8.

Spring protections with piped systems should be used for village numbers 4, 5 and 14 because there are springs which are available all year round located more than 1,000 meters from the communities for village numbers 4 and 5, and less than 1,000 meters for village number 14; the elevation differences more than 150 meters for those three villages. These three villages belong to category (d) with a score of 7.

A surface water with piped system and chlorination should be used for village number 11 because there is a river which is available all year round and its water quality is good (clear); no ground water during the dry season. This village belongs to category (i) with a score of 3.

Surface water with piped systems and complete treatment (chemical coagualtion, sedimentation, filtration and disinfection) should be used for village numbers 1, 8 and 9 because the only water source available during the dry season is surface water (rivers and irrigation canals) and its water quality is poor (turbid). These three villages belong to category (j) with a score of 1.

The score of this parameter is presented in Table 28.

TABLE 28

SCORE DISTRIBUTION OF TECHNOLOGICAL ALTERNATIVES
IN THE JAILOLO KECAMATAN

No.	Village	Category	Score
1.	Akediri	j	1
2.	Tedeng	b	10
3.	Acango	b	10
4.	Idamdehe Gamsungi	d	7
5.	Idamdehe Seruni	d	7
6.	Marimbati	b	10
7.	Gamtala	b	10
8.	Lolori	j	1
9.	Taboso	j	1
10.	Hoku-hoku Kie	b	10
11.	Porniti	i	3
12.	Jailolo Seruni	c	8
13.	Gamlamo	b	10
14.	Jalan Baru	d	7
15.	Gofasa	a	10
16.	Guwaemaadu	a	10
17.	Galala	a	10
18.	Rabanehena	a	10
19.	Payo	a	10
2o.	Bobo	a	10
21.	Saria	a	10

Population

Table B. 2 indicates that total population in the Jailolo Kecamatan is 10,893 spread out over 21 villages consisting of 1,738 families. The average number of people per family is 6.3 which is much higher than in the Ibu Kecamatan, that is only 4. The average population per village, as mentioned above, is 519 ranging from 145 to 2,135 people per village; this belongs to category (b) and the scores range from 2 to 6 as presented in Table 29.

Village Contributions

Table B. 12 indicates that all villages in the Jailolo Kecamatan are willing to contribute to the construction as well as the maintenance costs. Thus all villages in this Kecamatan belong to category (a) with a score of 10.

The remaining five parameters: Village Potential, Public Places, Excreta Disposals, Road Conditions, and Power Supply are not discussed because there is no data available for these five parameters.

The South Cirebon Kecamatan

The South Cirebon Kecamatan, Which belongs to the Cirebon Kabupaten of the West Java Province, has an average population of 2,286 people per village which is close to the national figure, that is about 2,200 people per village. Another interesting point about this Kecamatan is that more than one-half of the villages have cholera and all villages in this Kecamatan have skin disease.

TABLE 29

CATEGORY AND SCORE FOR POPULATION
IN THE JAILOLO KECAMATAN

No.	Village	Population	Category	Score
1.	Akediri	2,135	b.5	6
2.	Tedeng	432	b.1	2
3.	Acango	145	b.1	2
4.	Idamdehe Gamsungi	423	b.1	2
5.	Idamdehe Seruni	178	b.1	2
6.	Marimbati	195	b.1	2
7.	Gamtala	371	b.1	2
8.	Lolori	275	b.1	2
9.	Taboso	317	b.1	2
10.	Hoku-hoku Kie	329	b.1	2
11.	Porniti	333	b.1	2
12.	Jailolo Seruni	915	b.3	4
13.	Gamlamo	824	b.3	4
14.	Jalan Baru	500	b.2	3
15.	Gofasa	505	b.2	3
16.	Guwaemaadu	507	b.2	3
17.	Galala	327	b.1	2
18.	Babanehena	681	b.2	3
19.	Payo	693	b.2	3
20.	Bobo	553	b.2	3
21.	Saria	255	b.1	2
	Total	10,893		

Waterborne Diseases

Table B. 8 indicates that all villages in the South Cirebon Kecamatan have skin disease, seven villages have cholera, two villages have gastroenteric disease, two villages have trachoma, and no villages have typhoid. The score of this parameter is presented in Table 30.

TABLE 30

CATEGORY AND SCORE FOR WATERBORNE DISEASES IN THE SOUTH CIREBON KECAMATAN

No.	Village	Category	Score
1.	Kamanteren	c	8
2.	Wanasata Kidul	d[1]	6
3.	Wanasata Lor	d[1]	6
4.	Gegunung	d[1]	6
5.	Pejambon	c	8
6.	Sendang	e	1
7.	Cempaka	d[2]	5
8.	Kecomberan	e	1
9.	Cirebon Girang	d[1]	6
10.	Sampiran	d[1]	6
11.	Ciperna	e	1
12.	Kepompongan	d[2]	5

[1] Cholera is present but gastroenteric disease is not.

[2] Gastroenteric disease is present but cholera is not.

Difficulty in Obtaining Water

Table B. 3.2 indicates that the villagers in this Kecamatan get water from wells, springs and rivers. Table B. 6 indicates that the watersources are located in the communities and between 200 and 1,000 meters away from the communities. Table B. 7 indicates that two villages have to climb or descend less than 150 meters to get to the water sources. The score of this parameter is presented in Table 31.

TABLE 31

CATEGORY AND SCORE FOR DIFFICULTY IN OBTAINING WATER IN THE SOUTH CIREBON KECAMATAN

No.	Village	Category	Score
1.	Kamanteren	a	1
2.	Wanasata Kidul	e	6
3.	Wanasata Lor	a	1
4.	Gegunung	a	1
5.	Pejambon	a	1
6.	Sendang	a	1
7.	Cempaka	a	1
8.	Kecomberan	a	1
9.	Cirebon Girang	b	2
10.	Sampiran	d	4
11.	Ciperna	a	1
12.	Kepompongan	b	2

Technological Alternatives

Dug wells or tube wells with handpumps should be used for villages, numbers 1, 3, 4, 5, 6, 7 and 11 because there is ground water available all year round in those seven villages, its water quality is good and the ground water table is less than 15 metes as indicated by Tables B. 4, B. 5 and B. 9.

Spring protections with piped systems should be used for villages, numbers 2, 9 and 12 because there are springs which never dry located between 200 and 1,000 meters from the communities in those three villages and the elevation differences are less than 150 meters as indicated by Tables B. 4, B. 6 and B. 7.

Surface water with complete treatment systems should be used for villages, numbers 2 and 9 because the only turbid surface water is available during the dry season in those two villages.

The score of this parameter is presented in Table 32.

Population

Table B. 2 indicates that total population in the South Cirebon Kecamatan is 27,450 spread out over 12 villages consisting of 6,371 families. Thus the average number of people per family is 4.3 and the average number of people per village is 2,286 which belongs to category (c) with the scores range from 3 to 7. The score of this parameter is presented in Table 33.

TABLE 32

CATEGORY AND SCORE FOR TECHNOLOGICAL ALTERNATIVES
IN THE SOUTH CIREBON KECAMATAN

No.	Village	Category	Score
1.	Kemanteren	b	10
2.	Wanasata Kidul	d	7
3.	Wanasata Lor	b	10
4.	Gegunung	b	10
5.	Pejambon	b	10
6.	Sendang	b	10
7.	Cempaka	b	10
8.	Kecomberan	j	1
9.	Cirebon Girang	d	7
10.	Sampiran	j	1
11.	Ciperna	b	10
12.	Kepompongan	d	7

TABLE 33

CATEGORY AND SCORE FOR POPULATION
IN THE SOUTH CIREBON KECAMATAN

No.	Village	Population	Category	Score
1.	Kemanteren	2,041	c.3	5
2.	Wanasata Kidul	2,930	c.4	6
3.	Wanasata Lor	1,027	c.2	4
4.	Gegunung	1,570	c.3	5
5.	Pejambon	1,759	c.3	5
6.	Sendang	1,242	c.2	4
7.	Cempaka	1,813	c.3	5
8.	Kecomberan	1,729	c.3	5
9.	Cirebon Girang	5,075	c.5	7
10.	Sampiran	3,463	c.4	6
11.	Ciperna	2,101	c.3	5
12.	Kepompongan	2,700	c.4	6
	Total	27,450		

Village Contributions

Table B. 12 indicates that all villages in the South Cirebon Kecamatan are willing to contribute to the construction as well as the maintenance costs, therefore, all villages belong to category (a) with a score of 10. So this parameter does not affect ranking and tabulation is not necessary.

The remaining five parameters are not discussed because there is no data.

The Kadipaten Kecamatan

The Kadipaten Kecamatan, which belongs to the Majalengka Kabupaten of the West Java Province, represents a high population per village, which is 4,278 people per village as an average. This figure is almost double compared with the national figure. The most interesting point about this Kecamatan is that cholera, trachoma, gastroenteric and skin diseases are present in all of the villages.

Waterborne Diseases

Table B. 8 indicates that all villages in this Kecamatan have cholera, trachoma, gastroenteric and skin diseases and village number 12 also has typhoid. Therefore, 11 villages, numbers 1 to 11 belong to category (b) with a score of 12 (cholera is present) and one village, number 12 belongs to category (a) with a score of 15. Tabulation is not necessary because there is no variation in figures.

Difficulty in Obtaining Water

Table B. 3.1 indicates that there is an unprotected water supply system in village number 9 which is a spring with a bamboo pipe serving 200 people and there are two non free-flowing artesian wells located in village numbers 11 and 12 with piped systems and pumps serving 100 and 200 people respectively which are called protected systems. Other protected systems by means of dug wells with handpumps, as indicated by Table B. 3.2, are found in village numbers 4, 11 and 12 serving 50 people (one well), 55 people (two wells), and 1,200 people (30 wells) respectively.

