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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

POLICY REVIEW COMMITTEE

PRC/s/M/75-1

January 14, 1975

VILLAGE WATER SUPPLY

STAFF REVIEW

Attached please find the paper "Village Water Supply" prepared by the Public Utilities Department. A staff review will be held on Wednesday, January 29, 1975 at 4:00 p.m., in Conference Room D-556. Please inform this office if you cannot attend.

Frank Vibert
Secretary
Policy Review Committee

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VILLAGE WATER SUPPLY

Public Utilities Department

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I. Introduction

i. Probably over 1,000 million people living in rural areas do not have an adequate water supply, and waterborne or water-related diseases are among the top three causes of sickness and death. The rate of providing new water systems to these people is too slow to keep pace with population growth. Even when new systems are provided, they are often not operated or maintained properly and break down soon after installation.

ii. Governments of developing countries are becoming increasingly concerned with improving living conditions in rural areas. Accordingly, the Bank is shifting the emphasis of its lending program to have greater impact on the rural population, whether through projects in agriculture, integrated rural development or rural infrastructure. In the opinion of many health experts, provision of a safe and convenient water supply is probably the most important single activity that could be undertaken to improve the health of people living in these areas.

iii. The purpose of the paper is to describe the particular characteristics and problems of village water supply and to suggest ways of improving the present situation. It also examines the implications for the Bank of expanding lending for village water supply, in particular on its policies, operations and staffing. Because many countries, and the Bank itself, have hitherto largely neglected the rural water supply sub-sector, this is an interim paper, to be revised in the light of further experience and better information.

II. Background

iv. There are no internationally accepted definitions of "urban" or "rural". The paper is concerned with communities with populations in the general range 300 to 10,000, and with water systems ranging from simple protected springs to surface water systems with piped distribution of treated water.

v. The principal sources for the paper, besides the experience of the Bank, its staff, and the Inter-American Development Bank (IDB), have been a survey of water supply and sewage disposal in developing countries in December 1970 carried out by WHO, and research projects carried out by the Bank's Public Utilities Department. Most of the statistical data obtained from the WHO Survey should be regarded only as indicative, due to unreliable data, lack of common definitions, and wide variations between countries.

vi. In 1970 only about 15% of the rural population in developing countries had reasonable access to safe water. In these areas over one billion people, nearly one third of the world population, had no proper water supply. In urban areas the situation in 1970 was far better: about 70% of their inhabitants, usually those in the upper income bracket, had access to a piped water supply. Even so, about 150 million people were not served (and in many areas, nominally served, the quality of service was extremely low).

vii. To improve this situation, the UN Development Decade (UNDD) goals for 1971-80 are to supply safe water to 100% of the urban population and to 25% of the rural population. 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%. In rural areas the increase would be 273 million -- from 140 million to 413 million, or by nearly 200%. These global figures disguise the scale of the problem, which is immense: one Bank project in India covers 65,000 square kilometers, with a population of 6.4 million in 16,000 villages. Providing water supply to 2,000 of these villages, to serve 0.8 million people, will involve constructing 1,000 new systems and developing 300 sub-projects, with as many as 175 villages in one sub-project. It should be noted that, even if the UNDD goals were achieved, there would still be more rural inhabitants without proper water supply in 1980 than there are today. 1/

viii. The investments required to meet the UNDD goals are estimated in the Survey to be in the order of $11 billion for urban supplies and $3 billion for rural (at 1970 prices). Bank experience suggests that these estimates may be low. However, the estimated costs of extending water service vary so widely -- $1 to $300 per capita, depending on the local conditions -- that no firm judgment can be made.

ix. The probability of achieving the UNDD goals differs greatly from country to country. In some, continuation of existing water development progress will probably be sufficient. In others, particularly the larger and poorer countries, expenditure on water supply would have to be expanded

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1/ For the 91 countries in the WHO Survey, in 1970 1,076 million rural inhabitants were without proper water supply out of a total of 1,259 million. By 1980, even with the UNDD targets reached, the corresponding figures are 1,134 million out of 1,547 million.

ten-fold or even a hundred-fold, and would require a quite disproportionate share of total future investment. In these countries the goals are almost certainly unattainable. In general, countries seem more likely to achieve the urban targets than the rural ones, since past investment has been concentrated heavily in the urban sub-sector, 1/ and reasonably competent institutions have been built up. In contrast, investment in rural water supply has been relatively low, and the success record is poor, with many systems breaking down soon after commissioning.

x. The common problems in rural water programs are principally institutional and financial. The most important are:

- lack of rural water policies, probably due to lack of government conviction that this is a priority area;
- numerous agencies with undefined or overlapping responsibilities;
- institutional weakness at all levels;
- lack of trained manpower at all levels;
- low village incomes;
- failure to collect adequate charges from water users, due either to lack of financial policies or to ineffective means for collection;
- lack of public health education, so the benefits of improved supplies are not appreciated;
- frequent system failures, due to poor operation and maintenance procedures or lack of spares; and
- considerable communication difficulties between widely dispersed rural systems and their support agencies.

1/ For example, 77% of total water supply investment in 1970 was urban, according to the WHO Survey.

III. Technical Aspects and Costs

xi. Various factors affect the type of village water system to be constructed -- level of service, water quality and quantity, and nature and location of sources. Each of these also has an effect on costs.

xii. The level of service provided may range from a simple protected spring or a well with a hand pump to a fairly elaborate distribution system serving most consumers through private house connections. Both capital and operating costs increase with the level of service, and increased complexity makes mechanical failure more likely. Nevertheless, since higher levels of service result in greater health benefits, they should be encouraged whenever villages want them and are able to pay for them.

xiii. Quality standards should be set to ensure that the water supply does not contain any chemical or biological constituents that could affect its safety or acceptability. A number of chemical characteristics and substances which affect the design of urban systems (e.g., hardness, chlorides, iron and manganese content) can be disregarded in village water system design unless they affect acceptability or could cause technical problems through corrosion or encrustation.

xiv. Water quantity requirements depend largely on the level of service provided. They also vary widely from country to country, depending on climatic and cultural factors. Daily consumptions reported in the WHO survey range from 3 to 340 liters/capita/day (lcd). However, about half the countries report consumptions of 40 lcd or less, and as a rough guide 20 lcd might be adequate for simple systems which employ public hydrants. Where a high

proportion of house connections is proposed, 100 lcd would be more realistic. Even more will be required in the rare cases where water-borne sewage disposal is to be provided. Because of these wide variations, sampling and demonstration projects are important means for determining likely demands on new water systems.

xv. The source of water has a major effect on system design and hence on costs. Properly designed and operated groundwater systems will, in almost every case, yield water which is safe to drink without any form of treatment. Surface water sources will normally require disinfection (usually by chlorination and storage) and, depending on the degree of turbidity or contamination, may also require filtration, possibly preceded by sedimentation for very turbid waters. To reduce costs and operation and maintenance problems, surface water systems should usually be based on simple processes such as sedimentation lagoons, slow sand filters, or infiltration galleries making use of the natural filtration capacity of alluvial material. Four general principles can be applied to most village water programs:

- groundwater, which requires little or no treatment to make it safe, is preferable to surface water;
- systems must be rugged, designed for simple, trouble-free operation and maintenance by local technicians;
- replacement parts must be readily available; and
- standard designs, which can be slightly modified to meet local conditions, should be developed and used for cost estimation, procurement and construction.

xvi. System costs vary widely. Estimated costs for rural services shown in the WHO Survey vary from $1 to $150 for individual countries. Regional averages were from $6 to $24 per capita (1970 prices). Because of this variation, cost estimates have to be prepared for each particular project; generalizing from "typical" figures can lead to substantial errors.

xvii. The following general conclusions can be drawn concerning the effects of scale, levels of service and water source on costs (see Annex 2):

- There are considerable economies of scale in village water systems; for similar systems, the per capita cost of a system for a village of 10,000 may be only about 40% of that for a village of 1,000.
- Use of surface water requiring full treatment may be several times as expensive as using untreated groundwater.
- Providing a high level of house connections may at least double the per capita cost of the system.

xviii. Additional public health benefits to rural areas can be achieved by provision of other sanitation measures preferably taken at the same time that water is provided. Pit latrines can usually be constructed at very low cost on a self-help basis; septic tanks may be required where houses have individual water connections and use water-flushed toilets. Piped sewerage systems are expensive and unlikely to function effectively where only a few houses have inside toilets and should not be installed except in the rare cases where no cheaper alternative can be found.

IV Financial Aspects

xix. It is most uncommon for the full costs of village water systems to be recovered from the villages served. This may be due to a number of reasons -- government policy to charge less than full cost, justified on the grounds that water is a social service; unwillingness of villagers to pay, either because they regard water supply as their natural right or because they do not appreciate the benefits of improved water systems; or inability to pay because of poverty. As a result, government funds are usually necessary to cover initial capital costs and also many of the recurrent costs, and governments must recognize this implied commitment when they first embark on village water programs. Nevertheless, villages should be required to pay as much as they can towards the costs of constructing and operating their systems.

xx. There are five potential sources of funds for village water programs: central or local government budgets; foreign assistance; institutional lenders within the country; cross-subsidies from urban systems; and the villages themselves. The first two are generally determined on the basis of perceived national priorities. The third, local lending institutions, is frequently undeveloped or alternatively unwilling to lend to the non-creditworthy institutions responsible for rural water. The fourth source -- cross-subsidies from urban water systems -- is unlikely to have any major impact, since in many developing countries the urban systems themselves are having difficulties in meeting demands. The fifth source, the villages, therefore has an important effect on the size of program that can be undertaken, but is frequently not fully exploited at present.

xxi. There are a number of strong reasons for requiring payment by villages towards construction and recurrent costs:

- it is equitable that beneficiaries should pay for services received;
- it makes more funds available to the program and, by reducing the use of government funds to meet recurrent costs, allows more to be spent on extending new systems to other rural areas;
- it will help ensure that funds are available to meet operating expenses and the cost of minor repairs;
- it increases villages' sense of responsibility for new systems; and
- it will help to ensure that the level of service to be provided is appropriate to the needs and desires of the village.

xxii. The WHO Survey showed that 20% of countries require villages to make a contribution to capital costs, and 70% to pay all or part of operation and maintenance expenses. However, in the Bank's experience enforcement of these policies is irregular.

xxiii. Determining the ability and willingness of villages to pay is a problem, because of lack of data on rural incomes and because many villages have essentially a barter economy in which little cash changes hands. As a general rule, it appears realistic to require villages to contribute about 10% of capital costs (either in cash or in kind, by providing labor or materials), and to meet all operation and maintenance costs.[1/] These charges would be for a basic system, supplying water through public hydrants; where villages desire a higher level of service, with a number of private house connections, they should normally meet the full additional costs.

1/ Payment at this level would in many cases result in water charges not exceeding about 5% of total annual income, a level frequently adopted as a guideline for setting charges to poorer urban consumers.

xxiv. Levels of payment should be set above the levels in paragraph xxiii wherever possible. For example, in a number of development projects villagers' cash incomes may rise substantially as the project matures, and in these cases water charges might also recover depreciation. However, decisions on targets and the way in which they are to be applied have to be tailored to suit the individual circumstances of each case: ability to pay; system costs; and the social objectives of the program.

xxv. Collection of water charges from villages is normally a problem. Larger domestic consumers with individual house connections, and any commercial or industrial customers can be metered and charged accordingly, supplies being disconnected if payment is not made. Most supplies, however, will be given by public hydrants or through house connections whose small consumption would be uneconomical to meter. For these, flat rate charges, unrelated to consumption have to be used, raised through head taxes, individual or family fees, water tax or property assessments, or other methods. The most important thing is that the method chosen should be administratively simple and reasonably effective.

V. Organization and Management

xxvi. Institutional weakness is probably the most important single problem in rural water supply. In many countries there is no national policy. No coordinated objectives are set for the various agencies responsible, and there is no clear government financial commitment to meet the overall needs of the sub-sector.

xxvii. Numerous agencies are normally responsible for rural water, including various national and state ministries, national and regional

water authorities, and rural development agencies. This leads to uncoordinated or inefficient planning and execution of projects, and unnecessary duplication of demands on the limited pool of available trained manpower. It also results in an extremely complex legislative framework, which needs review and improvement as part of any restructuring of the sector organization; this work demands specialist knowledge and is very time-consuming.

xxviii. Most agencies suffer from inadequate staffing, usually because their conditions of service are unattractive compared to those in private sectors or in organizations working in metropolitan areas. To attract better staff in sufficient numbers, salaries and other benefits normally need to be significantly increased. In addition, training is required at all levels, from village operators and technicians to professional staff. In the early stages of a program, this training can be provided on the job, using model schemes and demonstration projects. Later, a more formal training program will be required, preferably combined with that for urban water supply personnel.

xxix. The need for proper operation and maintenance is commonly ignored. Schemes are constructed without any clear assessment of the funds and manpower needed to keep them running, or of the logistical problems involved. As a result, a high percentage break down soon after commissioning.

xxx. A village water program can be undertaken in various ways, with varying institutional implications:

- as part of a national or regional water supply program, including both urban and rural elements;
- as a rural water supply program; or
- as part of a multi-sectoral project such as a regional integrated rural development project.