Table B. 6 indicates that most of the water sources are located in the communities and only village numbers 3 and 6 have to travel between 200 and 1,000 meters and have to climb or descend less than 150 meters to get to the water sources. Therefore, ten villages belong to category (b) with a score of 1 and two villages, numbers 3 and 6, belong to category (e) with a score of 6. Tabulation is also not necessary because there is not much variation.

Technological Alternatives

Table B. 4 indicates that village number 1 has no water source available during the dry season because the ground water, the only water source available in this village, is dry, so a rain water collection system is suggested to be used for this village pending further investigation to find a more suitable water source. The remaining 11 villages have ground water available all year round, thus dug wells or tube wells with handpumps should be used for these 11 villages.

Therefore, village number 1 belongs to category (a) with a score of 10 and the other 11 villages belong to category (b) with a score of 10. Thus all villages in the Kadipaten Kecamatan receive the same score for this parameter, so it does not affect ranking and tabulation is not necessary.

Population

Table B. 2 indicates that the total population in the Kadipaten Kecamatan is 51,335 spread out over 12 villages consisting of 11,828 families. The average population per village is 4,278 ranging from 945 to 16,757 people per village and the average number of people per family is 4.3. This Kecamatan belongs to category (d) with the scores range from 4 to 8 as presented in Table 34.

TABLE 34

CATEGORY AND SCORE FOR POPULATION
IN THE KADIPATEN KECAMATAN

No.	Village	Population	Category	Score
1.	Jatipamor	2,013	d.2	5
2.	Cijurey	1,886	d.1	4
3.	Bantrangsana	945	d.1	4
4.	Bonang	2,046	d.2	5
5.	Babakan Anyar	1,460	d.1	4
6.	Pasirmuncang	2,777	d.2	5
7.	Jatiserang	2,423	d.2	5
8.	Panyingkiran	5,103	d.4	7
9.	Leuwiseeng	2,923	d.2	5
10.	Karangsambung	8,465	d.5	8
11.	Heuleut	4,537	d.4	7
12.	Kadipaten	16,757	d.5	8
	Total	51,335		

Village Contributions

Table B. 12 indicates that all villages in this Kecamatan are willing to contribute to the maintenance costs and eight villages are also willing to contribute to the construction costs. Therefore, eight villages belong to category (a) and four villages belong to category (b). The score of this parameter is presented in Table 35.

TABLE 35

CATEGORY AND SCORE FOR VILLAGE CONTRIBUTIONS
IN THE KADIPATEN KECAMATAN

No.	Village	Category	Score
1.	Jatipamor	b	5
2.	Cijurey	a	10
3.	Bantrangsana	b	5
4.	Bonang	b	5
5.	Babakan Anyar	a	10
6.	Pasirmuncang	a	10
7.	Jatiserang	a	10
8.	Panyingkiran	a	10
9.	Leuwiseeng	b	5
10.	Karangsambung	a	10
11.	Heuleut	a	10
12.	Kadipaten	a	10

The remaining five parameters are not discussed

The Manonjaya Kecamatan

The Manonjaya Kecamatan, Tasikmalaya Kabupaten, West Java Province, represents the second highest average population per village which is 7,380 ranging from 4,328 to 10,501 people per village. An interesting point here is that all villages have cholera, gastroenteric disease, trachoma and skin disease.

Waterborne Disease

Table B. 8 indicates that all villages in the Manonjaya Kecamatan, as above-mentioned, have cholera, gastroenteric disease, trachoma and skin disease and no villages have typhoid. Therefore, all villages belong to category (b) with a score of 12 (cholera is present); thus this parameter does not affect ranking.

Difficulty in Obtaining Water

Table B. 3.1 indicates that an unprotected system, using springs and bamboo piped systems serving 1,986 people are found in village number 3. Table B. 3.2 indicates that a protected system by means of wells with handpumps are found in village numbers 1, 3, 4, 5 and 7 serving 500 people (five wells), 5 people (one well), 20 people (four wells), 250 people (two wells) and 1,025 people (15 wells) respectively.

Table B. 6 indicates that the water sources are located in the communities for village numbers 3, 4, 6 and 7, and are between 200 and 1,000 meters away for village numbers 1, 2 and 5. Table B. 7 indicates that to get to the water sources, village numbers 2, 3, 4 and 6 have to climb or descend less than 150 meters, while village numbers 1 and 5 have to climb or descend more than 150 meters. The score of this parameter is presented in Table 36.

TABLE 36

CATEGORY AND SCORE FOR DIFFICULTY IN OBTAINING WATER IN THE MANONJAYA KECAMATAN

No.	Village	Category	Score
1.	Cikareo	f	8
2.	Cibeber	e	6
3.	Gunungtanjung	d	4
4.	Kamulyan	d	4
5.	Cilangkap	f	8
6.	Pasirpanjang	d	4
7.	Manonjaya	a	1

Technological Alternatives

Dug wells or tube wells with handpumps should be used for village numbers 2, 4 and 7 because the ground water is available all year round in those three villages and its water quality is good as indicated by Table B. 4 and B. 5 and as indicated by Table B. 9 the ground water table is less than 15 meters.

A spring protection without piped system should be used for village number 3 because there is a spring which is available all year round and located in the community as indicated by Table B. 6. And a spring protection with piped system should be used for village number 5 because there is a spring located between 200 and 1,000 meters away from the community as indicated by Table B. 6 and the elevation difference is more than 150 meters as indicated by Table B. 7.

A surface water treatment with piped system should be used for village number 1 because the only turbid surface water is available during the dry season as indicated by Table B. 4 and B. 5.

Finally, for village number 6, there is no water source is available during the dry season. In this case, a rain water collection is suggested for this village pending further investigation to find a more suitable water source.

The score of this parameter is presented in Table 37.

TABLE 37

CATEGORY AND SCORE FOR TECHNOLOGICAL ALTERNATIVES IN THE MANONJAYA KECAMATAN

No.	Village	Category	Score
1.	Cikareo	j	1
2.	Cibeber	b	10
3.	Gunungtanjung	c	8
4.	Kamulyan	b	10
5.	Cilangkap	d	7
6.	Pasirpanjang	a	10
7.	Manonjaya	b	10

Population

Table B. 2 indicates that the total population in the Manonjaya Kecamatan is 51,664 spread out over seven villages consisting of 11,017 families. The average number of people per family is 4.7 and the average number of people per village is 7,380 ranging from 4,328 to 10,501 people per village which belongs to category (e) with the scores range from 5 to 8 as presented in Table 38

TABLE 38

CATEGORY AND SCORE FOR POPULATION
IN THE MANONJAYA KECAMATAN

No.	Village	Population	Category	Score
1.	Cikareo	10,477	e.4	8
2.	Cibeber	4,328	e.1	5
3.	Gunungtanjung	10,501	e.4	8
4.	Kamulyan	5,355	e.2	6
5.	Cilangkap	7,383	e.3	7
6.	Pasirpanjang	6,246	e.2	6
7.	Manonjaya	7,374	e.3	7
	Total	51,664		

Village Contributions

Table B. 12 indicates that all villages in this Kecamatan are willing to contribute to the construction as well as the maintenance costs; therefore, all villages belong to category (a) with a score of 10 which does not affect ranking.

The remaining five parameters are not discussed because no data is available.

The Tasikmalaya Kecamatan

The Tasikmalaya Kecamatan, Tasikmalaya Kabupaten, West Java Province, represents the highest average population per village in the country which is 20,134, ranging from 10,091 to 36,498 people per village. Another interesting point about this Kecamatan is that all villages have cholera, gastroenteric disease, trachoma and skin disease, and four villages have typhoid. The west Java Province, in general, has the highest cholera and gastroenteric disease incidence in the country. This was one of the reasons why the West Java Province received a high priority for the implementation of a rural water supply program. In 1973 the PSA Group (3) conducted a study of a priority setting for a rural water supply program in the West Java Province and now, a significant number of sub-projects are being implemented with the assistance of the Dutch Government.

Waterborne Diseases

Table B. 8 indicates that all villages, as abovementioned, have cholera, gastroenteric disease, trachoma and skin disease, and four villages have typhoid. The score of this parameter is presented in Table 39.

Difficulty in Obtaining Water

Table B. 3.1 indicates that part of the villages, numbers 3, 6, and 7, are using protected systems by means of spring protections with piped systems serving 456, 10,500 and 8,250 people respectively. Table B. 3.2 indicates that wells are found in all villages in this Kecamatan and some of them with handpumps. Table B. 4 indicates that the ground water is available all year round in all villages and its water quality is good with the ground water table less than 7 meters as indicated by Table B. 5. Springs are also available in three villages. Thus water source is not a problem in this Kecamatan; Table B. 6 indicates that all water sources are located in the communities, therefore, all villages belong to category (a) with a score of 1 which does not affect ranking.

TABLE 39

CATEGORY AND SCORE FOR WATERBORNE DISEASES
IN THE TASIKMALAYA KECAMATAN

No.	Village	Category	Score
1.	Sukamanah	b	12
2.	Nagasari	b	12
3.	Tasikmalaya	a	15
4.	Kahuripan	a	15
5.	Tuguraja	b	12
6.	Cihideung	a	15
7.	Tawangsari	a	15

Technological Alternatives

Dug wells or tube wells with handpumps should be used for all villages in the Tasikmalaya Kecamatan because the ground water is available all year round in all villages, its water quality is good and the ground water table is less than seven meters as indicated by Table B. 4, B. 5, B. 6 and B. 9. Thus all villages belong to category (b) with a score of 10. However, considering the high population per village and the availability of springs in this Kecamatan, further investigation of the possibility of using a combined spring protection and piped system for some villages which are close each other is suggested.

Population

Table B. 2 indicates that the total population in the Tasikmalaya Kecamatan is 140,940 spread out over seven villages consisting of 35,502 families. Thus the average number of people per family is 4 and the average number of people per village is 20,134 ranging from 10,091 to 36,498 people per village which belongs to category (f) with the scores range from 6 to 10 as presented in Table 40.