The first approach, i.e., rural water a part of a national water program, will probably be the responsibility of an existing central body such as a national water agency, and will make best use of available manpower and ensure consistent application of sector policies. Pure rural water projects, the second approach, will usually require extensive institution-building to strengthen the agency responsible for rural water before it can successfully undertake the program, and may lead to some duplication of effort in the urban and rural sub-sectors.

xxxi. The third approach, rural water as a part of integrated rural projects, the most likely in the short term in many countries, may be administered either by the rural water agency or by a water unit within the rural development project agency. The former is preferable for many reasons, including making best use of sector expertise and avoiding proliferation of sector agencies. However, the project may not afford sufficient leverage to strengthen or reorganize a weak rural water agency, and if this is so only the second alternative may be feasible. In this case liaison should be maintained between the water unit of the rural development agency and the rural water organization, in particular on sector issues such as pricing policy. Care must also be taken to reconcile as far as possible any conflicts between objectives of the rural development project agency and of the rural water agency, which often do not coincide; for example, in a rural development project one may aim at rapid development of the whole of a geographic area, the other at extending service to selected villages, keeping pace with institution building.

VI. The Justification for Investment in Village Water Supply

xxxii. Ideally, investment decisions should be based on cost/benefit analyses in which both costs and benefits are quantified. However, despite considerable research, no satisfactory method has yet been developed for quantifying all the benefits of improved water supply.

xxxiii. In urban areas good water supply is essential to the existence of the city, and to protect public health. There is usually no alternative to a public water system. In these areas projects can normally be justified by consumers' willingness to pay for the service provided. In rural areas the justification becomes far more tenuous: the threat of epidemic due to waterborne disease lessens as population density decreases, but there is a greater number of prevalent diseases. Alternative sources frequently exist but are polluted, inconvenient or unreliable. Willingness to pay declines, due to poverty or to lack of appreciation of the possible benefits of improved supply.

xxxiv. In most cases it is therefore impossible to present a rigorous economic justification for village water projects. Instead, justification must rest on a qualitative assessment of the benefits anticipated from the investment. The most important direct benefits from improving the quality and quantity of water available from village water supplies are improved public health, greater convenience and some fire protection. The first two of these may also increase productivity. Indirect benefits commonly cited are slowing down of rural-urban migration; redistribution of real income in favor of the rural poor; better standard of living, and the development of village institutions. These are discussed below.

xxxv. Numerous epidemiological studies have clearly identified contaminated water as the principal agent in transmitting typhoid and cholera. Lack of safe water for drinking and washing is also an important factor in the spread of diarrheal disease, the most common cause of death in infants in the developing world. A number of other diseases, especially the debilitating parasytic diseases, are linked to inadequate and contaminated water supply and poor sanitary conditions. 1/ It is nevertheless difficult to predict the exact impact of improving water supply on disease reduction, partly because some of the diseases are epidemic in nature and may be temporarily absent in project areas. Nevertheless there is little doubt that safe water is essential to good health, and a prerequisite to the control of those diseases most common to the rural areas of developing countries.

xxxvi. The effect of water on health will depend on many factors, especially the prevalence of various diseases, and the extent to which villages use the water. To break the chain of transmission of certain diseases improved excreta disposal methods must be provided together with improved water supply; the combination of these two measures coupled with health education will frequently be found to be the most permanent means of control. Public health education will normally be necessary to achieve full health benefits, but it requires time and is demanding on skilled manpower.

xxxvii. Provision of a safe and convenient water supply should result in <u>improved productivity</u>, both from improved health and from a reduction in time and effort spent fetching water. It may also make possible directly

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1/ For a detailed discussion on the relationships between water supply and health see Warford and Saunders paper: "Village Water Supply and Sanitation in Less Developed Countries", Chapter III, or Bank Policy Paper 554a: "Background Paper on Health".

productive agro-industrial activities such as fruit and vegetable processing, fish freezing, or slaughterhouse operation. However, whether potential productivity benefits are realized depends on individual cases. In some villages ill-health of the labor force is a serious constraint on agricultural development, whereas in others there is underemployment and the benefits may not be realized unless the water supply project forms part of an integrated rural development project or similar project providing increased employment opportunities.

xxxviii. It is often argued that better rural water supply should reduce migration to urban areas, relieving their severe housing and other social problems. Even if a slowing of migration were desirable, which is a matter of debate, there is little evidence on the influence of better water supply; it is possible that improved rural health and lower infant mortality could actually increase migration, unless coupled with rural development to encourage people to remain in their villages.

xxxix. Rural water projects, which usually require subsidies from central government revenues or from more prosperous urban consumers, often have a positive income redistribution effect (although care must be taken that richer rural farmers do not benefit at the expense of the poor of the urban areas).

xl. Although no supporting data are available, it seems likely that community involvement in the construction, operation and funding of a water system would strengthen village institutions, helping villagers deal with other development decisions.

VII. Priorities - Selection of Sub-projects

xli. The benefits described above, being for the most part unquantifiable, do not provide a clear guide for setting priorities in a rural program extending over a number of years. This must be done following a judgment on the merits of various sector objectives and the characteristics of particular villages. Financial criteria alone are an unsatisfactory screening device, since too many important social benefits are ignored.

xlii. In many countries, basic information about the sector is lacking, and a sector survey is necessary. This survey should, in addition to data collection, identify the principal problems and constraints in the sector, analyze the strategy for development (or by examining alternatives, help to develop such a strategy), estimate needed investments, and recommend policies, institutional improvements and other measures necessary to assure the program's success. This work is extremely important, and must be carried out by competent and experienced staff. It is done entirely by local experts, but often some external assistance may be required.

xliii. Typical sector objectives are:

- to provide safe water to as many people as possible;
- to reduce waterborne or water related diseases;
- to encourage rural development; or
- to improve living conditions for the rural poor.

Any selected program will have to compromise to some degree between these various inter-related objectives, which cannot normally be maximized simultaneously.

xliv. Village characteristics which affect ranking in the selection process include:

- Village need
  - village involvement and interest, including willingness to pay for the improved supply;
  - adequacy of existing supply and distance from village;
  - prevalence of water-related disease;
- Village potential
  - growth potential;
  - village institutions;
- System costs
  - nature of sources;
  - population density;
  - level of service;
  - accessibility.

xlv. Of these, village participation is most important. Systems in villages expressing a real interest in having improved water supply are far more likely to remain in working order than systems installed regardless of village opinion. They can also be tailored to meet the needs and desires of the village, and prompt collection of water charges is more likely. Sufficient lead time must be allowed in project preparation to obtain this village participation.

xlvi. Whatever ranking is adopted, it will require review as projects are implemented, to determine whether the weights given to the various objectives and characteristics are appropriate. Careful monitoring, especially of the initial stages of programs, is therefore essential.