Village Contributions

Table B. 12 indicates that village number 1 is not willing to contribute to the construction and maintenance costs and the remaining six villages are willing to contribute to the construction as well as the maintenance costs. Therefore, village number 1 belongs to category (c) with a score of 0 and village numbers 2 to 7 belong to category (a) with a score 10.

TABLE 40

CATEGORY AND SCORE FOR POPULATION
IN THE TASIKMALAYA KECAMATAN

No.	Village	Population	Category	Score
1.	Sukamanah	10,091	f.2	7
2.	Nagarasari	10,638	f.2	7
3.	Tasikmalaya	19,174	f.3	8
4.	Kahuripan	15,763	f.3	8
5.	Tuguraja	14,508	f.2	7
6.	Cihideung	36,498	f.5	10
7.	Tawangsari	36,268	f.5	10
	Total	140,940		

The remaining five parameters are not discussed because there is no data available.

Priority Computation

Next, is an example of the priority computation used to determine the priority index of the villages in the six selected Kecamatans using the formula developed in the previous chapter which is expressed as follows:

$$PI = \sum_{i=1}^{10} \sum_{j=1}^{n} W_i \cdot S_{ij}$$

where

PI = priority index of each village,

W = weight of each parameter,

S = score of each parameter,

i = a subscript denoting the i-th parameter,

j = a subscript denoting the j-th village.

The value of W was determined in Chapter III, Methodology, using the Delphi method and summarized in Table 12 and the value of S was determined in the score assignment in this chapter. The scores of the five parameters for the six selected Kecamatans, namely, Ibu, Jailolo, South Cirebon, Kadipaten, Manonjaya and Tasikmalaya, are summarized in Tables 41, 42, 43, 44, 45, and 46 respectively. Thus the product of $W_i S_{ij}$ can easily be determined and the value of PI is the summation of $W_i S_{ij}$. The values of PI for the above six Kecamatans have been computed and summarized in Tables 47 to 52.

Discussion of Results

Tables 47 to 52 indicate the priority index of each village within the six selected Kecamatans; the higher the PI value the higher the priority of the village to receive the safe water system first. However, in practice, for special reasons such as political considerations or vociferous demands for service, the planner on behalf of the Bupati might increase the priority index of the villages under consideration by multiplying it by a factor which will obtain PI value desired. In this example, only five out of the ten proposed parameters were used; due to a questionnaire change, the data for the remaining five parameters was not available.

TABLE 41

SUMMARY OF SCORES OF THE FIVE PARAMETERS
FOR THE IBU KECAMATAN

No.	Village	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions
1.	Podal	0	1	8	3	10
2.	Tengwango	0	6	7	2	10
3.	Togowo	0	6	7	2	10
4.	Duno	0	6	3	3	10
5.	Tokowoko	0	1	8	1	10
6.	Goin	0	1	3	2	10
7.	Sangaji Nyeku	0	1	3	2	10
8.	Sangaji Adu	0	1	3	1	10
9.	Toguis	0	8	3	1	10
10.	Togoreba Sungi	0	1	3	2	10
11.	Borona	0	1	3	2	10
12.	Todake	0	2	3	2	10
13.	Sirimahu	0	6	8	2	10
14.	Pasalulu	0	1	3	3	10
15.	Togoreba	0	8	8	3	10
16.	Tobaol	0	1	8	3	10
17.	Tongutette	0	1	10	4	5
18.	Gam Lamo	0	1	3	3	5
19.	Gam Ici	0	1	10	4	5
20.	Tongute Sungi	0	4	3	4	5
21.	Akesibu	0	10	3	3	5
22.	Tongute Goin	0	1	3	3	5
23.	Maritango	0	1	3	3	5
24.	Kie Ici	0	10	3	3	5
25.	Naga	0	6	3	2	5
26.	Tosoa Togower	0	8	7	2	5
27.	Tababal	0	1	8	2	5
28.	Baru	0	1	8	5	5
29.	Aduu	0	4	8	2	5
30.	Ngawet Nanas Jere	0	4	8	3	5

TABLE 42

SUMMARY OF SCORES OF THE FIVE PARAMETERS
FOR THE JAILOLO KECAMATAN

No.	Village	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions
1.	Akediri	7	1	1	6	10
2.	Tedeng	7	1	10	2	10
3.	Acango	7	1	10	2	10
4.	Idamdehe Gamsungi	7	10	7	2	10
5.	Idamdehe Seruni	7	10	7	2	10
6.	Marimbati	7	2	10	2	10
7.	Gamtala	7	1	10	2	10
8.	Lolori	7	1	1	2	10
9.	Taboso	7	1	1	2	10
10.	Hoku-hoku Kie	7	8	10	2	10
11.	Porniti	7	8	3	2	10
12.	Jailolo Seruni	7	8	8	4	10
13.	Gamlamo	7	1	10	4	10
14.	Jalan Baru	7	8	7	3	10
15.	Gofasa	7	1	10	3	10
16.	Guawemaadu	7	8	10	3	10
17.	Galala	7	10	10	2	10
18.	Rabanehena	7	1	10	3	10
19.	Payo	7	1	10	3	10
20.	Bobo	7	1	10	3	10
21.	Saria	7	1	10	2	10

TABLE 43

SUMMARY OF SCORES OF THE FIVE PARAMETERS
FOR THE SOUTH CIREBON KECAMATAN

No.	Village	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions
1.	Kemanteren	8	1	10	5	10
2.	Wanasata Kidul	6	8	7	6	10
3.	Wanasata Lor	6	1	10	4	10
4.	Gegunung	6	1	10	5	10
5.	Pejambon	8	1	10	5	10
6.	Sendang	1	1	10	4	10
7.	Cempaka	5	1	10	5	10
8.	Kecomberan	1	1	1	5	10
9.	Cirebon Girang	6	2	8	7	10
10.	Sampiran	6	4	10	6	10
11.	Ciperna	1	1	10	5	10
12.	Kepongpongan	5	2	7	6	10

TABLE 44

SUMMARY OF SCORES OF THE FIVE PARAMETERS
FOR THE KADIPATEN KECAMATAN

No.	Village	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions
1.	Jatipamor	12	1	10	5	5
2.	Cijurey	12	1	10	4	10
3.	Bantrangsana	12	8	10	4	5
4.	Bonang	12	1	10	5	5
5.	Babakan Anyar	12	1	10	4	10
6.	Pasirmuncang	12	8	10	5	10
7.	Jatiserang	12	1	10	5	10
8.	Panyingkiran	12	1	10	7	10
9.	Leuwiseeng	12	1	10	5	5
10.	Karangsambung	12	1	10	6	10
11.	Heuleut	12	1	10	7	10
12.	Kadipaten	15	1	10	8	10

TABLE 45

SUMMARY OF SCORES OF THE FIVE PARAMETERS
FOR THE MANONJAYA KECAMATAN

No.	Village	Waterborne Disease	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions
1.	Cikareo	12	8	1	8	10
2.	Cibeber	12	6	10	5	10
3.	Gunungtanjung	12	4	8	8	10
4.	Kamulyan	12	4	10	6	10
5.	Cilangkap	12	8	7	7	10
6.	Pasirpanjang	12	4	10	6	10
7.	Manonjaya	12	1	10	7	10

TABLE 46

SUMMARY OF SCORES OF THE FIVE PARAMETERS
FOR THE TASIKMALAYA KECAMATAN

No.	Village	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions
1.	Sukamanah	12	1	10	7	0
2.	Nagarasari	12	1	10	7	10
3.	Tasikmalaya	15	1	10	8	10
4.	Kahuripan	15	1	10	8	10
5.	Tuguraja	12	1	10	7	10
6.	Cihideung	15	1	10	10	10
7.	Tawangsari	15	1	10	10	10

TABLE 47

PI VALUES FOR VILLAGES IN THE IBU KECAMATAN

No.	Village	$W_i . S_{ij}$					PI
		Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	
1.	Podal	0	14	111	35	161	321
2.	Tengwango	0	86	97	23	161	367
3.	Togowo	0	86	97	23	161	367
4.	Duno	0	86	42	35	161	324
5.	Tokowoko	0	14	111	12	161	298
6.	Goin	0	14	42	23	161	240
7.	Sangaji Nyeku	0	14	42	23	161	240
8.	Sangaji Adu	0	14	42	12	161	229
9.	Toguis	0	115	42	12	161	330
10.	Togoreba Sungi	0	14	42	23	161	240
11.	Borona	0	14	42	23	161	240
12.	Todake	0	29	42	23	161	255
13.	Sirimahu	0	86	111	23	161	381
14.	Pasalulu	0	14	42	35	161	252
15.	Togoreba	0	115	111	35	161	422
16.	Tobaol	0	14	111	35	161	321
17.	Tongutette	0	14	139	46	81	280
18.	Gam Lamo	0	14	42	35	81	172
19.	Gam Ici	0	14	139	46	81	280
20.	Tongute Sungi	0	58	42	46	81	227
21.	Akesibu	0	14	42	35	81	172
22.	Tongute Goin	0	14	42	35	81	172
23.	Maritango	0	14	42	23	81	160
24.	Kie Ici	0	144	42	35	81	302
25.	Naga	0	86	42	23	81	232
26.	Tosoa Togower	0	115	97	23	81	316
27.	Tababal	0	14	111	23	81	229
28.	Baru	0	14	111	58	81	264
29.	Aduu	0	58	111	23	81	273
30.	Ngawet Nanas Jere	0	58	111	35	81	285

TABLE 48

PI VALUES FOR VILLAGES IN THE JAILOLO KECAMATAN

No.	Village	$W_i \cdot S_{ij}$					PI
		Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	
1.	Akediri	104	14	14	69	161	363
2.	Tedeng	104	14	139	23	161	441
3.	Acango	104	14	139	23	161	441
4.	Idamdehe Gamsungi	104	144	97	23	161	529
5.	Idamdehe Seruni	104	144	97	23	161	529
6.	Marimbati	104	29	139	23	161	456
7.	Gamtala	104	14	139	23	161	441
8.	Lolori	104	14	14	23	161	316
9.	Taboso	104	14	14	23	161	316
10.	Hoku-hoku Kie	104	115	139	23	161	542
11.	Porniti	104	115	42	23	161	445
12.	Jailolo Seruni	104	115	111	46	161	537
13.	Gam Lamo	104	14	144	46	161	464
14.	Jalan Baru	104	115	97	35	161	512
15.	Gofasa	104	14	144	35	161	453
16.	Guawemaadu	104	115	144	35	161	554
17.	Galala	104	144	144	23	161	571
18.	Rabanehena	104	14	144	35	161	453
19.	Payo	104	14	144	35	161	453
20.	Bobo	104	14	144	35	161	453
21.	Saria	104	14	144	23	161	441

TABLE 49

PI VALUES FOR VILLAGES IN THE SOUTH CIREBON KECAMATAN

No.	Village	$W_i \cdot S_{ij}$					PI
		Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	
1.	Kemanteren	119	14	139	58	161	491
2.	Wanasata Kidul	89	115	97	69	161	531
3.	Wanasata Lor	89	14	139	46	161	449
4.	Gegunung	89	14	139	58	161	461
5.	Pejambon	119	14	139	58	161	491
6.	Sendang	15	14	139	46	161	375
7.	Cempaka	75	14	139	58	161	447
8.	Kecomberan	15	14	14	58	161	262
9.	Cirebon Girang	89	29	111	81	161	471
10.	Sampiran	89	58	139	69	161	516
11.	Ciperna	15	14	139	58	161	398
12.	Kepompongan	75	29	97	69	161	431

TABLE 50

PI VALUES FOR VILLAGES IN THE KADIPATEN KECAMTAN

No.	Village	$W_i.S_{ij}$					PI
		Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	
1.	Jatipamor	179	14	139	58	81	471
2.	Cijurey	179	14	139	46	161	539
3.	Bantrangsana	179	115	139	46	81	560
4.	Bonang	179	14	139	58	81	471
5.	Babakan Anyar	179	14	139	46	161	539
6.	Pasirmuncang	179	115	139	58	161	652
7.	Jatiserang	179	14	139	58	161	551
8.	Panyingkiran	179	14	139	81	161	574
9.	Leuwiseeng	179	14	139	58	81	332
10.	Karangsambung	179	14	139	69	161	562
11.	Heuleut	179	14	139	81	161	574
12.	Kadipaten	224	14	139	92	161	630

TABLE 51

PI VALUES FOR VILLAGES IN THE MANONJAYA KECAMATAN

No.	Village	$W_i \cdot S_{ij}$					PI
		Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	
1.	Cikareo	179	115	14	92	161	561
2.	Cibeber	179	86	139	58	161	623
3.	Gunungtanjung	179	58	111	92	161	601
4.	Kamulyan	179	58	139	69	161	606
5.	Cilangkap	179	115	97	81	161	633
6.	Pasirpanjang	179	58	139	69	161	606
7.	Manonjaya	179	14	139	81	161	574

TABLE 52

PI VALUES FOR VILLAGES IN THE TASIKMALAYA KECAMATAN

No.	Village	Waterborne Diseases	Difficulty in Obtaining Water	Technological Alternatives	Population	Village Contributions	PI
1.	Sukamanah	179	14	139	81	161	574
2.	Nagarasari	179	14	139	81	161	574
3.	Tasikmalaya	224	14	139	92	161	630
4.	Kahuripan	224	14	139	81	161	630
5.	Tuguraja	179	14	139	81	161	574
6.	Cihideung	224	14	139	115	161	653
7.	Tawangsari	224	14	139	115	161	653

Two of the five parameters used, Waterborne Diseases and Village Contributions, did not affect much the priority index (PI) values because most of the villages in the same Kecamatan had the same scores for these two parameters; the validity of the data for these two parameters seems to be questionable.

Concerning the Waterborne Diseases, it was widely known that this parameter receives the highest weight in selecting project localities, therefore, every village attempted to report as many as the waterborne diseases present. Since the waterborne diseases were not specified into the number of cases and the year when the diseases occurred, it is difficult to validate.

With respect to Village Contributions, almost all villages expressed their willingness to contribute to the construction as well as the maintenance costs, however, only verbal agreements have been made and it is difficult to determine, at this point, whether or not such village contributions will actually be made.

The remaining three parameters, Difficulty in Obtaining Water, Technological Alternatives and Population, were dominant; they determined the PI values of the villages in each Kecamatan, an exception is the Tasikmalaya Kecamatan where Difficulty in Obtaining Water and Technological Alternatives were the same for all villages in that Kecamatan due to same conditions. These three parameters were the most reliable because the data for these three parameters was resulted by the surveyor investigation and did not depend on the statement of the villages, as did the other two parameters, Waterborne Diseases and Village Contributions.

Actually, Village Potential is more important and realistic because it reflects the ability and capability of the communities to operate and maintain water supply systems to be installed. The data for this parameter is reliable and easy to validate using eihter the Indigenous Resources and Socio Technological Level of the Reid and Discenza Model (4) or the Village Growth Potential Factors of the PSA Group (3).

Public Places is also reliable data because it is easy to validate and relevant to the need of safe water, controlling the waterborne diseases, and teaching the villagers to appreciate the safe water system as well as teaching them personal hygiene.

The remaining three parameters, Excreta Disposals, Road Conditions and Power Supply, although their roles are not very significant, are reliable and easy to validate; this can be done by surveyors without being influenced much by the community.

However, the results of the test of the model indicated by Tables 47 to 52 seem to be workable; the figures vary from one village to another, although the range in figures is not broad due to two parameters, Waterborne Diseases and Village Contributions, which indicated the same figures for most villages in the same Kecamatan. For example, the figures for the Ibu Kecamatan ranged from 172, as the lowest figure, to 422, as the highest figure; this indicates that the highest is more than two fold of the lowest figure (see Table 47). In the Jailolo Kecamatan (see Table 48), the figures ranged from 316 to 571, which was less than double between the lowest and the highest. In the South Cirebon Kecamatan (see Table 49) the figures ranged from 262 to 516 which was almost double. In the Kadipaten Kecamatan (see Table 50) the figures ranged from 332 to 652 which was also double. In the Manonjaya Kecamatan the figures ranged from 561 to 633 whic was too close. Finally, in the Tasikmalaya Kecamatan the figures ranged from 574 to 653 which was also close. The figures of the last two Kecamatan as indicated by Tables 51 and 52 were very close because, as mentioned earlier, the conditions of the villages in those two Kecamatans were similar.

From the above discussion, although the result of the test of the model was not very satisfactory due to the questionnaire change and the data for two among the five used parameters had the same scores for villages in the same Kecamatan, a conclusion can be made that the priority model developed in this study is suitable to the present need for the Indonesian Rural Water Supply Program in selecting the project localities. For the future, it is suggested that the questionnaire used to collect the data be improved by including the ten proposed parameters as included in the Questionnaire Part I (see Appendix D), particularly Village Potential using the data sheet of the Reid and Discenza (4) presented in Appendix F. It is strongly suggested that the

the data collection should be conducted by the well-trained sanitarians and assistant sanitarians in order to ensure the reliability and validity of the data. Planning and design as well as implementation of rural water supply projects depend much on the reliability and validity of the data collected from the communities. It must be kept in mind that the reliability and validity of the data is the key to the success of the Indonesian Rural Water Supply Program which will cover more than 100 million Indonesian people living in rural areas.

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APPENDIXES

APPENDIX A

QUESTIONNAIRE A

VILLAGE WATER SUPPLY PROJECT PLANNING DATA SHEET

Note.

- This form is to be completed by sanitarians at the Kecamatan Level or Health Center personnel.

- Check the appropriate blank.

- To be filled out through direct observation of the clusters within the village.

A. 1. Province____________________

Kabupaten___________________

Kecamatan___________________

A. 2. Name of Village____________________

Number of houses___________________

Number of people___________________

A. 3. How do the villagers get water?

Note.

- Unprotected water sources with piped systems; the use of bamboo is an unprotected piped system.

- Evaluation is based on general conditions.

- A map which indicates the number of water sources and their locations is usually available at the Health

Center. If there is no map, the locations of water sources should be estimated by general investigation of the village and consultation with the community leaders.

A. 3.1. With piped system.

1. Unprotected:

Sources	Systems	Pipes
___ Springs	___ Gravity	___ G.I.[1]
___ Rivers	___ Pumping	___ PVC[2]
___ Others		___ Asbestos
		___ Bamboo

Population served by unprotected system ___________

2. Protected:

Source	System	Pipe
___ Springs	___ Gravity	___ G.I[1]
___ Artesian wells	___ Pumping	___ PVC[2]
___ Rivers with treatment		___ Asbestos
___ Others		

Population served by protected system _____________

A. 3.2. Without piped system.

1. Unprotected:

Sources	Number of sources	Population served
___ Wells	_____	______
___ Springs	_____	______

---

[1] Galvanized Iron; [2] Poly Vinyl Chloride.