VIII. Implications for the Bank Group

xlvii. The potential for Bank Group assistance to village water programs is considerable, since it already has much experience in other sectors in dealing with the complex, multi-dimensional problems of weak institutions, poor financial performance, inability to extend service to keep pace with population growth, and frequent breakdown of existing systems. The Bank Group's most important role would be in building up the capabilities of local institutions for sector and project planning, execution and operation.

xlviii. It is not possible at this stage to propose targets for future Bank lending to this sub-sector; these must await a clearer identification of projects already in the pipeline, an examination through CPPs of priorities and absorptive capacity in various countries, and better sector information obtained through surveys more specifically oriented towards the problems of the rural sector. The UNDD targets do not take account of country factors and do not provide a basis for Bank planning.

lix. The Bank's future lending program will contain a considerable number of integrated agricultural or rural development projects which should contain a village water supply component. 1/ In addition there will be a limited number of sector loans for village water supply as part of national or regional programs. A limited number of sub-sector projects for village water only may develop.

1/ The exact number will not be known until projects in the pipeline are more clearly identified; possibly 100 in FYs 75-79.

l. All these projects will usually need a long lead time for project preparation. Early involvement of water supply staff in project preparation is therefore essential, to make a preliminary review of proposed institutional arrangements, technology, health education requirements, training needs, etc. This review may show the need for a sector survey or for further pre-investment studies. The former can be carried out under the IBRD/WHO Cooperative Program, the latter, if government funds are not available, can be financed by international agencies such as UNDP or UNICEF, by bilateral sources or by the Bank Group itself (as in Columbia and Chile).

li. Initial projects are likely to contain many components: rehabilitation of existing systems; demonstration projects; pre-investment studies; sector data improvement; institution building; development of methodology and criteria; and training. Follow-up projects could be on a sectoral basis: the Bank Group would be involved to a minimum in the actual investment decisions, turning over increasing responsibility to the executing agency in project selection, following criteria agreed between the agency and the Bank Group (as is now being done in Minas Gerais, Brazil).

lii. For the reasons noted above, justification of village projects will not normally rest on quantified benefits nor on willingness to pay -- often used as a proxy in urban projects. Aggregating the costs of the water component with the other costs of an integrated project conceals but does not remove the difficulty. An explicit assessment should be made of the costs and of likely benefits, in particular improved health, better standard of living and increased productivity. In general, integrated projects are likely to show better returns since the target population is clearly identified

and the other investments (for example in agriculture or education) may enable potential benefits of the water project to be more fully realized.

liii. The financial performance of most projects will be low, measured by the Bank Group's normal standards for public utilities. As discussed in Chapter IV, a minimum target should be that villages make a contribution (cash or kind) to capital costs and that user charges cover operation and maintenance. This should be feasible provided that villages are carefully selected, systems are tailored to their needs, and health education is encouraged so that facilities are properly used and the benefits are appreciated.

liv. Preliminary guidelines for the Bank Group in assessing water programs are given in Annex 5 of the main report.

lv. Water supply staffing in the Bank Group is at present insufficient to deal with the village water projects forming part of integrated agriculture or rural development projects. The regional Public Utility divisions would have to be strengthened to provide the necessary support to the divisions responsible for these types of projects. As an interim measure, until the projects in the lending program can be clearly identified and their implications for each region assessed, it is recommended that one or two additional staff should be recruited for the Public Utilities Department of Central Projects Staff, to provide support to the regional Public Utility divisions as necessary.

Implications for the International Community

lvi. A number of international and bilateral agencies have been concerned with rural water supply over many years. Such activities have been largely uncoordinated. With the increasing concern for the poor in both urban and

rural areas, nearly all the agencies are becoming sensitive to the need to give greater attention to these people. This has been demonstrated during the past year by the establishment of an international panel to look into the actions which might be considered by the international community in helping countries to provide greater numbers of their people with adequate water supplies. This ad hoc panel, on which the Bank is a member and has provided financial support, will receive and consider the reports of its two task forces in February, 1975. Decisions on recommendations contained on the reports can be taken only when the implications for each of the agencies is known following receipt of the reports.

I. INTRODUCTION

Purpose of the Paper

1.01 Sanitary or public health conditions in many developing countries are extremely bad. Probably over 1,000 million people living in rural areas do not have an adequate water supply, and waterborne or water-related diseases are usually among the top three causes of sickness and death. The rate of extending water supplies to these people is slow, and is not keeping pace with population growth. Even when new systems are provided, they frequently become inoperable in a short time due to lack of proper operation and maintenance.

1.02 Governments of developing countries are becoming increasingly concerned with improving the lot of people living in rural areas. In the view of many health experts, provision of a safe and convenient water supply is the most important single activity that could be undertaken to improve the health of people living in these areas. As the Bank shifts the emphasis of its lending program, in response to governments' needs, so as to have greater impact on rural areas (whether through agriculture, integrated rural development, or infrastructure projects such as water supply) it will have to face the problems which have hitherto prevented successful development of the sub-sector. The purpose of this paper is, therefore, to describe the particular characteristics and problems of village water supply, to suggest ways of improving the present situation, and to examine the implications of expanding lending for village water supply on Bank policies, operations and staffing.

1.03 A major problem is that in many countries rural water supply has received little attention from the central government, and has been developed piecemeal. In these countries there are no centralized policies, and information on the sub-sector is lacking or inaccurate. In addition, the Bank has, as an institution, little experience so far in rural water projects, since past Bank lending for water supply has concentrated heavily on urban schemes (although many have also served adjacent villages and some, forming part of national or regional programs, have included quite large rural components). On this poor base, developing targets for future Bank lending for village water supply is not possible. This paper is therefore intended as an interim paper, to be revised and updated periodically as more information becomes available and as the Bank gains more experience in the sub-sector.

Definitions

1.04 There is no generally accepted distinction between "urban" and "rural" communities; each country selects the division most appropriate to its needs, and statistics (for example, the WHO Survey referred to below) are compiled on this basis; as a rough guide, this paper is concerned with communities with populations in the range 300 to 10,000.

1.05 The water supply systems for the communities considered in this paper may range from wells or protected springs, from which villagers fetch water, to quite elaborate systems with piped distribution of treated water. One common characteristic assumed for each of these systems is that they provide safe water, that is, water free from disease-carrying organisms and toxic substances, and protected against accidental contamination (see para. 6.10).

Source of Data

1.06 The principal source of the statistics in this paper is a special survey carried out by the World Health Organization to obtain data on water supply and sewage disposal in developing countries in December 1970. 1/ Ninety-one countries, with an estimated 1970 population of 1.7 billion, responded to part or all of the Survey. So far only the statistical results of the survey have been published; an analysis of the results is expected shortly.

1.07 Because the Survey used the definitions employed by each individual country, its consolidated statistics on the division between urban and rural population, reasonable access to safe water, etc., may be rather misleading. Apparent large differences between countries may be due partially to the use of different definitions, and WHO caution that the survey figures are only indicative. Spot checks of data for countries in which the Bank has been involved in water supply operations have shown a number of inconsistencies. However, the Survey is the best global data available at present, and the picture it paints is undoubtedly broadly correct.