Sources	Number of sources	Population served
___ Rivers/Irrigation canals	____	________
___ Lakes	____	________
___ Rain water collections	____	________
Total population served		________

2. Protected:

Sources	Number of sources	Population served
___ Shallow hand-pupms	____	________
___ Deep handpumps	____	________
___ Spring protections	____	________
___ Free-flowing artesian wells	____	________
___ Rain water collections	____	________
Total population served		________

A. 3.3. Summary of all systems

	Unprotected	Protected	Total
Population served by piped systems	______	______	______
Population served by other systems	______	______	______
Total population served by all systems			________

A. 4. Are the existing sources becoming dry?

	Yes	No
Wells/Ground water	___	___

	Yes	No
Springs	___	___
Rivers/Surface water	___	___

A. 5. How are the physical and chemical characteristics of water currently used?

	Ground water	Springs	Surface water
Good: Clear	___	___	___
Poor: Salty	___	___	___
Contains iron	___	___	___
Hard	___	___	___
Turbid	___	___	___

A. 6. Distances between water source and communities.

___ Less than 200 meters.

___ Between 200 and 1,000 meters.

___ More than 1,000 meters.

A. 7. Villagers must climb or descend to get to water source.

___ No.

___ Less than 150 meters.

___ More than 150 meters.

A. 8. The depth of ground water to ground level.

___ Less than 7 meters.

___ Between 7 to 15 meters.

___ More than 15 meters.

A. 9. General topographical conditions.

___ Mountainous.

___ Rocky.

___ Flat.

A.10. Does the community need an improved water supply system?

___ No.

___ Yes, because:

___ The water quality is poor.

___ The water source is too far.

___ Villagers must climb/descend to get to the water source.

___ The capacity of the water source is not sufficient.

___ The villagers are aware that the water source is polluted and have required an improved water system for their health.

A.11. If the water supply to be installed, the communities:

	Yes	No
Are willing to contribute to the construction cost.	___	___
Are willing to contribute to the operation and maintenance costs.	___	___

A.12. Suggested water supply system to improve the existing system.

Note.

- In making suggestions the opinions of the community and its leader should be taken into account.

- A suggested system is determined on the field.

- The water supply system is divided into four groups. Group I is considered to be more economical, practical and simple, in other words, Group I is of a higher priority than Groups II, III and IV, and Group II is higher priority than Groups III and IV, and so on.

- Choose the best alternative for every cluster of the village according to their priority ranking.

- The suggested system should be discussed with the Health Center Officer and the Kabupaten Public Works.

A.12.1. The suggested water supply system for this village is.

		Number of projects	Population served
Group I.	Gravitational Piped system.		
	___ Spring protection. The capacity of the spring must be at least 1 liter/second per 1,000 people, a good water quality, and an elevation higher than the community.	____	______
Group III.	Piped system with pump.		
	___ Spring protection. The capacity of the spring must be at least 1 liter/second per 700 people, a good water quality, and an elevation lower than the community.	____	______
	___ Artesian wells. Where artesian wells exist.	____	______
	___ Surface water treatment. There is a river or an irrigation canal which never dries.	____	______

		Number of projects	Pop. served
Group II.	Source protection without piped system.		
	___ Spring protection. There is a spring close to the community.	___	___
	___ Free-flowwing well. There is at least one free-flowing well in use in this area and it is possible to build some artesian wells. One well is designed for 400 to 500 people.	___	___
	___ Wells with shallow handpumps. The ground water table is not more than 7 meters below ground level, a good water quality, and one well for every 100 people.	___	___
	___ Wells with deep handpumps. The ground water table is more than 7 meters below ground level, but not more than 15 meters all year round, a good water quality, and one well for every 100 people.	___	___
Group IV.			
	___ Rain water collection. The only water source available in this area and presently the community is using it. One collection basin for every 100 people.	___	___
	Total	___	___ *

* Total designed population from Groups I, II, III and IV.

A.12.2. Summary of Population.

- Population to be served with safe water. ________
- Population can not be designed because a more detailed survey is required. ________
- Population does not need water because it has a protected system. ________

Total __________

A.13. Do the villagers use household latrines?

___ Estimate the percentage of houses using individual latrines (with or without water seals). ________

___ Number of houses in the village. ________

___ Number of houses using latrines. ________

___ Number of people using latrines (baesd on average number of resident per family). ________

___ Number of people not using household latrines. ________

Name of Surveyor: ________________________

Date of survey : ________________________

APPENDIX B

QUESTIONNAIRE B

VILLAGE WATER SUPPLY AND SANITATION PROJECTS
DATA COLLECTION FOR PLANNING
TABULATION AT KECAMATAN LEVEL

Note: Write the names of villages in the same order.

B. 1. Province ____________________

Kabupaten ____________________

Kecamatan ____________________

B. 2. Number of villages in Kecamatan __________

Number of families in Kecamatan __________

Number of people in Kecamatan __________

TABLE B. 2.

NUMBER OF FAMILIES AND PEOPLE IN EACH SURVEYED VILLAGE

Village	Number of Families	Number of People
Total		

TABLE B. 3.1.
(Summary of A. 3.1.)

CHECK THE APPROPRIATE BLANK

Village	Unprotected										Protected									
	Water sources			Systems		Pipes				Population Using	Water sources				Systems		Pipes			Population Using
	Springs	Rivers	Others	Gravity	Pumps	G.I.	P.V.C.	Asbestos	Bamboo		Springs	Artesion Wells	River water treatment	Others	Gravity	Pumps	G.I.	P.V.C.	Asbestos	
Total																				

TABLE B. 3.2.
(From A. 3.2.)

FILL IN THE NUMBER IN THE APPROPRIATE BLANK

Village	Unprotected Systems						Protected Systems				
	Number of Sources					Population Using	Number of Sources				Population Using
	Wells	Springs	Rivers/Ir-rigation canals	Lakes	Rainwater collections		Wells with handpumps	Spring pro-tections	Free-flow-ing wells	Rainwater collections	
Total											

TABLE B. 3.3.
(From A. 3.3.)

FILL IN THE NUMBER IN THE APPROPRIATE BLANK

Village	Summary of Population					
	Unprotected			Protected		
	Population using piped systems	Population using other systems	Total population using all of the systems	Population using piped systems	Population using other systems	Total population using all of the systems
Total						

TABLE B. 4.
(From A. 4.)

CHECK THE APPROPRIATE BLANK

Villages	Water Sources which are running dry					
	Dry			Not Dry		
	Wells	Springs	Rivers/Irrigation canal	Wells	Springs	Rivers/Irrigation canal
Total						

TABLE B. 5.
(Form A. 5.)

CHECK THE APPROPRIATE BLANK

Village	Water Quality														
	Ground water					Springs					Rivers/Surface water				
	Clear	Salty	Contains Fe	Hard	Turbid	Clear	Salty	Contains Fe	Hard	Turbid	Clear	Salty	Contains Fe	Hard	Turbid
Total															

CHECK THE APPROPRIATE BLANK

TABLE B. 6. (From A. 6.) B. 7. (From A. 7.)

Village	Distances			Climbing/Descending		
	Less than 200 meters	Between 200 and 100 meters	More than 1,000 meters	None	Less than 150 meters	More than 150 meters
Total						

CHECK THE APPROPRIATE BLANK

TABLE B. 8 (From Health Center or Kabupaten Health Service) B. 9 (From A.8.)

Village	Waterborne disease incidence					Ground water		
	Cholera	Gastro-enteric disease	Typhoid	Trachoma	Skin disease	Less than 7 meters	Between 7 and 15 meters	More than 15 meter
Total								

CHECK THE APPROPRIATE BLANK

TABLE B. 10. (From A. 9.) B. 11. (From A. 10) B. 12. (From A. 11.)

Village	Geographical conditions			Community needs					Funds provided by the communities	
	Mountainous	Rocky	Flat	No	Yes-Due to poor water quality	Yes-Due to difficulty in getting water	Yes-Due to climbing/ descending	Yes-Due to Health Problems	Yes-Construction costs	Yes-Maintenance costs
Total										

FILL IN THE APPROPRIATE BLANK OF EACH VILLAGE ACCORDING
TO ITS PROBLEMS, (a), (b), (c) AND (d)

TABLE B. 13. (From B. 4.) (From B. 5.) (From B.6.; B.7.) (From B. 8.)

Village	(a) Classification Ground water running dry	(b) Classification Water quality is poor, salty, hard or turbid	(c) Classification Difficulty in getting water; the source is more than 1,000 m or climbing/descending more than 150m	(d) Classification One or more diseases present
Total				

TABLE B. 14
(From B. 13. and A. 12. 1.)

SUGGESTIONS FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS OF VILLAGE CLASSIFICATION

Viallage Classification	Village	Suggestions for improvement of water supply systems																		Total Population Served	Total Population Unserved
		Wells with handpumps				Spring protections		Free-flowing wells		Rain water collections		Piped systems									
		Shallow pumps		Deep pumps								Springs		Artesion wells		River water treatment					
		No	Pop	No	Pop	No	Pop	No	Pop	No	Pop	No	Pop	No	Pop	No	Pop				
Total																					

Note: No = Number os systems
Pop = Population using the systems

TABLE B. 15.
(From A. 12. 2.)

SUMMARY OF B. 2. THROUGH B. 14.

Village	Number of designed population	Number of uncovered population	Population using unprotected systems	Population using protected systems	Total population in villages
Total					

TABLE B. 16
(From A. 13)

FAMILIES AND PEOPLE USING HOUSEHOLD LATRINES

Village	Number of families using latrines	Nunber of people latrines
Total		

APPENDIX C

QUESTIONNAIRE C

VILLAGE WATER SUPPLY AND SANITATION PROJECTS
DATA COLLECTION FOR PLANNING
TABULATION AT KABUPATEN LEVEL

(Note: Write down all names of Kecamatans in the same order).