1.08 In addition to the WHO Survey, the paper draws on:

- a research project carried out by the Bank's Public Utilities Department in 1972-74; 2/
- sector studies executed under the WHO/IBRD Cooperative Program;

1/ WHO: World Health Statistics, Vol. 26, No. 11, 1973. Special subject: Community Water Supply and Sewage Disposal in Developing Countries, 1970. (Referred to in the remainder of this paper as "the WHO Survey".)

2/ Village Water Supply and Sanitation in Less Developed Countries: R. J. Saunders and J. J. Warford (first issued as RES 2 on March 15, 1974; recently revised for outside publication).

- experience gained by the Bank in its lending operations for water supply, agriculture and rural development;
- the experience of the Inter-American Development Bank, which has made some twenty loans for rural water supply in Latin America (see Annex 4);
- the experience of the Bank's water supply staff; and
- the preliminary findings of the Technical Panel of the Ad Hoc Group on Rural Potable Water Supply and Sanitation established in April 1974 by a number of international agencies. 1/

1.09 Several ongoing Bank research projects -- on measuring the impact of Bank projects on public health; on the design and operation of public hydrants; and on the nutritional effects of reducing enteric diseases -- have a bearing on this paper, and their findings will be taken into account in subsequent editions.

Contents of the Paper

1.10 Following this chapter, the paper is arranged as follows:

Chapter II: Background Information

Chapter III: Technical Aspects and Costs

Chapter IV: Financial Aspects

Chapter V: Organization and Management

Chapter VI: The Justification for Investment in Village Water Supply

Chapter VII: Priorities - Selection of Sub-projects

Chapter VIII: Implications for the Bank

All these chapters except the last are of general application irrespective of the source of finance.

1/ UNICEF, UNDP, UNEP, IBRD, WHO, IDRC, AND OECD.

II. BACKGROUND

2.01 This chapter gives basic background material for the remainder of the paper. The first part of the chapter is based largely on the statistical material in the WHO Survey and reviews the worldwide water supply situation in 1970; the United Nations Development Decade (UNDD) targets for 1980; the investments needed to meet those targets; a comparison with past achievements and with past total investment; and the level of past financial assistance. The second part of the chapter lists the principal problems encountered in village water supply projects.

The Situation in 1970

2.02 The WHO Survey (see para. 1.06) obtained data on the water supply situation in 91 developing countries at the end of 1970.

The population of the countries surveyed was 1.7 billion, of whom over 70% lived in rural areas. A breakdown by WHO Regions is given in Annex 1, Table 1.

2.03 The percentage of this population with reasonable access to safe water ("reasonable", being defined by each country), varied widely between countries and regions; a summary is shown in Annex 1, Table 2. In every region rural areas are very much worse served than urban -- overall, only 14% of the rural population compared to 68% of the urban inhabitants.[1/]

2.04 In numerical terms the results are even more disturbing. In

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1/ This latter value is probably too high since in many cities the population is technically "served", but the quality of service (a few hours a day) and the quality of water badly need improvement. This is particularly true of fringe slum areas, the usual destinations of poor rural migrants

urban areas 144 million people were without service, whereas in rural areas 1,076 million people -- about one-third of the total world population -- were without reasonable access to safe water (for details see Annex 1, Table 3).

Targets for 1980

2.05 The targets adopted for the United Nations Development Decade 1971-1980 (UNDD) are to serve 100% of the urban population (60% through house connections, and 40% through public hydrants) and to give 25% of the rural population easy access to safe water. For Latin America and the Caribbean slightly different targets were adopted by a conference of the various Public Health Ministers in Santiago in 1972: to reduce the percentages of population not served in 1970 by at least 50% for city dwellers and 30% for the rural population. These targets are useful as broad goals, but are necessarily arbitrary with respect to individual countries, which will need to determine their own priorities and their own urban/rural mix.

2.06 By combining these targets with a forecast growth of population 1971-1980 (Annex 1, Table 4), the WHO Survey estimated the additional numbers of people to be served by 1980 (Annex 1, Table 5). On the basis of these figures, several conclusions can be drawn:

- The urban population growth rate (averaging 4.5% p.a.) is substantially higher than the rural (2.2%).1/ This is particularly marked in Africa, where the urban growth rate, 5.6%, is 2.5 times higher than the rural (2.2%).
- Because of this high urban growth rate, there is at least as much need for additional urban supplies as there is for rural.

1/ In Latin America, several countries (Argentina, Chile, Uraguay) anticipate a decrease in rural population in this period.

World-wide, about 400 million new consumers will have to be served in urban areas, compared to about 250 million in rural.

- To meet the targets usually involves at least doubling, and in some cases tripling or quadrupling, the number of persons served, taking 1970 as the base year.

Investments to Meet Development Decade Targets

2.07 WHO prepared estimates of the investments needed to meet the UNDD targets, based on the number of additional people to be served (Annex 1, Table 5) and estimated per capita costs (Annex 1, Table 6). The results are summarized in Annex 1, Table 7, which shows that a total of US$14 billion may be required, $11 billion for urban supplies and $3 billion for rural. Spot checks of estimates for individual countries, using data from Bank projects in these countries, suggest that these estimates are low; however, in view of the wide country variations described below, it would be unwise to increase these estimates across the board on the basis of a few samples. Actual expenditures to meet the targets, in current $, will of course need to be very much higher than the WHO figures, which are in 1970 $ but probably based on data from 1969 or earlier.

2.08 Annex 1, Table 6 shows the assumed per capita costs for extending water service. These costs, averaged by WHO Region, vary widely: $12-53 for urban supplies through house connections, $9-28 for urban public hydrant supplies, and $6-24 for rural supplies. Even wider variations occur by countries, ranging from $1 to $300 per capita. This underlines the possible errors from using "typical" system costs for estimating.

Comparison of Development Decade Goals with Past Achievements

2.09 The WHO Survey was a rather more extensive version of an earlier survey in 1962, in which urban supplies in 77 countries were covered.

This permits a comparison of past achievements in urban water (summarized in Annex 1, Table 8) with the Development Decade goals. Comparing Annex 1, Tables 5 and 8, it will be seen that, whereas the rate of growth of urban population served in 1962-70 was comparable to that needed to meet the Development Decade goals, the numbers of new urban consumers to be served in 1971-80 are about three times those served in 1962-70 (390 million compared to 134 million). Unfortunately there are no comparable figures for the achievements in rural water supply. However, since past investments have been predominantly for urban systems, meeting the rural UNDD targets will probably call for an even greater expansion of effort.

2.10 The global needs, $3 billion investment (1970 $) to serve 250 million people, estimated by WHO as necessary to meet the UNDD targets are misleadingly simple. For the difficulty of the task to be fully comprehended, the needs should be expressed in terms of the enormous number of villages to be served and of small sub-projects to be developed. A Bank project being developed in Uttar Pradesh, India, illustrates the scale of the problem. The project area is 65,000 square kilometers, with 16,000 villages and a population of about 6.4 million. At present only 25% of the villages (17% of the people) have adequate water. The project, estimated to cost $30 million, will involve the construction of over 1,000 water systems to serve an additional 2,000 villages with a population of 0.8 million, so that by 1981 40% of the villages and 35% of the people will have service. To achieve this 300 sub-projects will have to be developed, with as many as 175 villages grouped to form one sub-project.

2.11 Accurate figures for investment in water supply are difficult to obtain because of the many sources of funds and, particularly in the rural sub-sector, because of the many agencies responsible. The WHO Survey estimated that in one year, 1970, a total of US$932 million was spent, $765 million (77%) in urban areas and $217 million (23%) in rural. A regional breakdown is given in Annex 1, Table 9. Checks of these figures for some countries where the Bank made loans for water supply in that year suggest that actual expenditure was probably considerably higher.

2.12 The WHO estimates of expenditures needed to meet the UNDD goals (see para. 2.07) average $1,100 million per annum for urban supplies and $300 million for rural. Worldwide, a substantial increase in real terms over the reported 1970 investment levels will therefore be needed to meet the UNDD goals. Regionally, by far the greatest increases will be needed in Africa and South East Asia (in each case, approximately a threefold increase). However, it is unwise to generalize: an assessment must be made in each particular country. In some developing countries, for example Mali, Ethiopia, Zaire and Pakistan the calculated increases are so great (approximately 140-, 145-, 70- and 25-fold respectively) that, even allowing for under-reporting of 1970 investment levels, the UNDD targets appear unattainable. In others the 1970 investment level, if sustained throughout the decade, appears adequate to meet the UNDD targets.

External Financing for Water Supply Projects

2.13 External financial assistance for water supply projects was reported in the WHO Survey to total US$711 million in the five years 1966-70, an annual average of $140 million. Spot checks show that some Bank loans were not reported in the Survey, so the true total is certainly higher.

2.14 No consolidated information is available from the various international and bilateral agencies on the magnitude of their past or planned future investment in water supply. This information is not even available for future Bank Group operations because investment may be not only through sector loans but also through components of other projects such as agriculture, tourism or urbanization. For these, the relevant data have not been disaggregated from total project costs for identified projects; in addition, many projects are not yet identified. No judgment can therefore be made on the adequacy of the response of the lending agencies, in particular the Bank, to the investment needs described in paragraph 2.13.

Common Problems in Rural Water Programs

2.15 Sector characteristics change markedly as one progresses from large urban centers, through medium size cities, small towns and villages, to the dispersed population. The administrative structure becomes more diffuse, income levels decline, and per capita costs for equivalent levels of service tend to increase. Inherent in these changing characteristics are many of the typical problems encountered in rural water programs. These problems may be grouped into the following broad categories, although they naturally overlap:

Institutional

- lack of a rural water supply policy forming part of a national water supply policy;
- existence of several government agencies whose lines of responsibility overlap or are ill-defined;
- lack of institutions capable of project development;

- lack of water organizations at local level;
- lack of trained manpower at every level;
- lack of criteria for project evaluation and priority selection;

Financial

- per capita costs which increase inversely with village size for a given level of service;
- relatively low income of villagers and limited village financial resources;
- lack of a policy to obtain maximum financial support from areas to be served;
- lack of local government infrastructure, inability to collect and retain locally collected taxes for local use, and difficulty in collecting fees from water users;
- lack of public health education, so that villagers are unaware of the potential benefits of improved water systems and are not willing to pay for them;
- seasonal availability of water from ponds, streams, shallow wells and other sources of questionable quality to which the rural population may return if high charges for piped water are imposed;

Technical

- a record of short operating life for equipment, poor maintenance, and of many project failures;
- lack of local capacity to fabricate simple, reliable equipment for which spares and service would be available locally;

- use of a wide variety of types and makes of equipment by the various national agencies, compounding the problem of operation and maintenance;
- severe communications problems between remote rural systems and their support organizations in areas with poor or non-existent telephone service, so that system breakdowns are not reported promptly;
- difficulty in obtaining spares due to lack of money, scarcity of foreign exchange, cumbersome procurement procedures, problems of logistics, and absence of a support agency which maintains an inventory of needed parts; and
- difficulty in providing sufficient repair staff and transport to attend promptly to breakdowns in widely dispersed rural systems with very poor road links.

By far the most crucial problems are the institutional and financial ones; if these were resolved the technical problems would largely disappear.

III. TECHNICAL ASPECTS AND COSTS

3.01 Factors affecting the type of water supply system to be constructed in a village include the level of service, water quality and quantity, and the nature and location of water sources, This chapter discusses each of these aspects, and their effect on costs is illustrated in Annex 2. The chapter ends with a brief discussion of excreta disposal systems which might be included in rural programs.

3.02 The chapter proposes certain general principles which can be applied to most village water programs:

- groundwater, which requires little or no treatment to make it safe, is preferable to surface water;
- systems must be designed for simple, trouble-free operation, and be capable of being operated and maintained by local technicians;
- equipment must be able to withstand hard usage, and replacement parts must be readily available; and
- standard designs, which can be slightly modified to meet local conditions, should be developed and used for cost estimation, procurement and construction.

3.03 Wide variations between systems and between countries make it difficult to generalize on quantities of water to be provided or on system types or costs. Typically, consumption is likely to be in the range 20 - 100 liters/capita/day (lcd) and capital costs in the range $20 - 60 per capita. The level of service to be provided should reflect the village characteristics and the wishes of its inhabitants, in particular their

willingness to pay the necessary water charges; this is discussed in Chapter 4.

Levels of Service

3.04 Village water systems can be classified according to the level of service as follows:

(a) Those with one or more water points such as a protected spring or a well with a pump, but with no distribution system.

(b) Those which supply water from a single source through a simple distribution system to a few public hydrants.

(c) Those with a more elaborate distribution system serving a substantial number of public hydrants and some house connections.

(d) Those with a substantial number of house connections and few public hydrants.

Both capital costs of the facilities and the operating costs associated with the volume of water produced will rise with the level of service. For example, levels (a) and (b) are likely to be very simple systems, using a gravity supply or a hand pump, whereas (c) and (d), which require larger quantities of water, will probably require motorized pumps. They will also probably need to include some treated water storage to meet peak demands and guard against breakdown. Selection of a higher level of service may also necessitate changing to a more expensive source, for example to poor quality surface water, requiring treatment, because the supply of good quality ground water is inadequate. However, systems with house connections should be encouraged whenever income levels permit, since full health benefits are not achieved until a plentiful supply of water, free of risk of contamination, is available in the house. (Experience on Inter-American

Bank projects also shows that collection of charges for water is more likely where house connections are provided.)

Quality

3.05 Quality standards for village water supply are principally concerned with ensuring that the water does not contain any constituents, either chemical or biological, which could affect its safety or acceptability. Quality factors which have little bearing on health (such as hardness, iron, manganese, and chlorides), unless they give rise to technical problems such as encrustation or corrosion, can normally be disregarded so long as the villagers find the water acceptable. Acceptability can be an important factor: for example, groundwater with a high iron or manganese content will have a distinctive taste and will discolor laundry and foods such as rice, and may be rejected if an alternative river or pond is available, even if the alternative source is contaminated.