C.1. Province :___________________________

Kabupaten :___________________________

C.2. At Kabupaten Level

Surveyed Kecamatans	Number of villages	Population

C.3. Piped systems

	Protected	Unprotected
C.3.1. Population using piped systems		
Villages using piped systems		
Breakdown:		
Villages using sources:		
Springs		
Artesian wells		
Others		

		Protected	Unprotected
	Villages using systems:		
	Gravity	________	________
	Pumping	________	________
	Villages using pipes:		
	G.I.	________	________
	PVC	________	________
	Asbestos	________	________
	Bamboo	________	________
C.3.2.	Other systems		
	Population using unprotected sources		________
	Number of wells		________
	Number of springs		________
	Number of rivers		________
	Number of collection basins		________
	Population using protected sources		
	Number of wells with handpumps	________	
	Number of protected springs	________	
	Number of free-flowing wells	________	
	Number of rain water collection basins	________	
C.3.3.	All systems		
	Population using piped systems	________	________
	Population using other systems	________	________

	Protected	Unprotected
Total populations using all systems	________	________
Percentage of population using all systems (from total populations surveyed).	______	______

C.4. Number of villages whose sources dry

Wells ______

Springs ______

Rivers ______

C.5. Number of villages with clear ground water ______

Number of villages with poor ground water (salty, contains iron, hard or turbid) ______

C.6. Number of villages having distances from the sources:

Less than 200 meters ______

Between 200 t0 1,000 meters ______

More than 1,000 meters ______

C.7. Number of villages to get water have to climb/descend:

No ______

Up to 150 meters ______

More than 150 meters ______

C.8. Number of villages where waterborne diseases present:

* Five diseases present ______

* Four diseases present ______

* Three disease present ______
* Two diseases present ______
* One disease present ______
* Cholera is present ______

C. 9. Number of villages having ground water table:

* Less than 7 meters ______
* Between t to 15 meters ______
* More than 15 meters ______

C.10. Number of villages with topographical conditions:

* Mountainous ______
* Rocky ______
* Flat ______

C.11. Number of villages do not need improved water supply systems. __________

Number of villages needing water due to difficulty in obtaining water, the existing source is not sufficient, does not meet the minimum standard, need improved water for basic health care. __________

Based on 4 reasons ______

Based on 3 reasons ______

Based on 2 reasons ______

Based on 1 reason ______

C.12. Villages willing to contribute funds

For construction and operation costs _______

For construction only _______

For operation only ______

C.13. Villages are classified as below:

a. Having source but dry during the dry season.

b. Poor quality (salty, contains iron, hard or turbid).

c. Difficult to get water (villagers have to travel 1,000 meters or more or to climb/descend 150 meters or more).

d. There are waterborne diseases (Cholera, Gastroenteric, typhoid, trachoma and skin diseases).

TABLE C.13.1

VILLAGE CLASSIFICATION ASSOCIATED TO THE NEED OF SAFE WATER

Classification	Number of villages	Number of people
a b c d		
a b c		
a b d		
a c d		
b c d		
a b		
a c		
a d		
b c		
b d		
c d		
a		
b		
c		
d		

Number of villages belong to one class, included combination with other classes:

a. ______
b. ______
c. ______
d. ______

TABLE C.14

SUGGESTIONS TO IMPROVE WATER SUPPLY SYSTEMS

Names of Kecamatans	Number of Systems								Designed Population
						Piped Systems			
	Shallow Handpumps	Deep Handpumps	Spring Protection	Free-Flowing Artesian Wells	Rain Water Collection	Springs	Artesian Wells	Rivers/Surface Water Treatments	
Total									

C.15. Number of families ________

Number of families using household latrines ________

Number of people using household latrines ________

Number of people in the Kabupaten ________

Percentage of people using household latrines ________

C.16. - Number of manpower at the Kabupaten Health Service.

Education	Numbers	Sanitation Staffs
Health Controller	______	______
Sanitarian	______	______
Assistant Sanitarian	______	______

- Number of manpower at the Kabupaten Public Works.

Engineer	________
Bachelor Engineer	________
Senior Technical School	________
Junior Technical School	________

- Manpower at the Kabupaten Offices or other Department who can be involved in implementing the rural water supply program at Kabupaten Offices.

Name of the Department	Educational Background of Employees	Number of Employees
____________	____________	________
____________	____________	________
____________	____________	________
____________	____________	________
____________	____________	________
____________	____________	________

APPENDIX D

QUESTIONNAIRE - PART I

RURAL WATER SUPPLY AND SANITATION
DATA SHEET

Note 1. To be completed by the SANITATION DIVISION of the Kabupaten/Kecamatan.

2. The survey data should be shown in this completed Questionnaire <u>and</u> a Drawing prepared to Guid 4.

3. All survey data (Questionnaire and Drawing) should be sent as follows:

- three (3) copies of the Questionnaires and one original drawing to the Provincial Healt Office.

- one (1) copy of the Questionnaire and one drawing (copy) kept at the Kabupaten Health Office.

1. AREA LOCATION

1. 1. Area in which the community has been surveyed, data collected and the drawing prepared.

Province ____________________

Kabupaten ____________________

Kecamatan ____________________

1. 2. Desas that have been surveyed.

Name of Desa	Total Population	Population Surveyed
____________	__________	__________
____________	__________	__________
____________	__________	__________

1\. 3. Institutions and Public Places in the survey area.

___ Hospital with ______ beds

___ Healt Center with ______ beds

___ Polyclinic

___ MCH Center

___ Number of Markets _____

___ Number of religious places _____

___ Others - give details: ________________________

____

1\. 4. Distances from Survey Area:

	Distances	Road Conditions
to Kecamatan Town	_________	_________
to Kabupaten Town	_________	_________

2\. EXISTING CONDITIONS

2\. 1. Diseases in the survey area associated with use of unsafe water.

Disease	Year ______ Incidence	Fatality	Year ____ Inc.	Fat.	Year ____ Inc.	Fat.
_______						
_______						
_______						

2\. 2. Sources of water now used by the community in survey area.

2\. 2. 1. Without piped system:

Unprotected sources		Water condition Clear	Turbid	Salty	Odor
Dug well	No. of sources	___	___	___	___
	Pop. using	___	___	___	___

Unprotected sources		Water condition: Clear	Turbid	Salty	Odor
Spring at sources					
	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
Spring river					
	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
River	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
Canal	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
Pond	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
______	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
Protected sources					
Well with handpump					
	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
Protected spring					
	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
Deep artesian well					
	No. of sources	____	____	____	____
	Pop. using	____	____	____	____
____________________					
	No. of sources	____	____	____	____
	Pop. Using	____	____	____	____

2. 2. 2. With piped systems

Source	Pop. using	Water condition: Clear	Turbid	Salty	Odor
__________	__________	____	____	____	____

Details of systems:

	Description	Structure Good	Structure Broken
Source: Type	________________	___	___
Capacity	________________		
Reservoir: Capacity	__________ cu.m	___	___
Reservoir stand: Height	_______ m	___	___
Pump house: Size	_____________	___	___
Pumps: Diesel	________________ ea	___	___
Electric	______________ ea	___	___
Filter bed: area	_____________ sq.m	___	___
Pipes G.I.: Total length	______ m	___	___
AC. : Total length	______ m	___	___
Bamboo: Tot. "	______ m	___	___
Public reservoir No.	__________	___	___
Capacity	_____ cu.m		
Public taps No.	__________	___	___

2. 3. How far away are the present sources of water.

___ The sources are in the community area.

___ The sources are about _____ km. from the community area.

2. 4. Existing method of excreta disposal.

	Number Existing	Number used	Pop. using
Water seal bowl with septic tank	_____	_____	_____
Water seal bowl with pit	_____	_____	_____
Open hole pit latrine	_____	_____	_____
Latrine overhanging ponds and rivers	_____	_____	_____
Other methods: __________	_____	_____	_____

3. FIELD INVESTIGATION

3. 1. Sources of water which have been measured for yield.

	Location Desa	Yield L/sec	How measured
____ Spring, at source	________	___	________
____ Spring river	________	___	________
____ River	________	___	________

____ Existing deep artesian well with positive head

Location Desa ____________

Diameter ____________ m

Depth ____________ m

Positive head above ground level ________ m

Discharge ________ L/sec

____ Existing well artesian negative

shallow well

Location Desa ______________________

Diameter ________ m

Depth from ground level to well bottom ________ m

Depth from ground level to water level in dry season ________ m

Depth from ground level to water level in rainy season ________ m

Dates of pumping	Pumping hours	Pump discharge L/sec	Depth from ground to static water when pumping
____	____	____	____
____	____	____	____
____	____	____	____

___ There is no suitable sources to measure the yield.

___ The rainfall in the area is

Month	Average monthly rainfall(mm)	
_____	Figures for Kecamatan	For Kabupaten
_____	_____	_____
_____	_____	_____

3. 2. What is the depth of ground water from ground level.

___ in dry season _________m

___ in rainy season _______m

3. 3. What is the Electric Power Supply available in survey area:

___ No supply

___ A supply of __________Volts.

___ Countinously
___ from ____ hrs. to ___ hrs.

___ The supply is

___ by P.L.N. (Government Electric Company).
___ by Local Generator.

4. STAFF & COMMUNITY ORGANIZATION

4. 1. What is the existing sanitation staff.

	Names		
	Health Controller	Sanitarian	Assistant Sanitarian
Full time			
-At the Desa	__________	__________	__________
-At the Kecamatan	__________	__________	__________
-At the Kabupaten	__________	__________	__________

	Health Con-troller	Names Sanitarian	Assistant Sanitarian
Part time			
-At the Desa	____	____	____
-At the Kecamatan	____	____	____
-At the Kabupaten	____	____	____

4. 2. What this the number of existing staff at the Kabupaten Public Works.

Engineer ____

Bachelor ____

Technician (High School) ____

Technician (Junior School) ____

4. 3. Give names of Kabupaten Public Works or other officials who will assist the Projects.

	Name	Title
Survey	____	____
	____	____
Preliminary Design	____	____
	____	____
Detailed Design for construct-ion	____	____
Construction	____	____
Operation & Maintenance	____	____

4. 4. Is there an active community organization in the area.

____ Yes. Give a list of some works done by the organization during the past six months:

____

____

____ No.

4. 5. Give the name of a member of the community (not an official) who could be trained to operate and maintain the water supply systems.

Name	Adress
______________	______________

4. 6. Give the names of officers doing the following work.

Item	Dates work done	Names and Title of officers Doing the work	Assisting
Data collection	______	______	______
	______	______	______
Filling out questionnaire	______	______	______
	______	______	______
Preparing the drawing	______	______	______
	______	______	______

4. 7. Attach a letter signed by Desa Chief:

-requesting a Project.

-agreeing to assist in construction, operation and maintenance.

Date ______________

____

Name, Title and Signature of Responsible Officer.

APPENDIX E

23 COMPLETED QUESTIONNAIRES

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	20
2.	Difficulty in Obtaining Water	20
3.	Technological Alternatives	0
4.	Population	20
5.	Village Contributions	20
6.	Village Potential	10
7.	Public Places	5
8.	Excreta Disposals	0
9.	Road Conditions	5
10.	Power Supply	0
	Total	100

Date Jan. 15/77

Name Jorge Arboleda

Title Manager Hidrosan Lta

Consulting Engeneer

Bogota, Colombia.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Wàterborne Diseases	0
2.	Difficulty in Obtaining Water	20
3.	Technological Alternatives	20
4.	Population	20
5.	Village Contributions	38
6.	Village Potential	0
7.	Public Places	2
8.	Excreta Disposals	0
9.	Road Conditions	0
10.	Power Supply	0
	Total	100

Date Feb. 21-77

Name Dr. R.C.Ballance

Title Sanitery Engineer, Community
Water Supply and Sanitation,
Division of Environmental Health
WHO, Geneve, Switzwrland.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	15
2.	Difficulty in Obtaining Water	10
3.	Technological Alternatives	15
4.	Population	5
5.	Village Contributions	25
6.	Village Potential	15
7.	Public Places	0
8.	Excreta Disposals	5
9.	Road Conditions	5
10.	Power Supply	5
	Total	100

Date 3 Nov. 1976

Name Dr. Carl Bartone

Title Systems Analyst

CEPIS - PAHO/WHO,

Lima, PERU

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	20
2.	Difficulty in Obtaining Water	20
3.	Technological Alternatives	10
4.	Population	5
5.	Village Contributions	15
6.	Village Potential	3
7.	Public Places	10
8.	Excreta Disposals	10
9.	Road Conditions	5
10.	Power Supply	2
	Total	100

Date 26 Oct. 1976

Name Martin G. Beyer

Title Adviser, Drinking Water

Programmes UNICEF United Nation

New York, USA.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	0
2.	Difficulty in Obtaining Water	15
3.	Technological Alternatives	20
4.	Population	5
5.	Village Contributions	20
6.	Village Potential	15
7.	Public Places	0
8.	Excreta Disposals	5
9.	Road Conditions	10
10.	Power Supply	10
	Total	100

Date

Name David Donaldson

Title Sanitary Engineer PAHO/WHO

Washington, USA.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	30
2.	Difficulty in Obtaining Water	20
3.	Technological Alternatives	10
4.	Population	10
5.	Village Contributions	5
6.	Village Potential	4
7.	Public Places	5
8.	Excreta Disposals	10
9.	Road Conditions	3
10.	Power Supply	3
	Total	100

Date Februari, 28 1977

Name Mr. Soebeno Hadiwidjojo

Title Chief, Dringking Water Sub-Directorate
Hygiene & Sanitation, Directorate General of Communicable Diseases, Ministry of Health, Jakarta, INDONESIA.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	15
2.	Difficulty in Obtaining Water	18
3.	Technological Alternatives	12
4.	Population	10
5.	Village Contributions	20
6.	Village Potential	8
7.	Public Places	3
8.	Excreta Disposals	4
9.	Road Conditions	3
10.	Power Supply	7
	Total	100

Date November 9, 1976

Name Prof. Ir. L. Huisman

Title Professor of Sanitary Engineering

University of Technology Delft

The Netherlands.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	5
2.	Difficulty in Obtaining Water	10
3.	Technological Alternatives	15
4.	Population	20
5.	Village Contributions	10
6.	Village Potential	10
7.	Public Places	20
8.	Excreta Disposals	3
9.	Road Conditions	2
10.	Power Supply	5
	Total	100

Date 22 Jan 1977

Name Prof. Dr. J.F. Malina

Title Professor of Civil Engineering

The University of Texas at Austin

Texas, USA.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	35
2.	Difficulty in Obtaining Water	15
3.	Technological Alternatives	5
4.	Population	5
5.	Village Contributions	10
6.	Village Potential	10
7.	Public Places	10
8.	Excreta Disposals	5
9.	Road Conditions	0
10.	Power Supply	5
	Total	100

Date 30 - 10 - 76

Name W. T. Mills

Title United Nations

New York, USA.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	10
2.	Difficulty in Obtaining Water	11
3.	Technological Alternatives	13
4.	Population	15
5.	Village Contributions	19
6.	Village Potential	9
7.	Public Places	6
8.	Excreta Disposals	4
9.	Road Conditions	4
10.	Power Supply	9
	Total	100

Date 8th November, 1976

Name Dr. Nguyen Cong Thanh

Title Associate Professor & Acting Chairman,
Asian Institute of Technology,
Bangkok, Thailand.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	8
2.	Difficulty in Obtaining Water	15
3.	Technological Alternatives	12
4.	Population	16
5.	Village Contributions	14
6.	Village Potential	8
7.	Public Places	7
8.	Excreta Disposals	10
9.	Road Conditions	5
10.	Power Supply	5
	Total	100

Date 11/10/76

Name Dr. M.Piot

Title UNICEF, United Nations

New York, USA

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	20
2.	Difficulty in Obtaining Water	25
3.	Technological Alternatives	10
4.	Population	10
5.	Village Contributions	8
6.	Village Potential	8
7.	Public Places	10
8.	Excreta Disposals	4
9.	Road Conditions	2
10.	Power Supply	3
	Total	100

Date 10 January 1977

Name Uton Muchtar Rafei M.D. M.P.H.

Title Chief of Health Officer in
West-Java Province
Indonesia.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	15
2.	Difficulty in Obtaining Water	15
3.	Technological Alternatives	10
4.	Population	15
5.	Village Contributions	10
6.	Village Potential	10
7.	Public Places	10
8.	Excreta Disposals	5
9.	Road Conditions	5
10.	Power Supply	10
	Total	100

Date 15 December 1976

Name Dr. W.L.Reyes

Title WHO Sanitary Engineer,
WHO Regional Office for South East Asia,
New Delhi, India.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	16
2.	Difficulty in Obtaining Water	13
3.	Technological Alternatives	8
4.	Population	11
5.	Village Contributions	14
6.	Village Potential	10
7.	Public Places	9
8.	Excreta Disposals	12
9.	Road Conditions	4
10.	Power Supply	3
	Total	100

Date 6 November 1976

Name H. Sanchez

Title WHO Engineer in Jakarta
Indonesia.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	13
2.	Difficulty in Obtaining Water	12
3.	Technological Alternatives	15
4.	Population	13
5.	Village Contributions	15
6.	Village Potential	12
7.	Public Places	5
8.	Excreta Disposals	5
9.	Road Conditions	5
10.	Power Supply	5
	Total	100

Date January 10, 1977

Name Dr.Ir. Soepangat Soemarto

Title Rector Secretary of Student Affairs and Ex Chairman of the Department of Sanitary Engineering, Bandung Institute of Technology, Indonesia.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	17
2.	Difficulty in Obtaining Water	17
3.	Technological Alternatives	10
4.	Population	10
5.	Village Contributions	10
6.	Village Potential	10
7.	Public Places	13
8.	Excreta Disposals	5
9.	Road Conditions	5
10.	Power Supply	3
	Total	100

Date 6 January 1977

Name Mrs. Sri Soewasti Soesanto (C.E., MPH)

Title Chief Division of Physical Environment
Health Ecology Research Centre
National Institu-e of Health Research &
Development, Ministry of Health
Jakarta, Indonesia.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	10
2.	Difficulty in Obtaining Water	15
3.	Technological Alternatives	25
4.	Population	15
5.	Village Contributions	15
6.	Village Potential	10
7.	Public Places	5
8.	Excreta Disposals	0
9.	Road Conditions	0
10.	Power Supply	5
	Total	100

Date Nov, 13, 1976

Name Dr. C.D.Spangler

Title Consulting Sanitary Engineer
International Bank for Reconstruction
and Development, Washington, USA

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	15
2.	Difficulty in Obtaining Water	20
3.	Technological Alternatives	25
4.	Population	5
5.	Village Contributions	20
6.	Village Potential	0
7.	Public Places	10
8.	Excreta Disposals	5
9.	Road Conditions	0
10.	Power Supply	0
	Total	100

Date January 25, 1977

Name Dr. Eng. Albert P. Talboys

Title Project Manager, UNDP/PAHO
Training Project Trinidad.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	25
2.	Difficulty in Obtaining Water	10
3.	Technological Alternatives	10
4.	Population	15
5.	Village Contributions	10
6.	Village Potential	4
7.	Public Places	10
8.	Excreta Disposals	10
9.	Road Conditions	1
10.	Power Supply	5
	Total	100

Date Oct. 26, 1976

Name Dr. H.J. Thung

Title District Engineer

Water Quality Services

Oklahoma State Health Dept.