Quantity

3.06 In most villages water is primarily for personal use. The quantity consumed depends on several factors, of which the most important is convenience; if there is a supply in the house or courtyard, consumption may be ten times greater than if water has to be fetched from a public water point. If water has to be carried a considerable distance -- say more than one mile -- consumption may fall to as low as 5 lcd which approaches the minimum necessary to sustain life. The climate and cultural patterns of bathing, laundering and preparation of food are also important factors. The provision of public bathing and laundry facilities can increase demand considerably. Waste may also be a major problem unless public hydrants are properly designed to prevent faucets from being left to run continuously, or measures taken to supervise their use. 1/

1/ The Bank is now undertaking research (Research Project RPO 312) into possible improvements in public hydrant design and other methods for reducing waste.

3.07 The WHO Survey gives the following data for average daily consumption in rural areas:

	lcd	
	Min.	Max.
Africa	15	35
South East Asia	30	70
Western Pacific	30	95
Eastern Mediterranean	40	85
Europe (Algeria, Morocco, Turkey)	20	65
Latin America & Caribbean	70	190
World Average	35	90

Judging by Bank experience, these figures appear to be overestimates. Possible reasons for this include the use of design criteria or production data rather than true consumption figures, and not weighting consumption figures according to population when calculating regional and world averages.

3.08 The individual data for 91 countries, from which WHO's regional figures were consolidated, show a minimum use figure of about 5 lcd for 7 countries; 20 lcd or less for 24 countries; and 40 lcd or less for 45 countries. Because of the wide regional and country variations, no single consumption figure can be adopted for world-wide design of rural systems. In some villages with only public hydrants 20 lcd would be adequate, whereas if a number of houses are supplied through private connections, more than 100 lcd might be required. To obtain design data, samples should be taken either in villages within the proposed project area which already have water supply or in other villages

with similar cultural, economic and climatic conditions. Allowances should be made for the growth of demand for water for productive purposes: livestock watering, irrigation of small gardens, preparation of produce for market and, in some instances, establishment of small industries and food processing plants. Demonstration projects or initial programs will give reliable design data for planning subsequent stages.

Sources

3.09 The requirement that the water supplied be safe to drink has an important bearing on design and costs, since different sources of water require differing degrees of treatment. Where groundwater is available, springs and wells which are properly located, constructed and maintained will normally yield water which, without any treatment, will meet the most stringent standards for biological purity. An exception is in areas of fissured limestone, where ground water may be contaminated by surface water.

3.10 Where groundwater is polluted, or where surface water has to be used, some treatment will be required because of the possibility of contamination of the source by humans or animals. Introducing treatment will always increase the cost of the system and the likelihood of breakdown, so wherever possible safe groundwater sources should be used. The degree of treatment will be determined by the nature and degree of possible contamination and by the raw water characteristics. Where the water has little turbidity and is unlikely to be contaminated by parasytic cysts and ova, simple chlorination and storage will usually be sufficient. Some storage will normally be required in the system in any case, so the additional cost of treatment is that of a chlorinator and of hypochlorite powder. Solution-feed chlorinators, which are comparatively trouble-free and easy to operate,

can be fabricated locally. Careful organization will be necessary to ensure that the villages receive a reliable supply of fresh hypochlorite powder.

3.11 For water with moderate turbidity, chlorination alone is not effective, and some type of filtration will be required. Well points or simple sand and gravel infiltration galleries, constructed mainly with local materials and labor, can be used to abstract water. Slow sand filters are another alternative. Costs are mainly determined by the extent of works needed to connect the river, lake or irrigation canal to the infiltration gallery or filters; the topography; the availability of sand and gravel; and the required output. Pressure filters, either built locally or purchased abroad, can also be used for small systems.

3.12 Where high turbidities occur regularly, adaptations of standard water treatment plants will be required. Most installations can be fabricated from local materials but are still expensive. Since these plants show considerable economies of scale, and since they also require fairly skilled operation, the possibility should always be considered of constructing one large plant to serve a group of villages. Where sufficient sand is available, settling basins followed by slow sand filters should always be considered, since their use could reduce costs significantly even for turbid raw waters. They have the further advantage of providing comparatively safe water even if the chlorination system fails.

3.13 Transmission costs vary significantly with the source of water. They are zero for a well within a village with no distribution system, small for a gravity supply from a neighboring protected spring, but may be thousands of dollars for a river source at some distance and where both raw and treated water has to be pumped.

Typical Costs

3.14 Annex 2 illustrates the effects on system costs of various levels of service, sizes of community, and types of source. The following conclusions can be drawn:

- There are considerable economies of scale in village water systems; for similar systems, the per capita cost of a system for a village of 10,000 may be only about 40% of that for a village of 1,000.
- Use of surface water requiring full treatment may be several times as expensive as using untreated groundwater.
- Providing a high level of house connections may at least double the per capita cost of the system.

3.15 The costs quoted in the annex, while taken from actual projects, are illustrative only, and should not be used for estimates. The WHO Survey showed capital costs ranging from $6 to $24 per capita (at 1970 prices), taking the average for the WHO regions. Individual country costs varied much more widely, extending from $1 to $150 per capita. On Interamerican Development Bank projects, where rather over 60% of houses are supplied through private connections, per capita costs average about $60. These variations emphasize the need for a careful review of project estimates.

Standard Designs

3.16 To reduce both project preparation time and engineering costs, sets of standard designs may be developed with corresponding standard costs. These standard designs must be carefully considered initially, and modified as necessary in the light of field experience. It is essential that they are tailored to suit conditions in the country. For example, voltage fluctuations or supply outages in the electricity system may mean that electric pumps can only be used satisfactorily if extra pumping capacity and treated water storage are provided to compensate for reduced hours of pumping, and if extra protective measures are incorporated. Pumps ordered "off the shelf" to meet the nominal duty will not meet the full demand and will suffer early motor failure. Alternative sources of power (diesel, gasoline, local hydro) may therefore be more economical even in areas with an electricity supply.

3.17 The technology involved should be kept as simple as possible, so that local operators will be able to operate and maintain the system for long periods of time without the assistance of a trained operator from a central agency or of a qualified engineer. Sufficient attention must be given to the cost-effectiveness of the designs and materials selected; too often cheap materials are used to minimize initial costs, leading to early failure in service and a loss of supply for protracted periods while replacements are obtained and installed.

3.18 Each individual system will then comprise a number of standard design units, amended as necessary to suit the particular conditions. Careful engineering review will still be necessary to ensure that the

standard designs and cost estimates have been correctly adjusted to reflect conditions in the project area.