Oklahoma, USA

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	20
2.	Difficulty in Obtaining Water	5
3.	Technological Alternatives	10
4.	Population	10
5.	Village Contributions	25
6.	Village Potential	10
7.	Public Places	5
8.	Excreta Disposals	5
9.	Road Conditions	5
10.	Power Supply	5
	Total	100

Date 28th February 1977

Name Ir. T.K. Tjiook

Title International Reference Centre

P.O. Box 140 Leidschendam,

The Netherland

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	4
2.	Difficulty in Obtaining Water	5
3.	Technological Alternatives	30
4.	Population	10
5.	Village Contributions	15
6.	Village Potential	25
7.	Public Places	5
8.	Excreta Disposals	1
9.	Road Conditions	0
10.	Power Supply	5
	Total	100

Date 28th February 1977

Name Dr. J.M.G. Van Damme

Title Manager WHO international Reference Center
for Community Water Supply, The Hague,
The Netherlands.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	4
2.	Difficulty in Obtaining Water	5
3.	Technological Alternatives	30
4.	Population	10
5.	Village Contributions	15
6.	Village Potential	25
7.	Public Places	5
8.	Excreta Disposals	1
9.	Road Conditions	0
10.	Power Supply	5
	Total	100

Date 10 November 1976

Name Dr. Fabian Yanez

Title Adviser in Wastewater Treatment

CEPIS - PAHO/WHO, Lima

Peru.

QUESTIONNAIRE FOR DETERMINING PARAMETER WEIGHTS

No.	Parameter	Weight
1.	Waterborne Diseases	10
2.	Difficulty in Obtaining Water	15
3.	Technological Alternatives	25
4.	Population	10
5.	Village Contributions	7
6.	Village Potential	6
7.	Public Places	3
8.	Excreta Disposals	10
9.	Road Conditions	7
10.	Power Supply	7
	Total	100

Date 3 - 18 - 1977

Name S. Yunis

Title United Nations Expert
Economic Commission for
Western Asia, Amman,
Jordan.

APPENDIX F

THE WATER AND WASTEWATER TREATMENT PLANNING MODEL DATA SHEET

I. <u>General Information</u>

1. Location of Community

City Name______________________________

State or Province___________________

Country________________________________

2. Planning Group or Agency_______________________________

II. <u>Demographic</u> - The model requires some basic population data for the purpose of capacity planning. Two inputs are required. If local or site data is not available please use national estimate and also indicate whether it is national or local source.

Answer either A or B.

A. 1. Present population - The figure or estimate of present population should reflect the number of inhabitants that the proposed water or wastewater treatment facility is going to serve.

Actual population_______________or estimate the following:

_____ (1) Between 500 and 2,500 people

_____ (2) 2,500 - 15,000

_____ (3) 15,000 - 50,000

_____ (4) 50,000 - 100,000

_____ (5) Source_________________

2. Annual growth rate_______or estimate in the following:

_____ (1) Less than 1%

_____ (2) 1%-1.5%

_____ (3) 1.5%-2.0%

_____ (4) 2.0%-2.5%

_____ (5) 2.5%-3.0%

_____ (6) 3.0%-3.5%

_____ (7) 3.5%-4.0%

_____ (8) Greater than 4%

(9) Source_________________

B. Population estimate at last census_________________

Date of Census__________Source of Census___________

Annual Growth rate at time of last census or present

annual growth rate_________________________________

III. Socio-Economic Data - The purpose of this section is to gather enough information about the community so that it can be classified into one of the four levels of development. The approach has been to request information that is generally available and can be obtained on a local level. Please include any other information you feel is relevant.

CHECK THE MOST APPROPRIATE CATEGORY FOR THE FOLLOWING QUESTIONS

1. Average level of education obtained by inhabitants living in the community.

	Level	None	Primary	High School	Technical Institute	College
_____	(1)	95%	4%	1%	0%	0%
_____	(2)	70%	19%	7%	3%	1%
_____	(3)	55%	22%	14%	6%	3%
_____	(4)	9%	34%	42%	8%	7%
_____	(5)	Other				

2. Average distribution of labor force in the community.

	Level	Unskilled	Semi-Skilled	Professional
____	(1)	97%	2%	1%
____	(2)	80%	16%	4%
____	(3)	61%	27%	12%
____	(4)	45%	30%	25%

3. Annual average income per family in your country's currency.

________________________ ________________________

amount unit

If available, also check the approximate U.S. dollars equivalency of this amount shown in the following.

____ (1) Less than \$100

____ (2) \$100 - \$500

____ (3) \$500 - \$1,000

____ (4) \$1,000 - \$3,000

____ (5) Greater than \$3,000

4. Among the highly skilled and technical workers (for example, engineer, chemist, and so on) what percentage of these is non-local or non-native people.

____ (1) Less than 10%

____ (2) 10%-25%

____ (3) 25%-50%

____ (4) 50%-75%

____ (5) 75%-100%

5. Are there any primary and secondary schools operated by voluntary or missionary organizations rather than the government itself?

____________ (1) Yes ____________ (2) No

6. What is the highest grade offered by local schools on a regular basis? (Circle one)

1 2 3 4 5 6 7 8 9 10 11

12 12+

7. If the number selected in #6 above is less than 12, how far away is the nearest high school offering the 12th grade?

____ (1) Less than 10 miles (or less than 16 kilometers)

____ (2) 10-30 miles (or 16 to 48 kilometers)

____ (3) 30-50 miles (or 48 to 80 kilometers)

____ (4) Greater than 50 miles. (Greater than 80 kilometers).

____ (5) Other (specify)______________________________

8. Are there any technical or vocational schools in the community?

____ (1) Yes ____ (2) No

9. Has the community achieved compulsory primary education of at least six years?

____ (1) Yes ____ (2) No

10. Are there any formal in-service training programs by the government or local industry for their employees?

____ (1) Yes ____ (2) No

11. Is there a college or university in the local community?

____ (1) Yes ____ (2) No

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

____ (1) Yea ____ (2) No

13. How do you rate the ability of the community to finance a water and sewage treatment project?

____ (i) Unable to repay; the project is a gift because the beneficiaries are poor.

_____ (2) Limited ability to repay; however, the benefits exceed the costs.

_____ (3) Repayment prospects are good; the beneficiaries have relatively high incomes.

14. Is unemployment widespread?

_____ (1) Yes _____ (2) No

15. Are advisory services available to farmers for community development or for other pgrograms designed to upgrade the skills and enlist the participation of the inhabitants?

_____ (1) Yes _____ (2) No

16. Do most college or university students of the community receive their education in neighboring communities, neighboring countries, or other foreign countries?

_____ (1) Yes _____ (2) No

17. The level of technology available can generally be classified as

_____ (1) Hand tools only

_____ (2) Mechanical tools (i.e., gasoline powered equipment)

_____ (3) Chemical products (fertilizers, chlorine)

_____ (4) Electronic technology

18. Does the government dominate the labor market?

_____ (1) Yes _____ (2) No

19. Are public employment services readily available?

_____ (1) Yes _____ (2) No

Questions 20-23 relate to the availability of materials and equipment. Check those items that are <u>never</u> available in the community.

20. Operation equipment. Which of the following are never available in the local community?

_____ (1) Water meters

_____ (2) Soldering equipment

_____ (3) Acetylene torches

_____ (4) Recording devices - such as thermostats

_____ (5) Laboratory equipment i.e. test tubes

_____ (6) Portable power plant i.e. gasoline powered electric generators

_____ (7) Motors i.e. 1-3 horsepower electric motors

_____ (8) Water pumps

21. Process materials. Which of the following are never available in the local community?

_____ (1) Pipe (clay, steel, cement, plastic, copper, and so on)

_____ (2) Pipe fittings

_____ (3) Paint

_____ (4) Valves

_____ (5) Tanks

_____ (6) Vacuum gauges

_____ (7) Heat exchangers

22. Operation and Maintenance supplies: Which of the following are never available in the local community?

_____ (1) Silica sand

_____ (2) Graded gravel

_____ (3) Clean water

_____ (4) Gasoline

23. Chemical supplies: Which of the following are never available in the local community?

_____ (1) $Al_2(SO_4)_3$ (aluminum sulfate)

_____ (2) $FeCl_3$ (ferric chloride)

_____ (3) Activated charcoal

____ (4) CaO (lime)

____ (5) Na_2CO_3 (Soda ash)

____ (6) Cl_2 (Chlorine)

____ (7) O_3 (Ozone)

____ (8) Laboratory chemicals

24. Major Water Source (check appropriate category)

____ (1) River or stream

____ (2) Lake or impoundment

____ (3) Wells

____ (4) Spring

____ (5) Rain water

____ (6) Sea or brackish

25. Approximate per capita water demand (daily)

(1) Current demands__________in__________(units)

(2) 10 year projection:__________________________

26. Is ground water available?

____ (1) Yes ____ (2) No

27. Are wells already drilled? Current Capacity?____mgd

____ (1) Yes ____ (2) No

28. Is a central wastewater collection system in existance?

____ (1) Yes ____ (2) No

29. Is the following wastewater data available? Please fill in the percentage of people in the community that are:

(1) Currently connected to the system_________%

(2) To be connected within 5 years of the start of the project____________________%

(3) To be connected within 10 years____________%

30. Are industrial and commercial concerns using the wastewater system and if so, in what quantity (in thousands of gallons)?

(1) Currently________________

(2) Within 5 years___________

(3) Within 10 years__________

IV. A. Raw Water Quality - The purpose of this section is to provide as input to the model the results of tests that have been carried out on the input or raw water. Presently, the results of seven tests are rquested; however, only two are required, turbidity and coliform.

(1) *Number of coliforms____________(MPN/100 ml)

(2) *Turbidity______________________(mg/l or JTU)

(3) BOD_____________________________(mg/l)

(4) pH______________________________(0 to 14)

(5) Dissolved oxygen________________(mg/l)

(6) Temperature_____________________(^{o}C)

(7) Chlorine________________________(mg/l)

B. WasteWater Quality:

(1) *Hardness_______________________(mg/l)

(2) *Total dissolved solid__________(mg/l)

(3) *Dilution_______________________(CFS/1000 PE)

(4) *Fe and Mn______________________(mg/l)

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*Data needed for the predictive model.