Excreta Disposal

3.19 As discussed in Chapter 6, provision of safe water is the most important contribution to improving public health, but proper excreta disposal facilities also play a significant part. However, if waterborne sewerage is required, its per capita cost may be more than double that of the water system. It is clear that finance will be a serious constraint on village water supply programs, and if these other facilities are included the financial problem will be greatly aggravated. Many villages perceive little need for sewage disposal and are much less willing to pay for it than for water supply. There is also the technical problem that, unless a sufficient number of houses can afford water-flushed toilets and connect to the sewer system, the flow in the sewers will not be enough to prevent them from becoming clogged. Fortunately the population density of many villages is low enough to accomodate traditional excreta disposal methods such as pit latrines, which can be constructed at low cost and with a large self-help component. Typical installations are discussed in Annex 3.

IV. FINANCIAL ASPECTS

4.01 In most cases the financial policy of public utilities is to ensure that revenues cover all costs and provide an acceptable return on the capital investment. This policy has four objectives:

- stimulating cost-conscious, disciplined, business-like management;
- ensuring the availability of adequate funds for operation and maintenance;
- ensuring that part of the utility's capital requirements will be available from its own resources, and that it will be able to service its borrowings; and
- making consumers aware of the financial consequences of their use of the service.

4.02 These objectives are as valid for water supply undertakings as for other utilities, and there is no inherent reason why these undertakings should aim for lower financial performance. In many countries, however, there is an attitude, both in governments and among consumers, that good water supply is the right of every citizen as a social service, for which charges should be kept to a minimum. Typically, a consumer expects to pay the full cost of his electricity supply on the basis of metered consumption, with disconnection the penalty for non-payment, but resents paying more than a nominal flat rate charge for water.

4.03 In villages relatively high unit costs and relatively low consumer incomes make inability to pay a further problem in recovering a reasonable proportion of total costs. Moreover, the existence of some

alternative source of water -- however inconvenient and unsafe -- and a general lack of appreciation of the benefits of using a safe water supply makes the imposition of high user charges undesirable. The problem is, therefore, how to achieve these objectives -- which remain applicable even at low levels of financial performance 1/ -- in these circumstances.

4.04 Changing government and public attitudes to water charges takes time and education. As a general principle, user charges should be maximized because the size of the program, and to some extent its continuing operation, depend on this source of funds. However, whatever pricing policies are adopted, village water supply programs in many countries are likely to require continuing support from national revenues. Government funds will be necessary to cover not only initial capital costs but also the costs of establishing and running the administrative unit, initial and continuing training, and possibly part of the operation and maintenance expenses, at least in the early stages. Governments should recognize this implied commitment when they first undertake such programs; failure to look beyond first costs has been the cause of severe problems in the operating stages of many programs.

4.05 This chapter discusses the possible sources of funds for village water programs, minimum targets for the payment by the villages, and methods of collection. It concludes that the village payment should be as high as possible, covering at the least all operating and maintenance costs, and preferably including a contribution toward the capital cost of the scheme. However, the method of assessing these charges -- by region, by individual village, or on some other basis -- will need careful adjustment to the characteristics of each particular program.

1/ Where a water undertaking is heavily dependent on government funding to meet debt service and serve recurrent costs, the third objective clearly cannot be achieved in the form it is expressed in paragraph 4.01. However, the underlying concept behind the objective can still be realized if the undertaking makes proper financing plans and obtains clearly defined government contributions towards these plans, rather than proceeding on the basis of an ad hoc annual budget.

Sources of Funds

4.06 There are five potential sources of funds for village water programs: the government budget, foreign loans, institutional lenders within the country, subsidies from urban water systems, and the villages themselves. The amount of funds allocated to village water supply from the first two sources is usually determined by the government on the basis of national priorities and the needs of other sectors of the economy (see Chapter 6). As discussed below, the amount of funds available from the second two sources is likely to be relatively small in many cases. The total amount available to meet initial and recurrent costs is therefore dependent to a large degree on the contribution from villages. It seems clear that, if the needs for village water supply are to be met in a reasonable time, the targets for collection of capital and operating costs from the villages must be as high as possible. The more that government funds have to be used to cover operating costs, as is now usually the case, the fewer new systems will be built.

4.07 The third potential source of funds, subsidies from urban water systems, is a natural extension of internal cross-subsidization already occurring within the urban systems (typically, industrial and commercial consumers pay a relatively high tariff, while only a nominal charge, if any, is made for water distributed through public hydrants). However, many urban systems, particularly those where migration has greatly increased the numbers of urban poor, are already having difficulty in maintaining an adequate service. Urban dwellers naturally strongly resist any large increase in their tariffs in order to subsidize supplies to other areas.

Given these circumstances, the transfer of funds from urban systems to rural is unlikely to have any major impact on the latter, except for the rather special case of rural areas adjacent to urban systems, which can be served by extending the urban system and charging at subsidized rates. Nevertheless, the sector pricing policy should be examined to ensure that, as far as possible, urban water tariffs are cost-reflecting and that the possibility of using them to finance expansion of both urban and rural schemes is fully considered. In addition, as a general principle, broadly similar policies should be applied to urban and rural poor having similar service facilities.

4.08 The fourth source of funds, the institutional lenders of the country (insurance companies, banks, etc.) has been largely untapped so far, either because the lending institutions themselves are relatively undeveloped or because the institutions responsible for rural water would not be acceptable as borrowers. One of the objectives of improving rural water institutions should be to make them able to attract funds from these sources.

Level of Villages' Payment

4.09 It is widely held that villages in general are so poor that they are unable to pay anything toward the costs of a water supply system. While this view may be correct in the case of the smallest and poorest villages, the prospects for collecting a reasonable proportion of the costs are probably better than is generally thought if the following conditions are fulfilled: the standard of service is carefully tailored to the needs of the individual village; villagers are given basic health education so that they appreciate

the benefits of improved water supply; and a policy of maximizing user charges is vigorously enforced.

4.10 There are several good reasons for asking villages to pay part of the costs, both of construction and of operation and maintenance, of their water supplies:

a) it is equitable;

b) as discussed above, it will enable the program to be larger;

c) it will help to ensure that funds are available to meet operating expenses and the costs of minor repairs;

d) it will increase the villagers' sense of responsibility for the system, and so encourage good maintenance and careful use of facilities;

e) since villagers should participate in the decision on the level of service to be provided (see Chapter 7), the requirement that they make a capital contribution (whether in money, materials or labor) will ensure that this decision is carefully considered;

f) it will establish the principle of payment for services received; this will become more important if, at a later stage of development, a higher level of service is desired.

The WHO Survey showed that 20% of the countries studied required villages to make some payment towards capital costs, and 70% some payment towards operating expenses. However, the Bank's experience is that in many countries these policies are not consistently enforced.

4.11 Even with a decision in principle that villages should meet part of the costs, determining their ability and willingness to pay remains a

serious problem. Attempts to establish guidelines have not been successful because of lack of reliable data on rural incomes, and because many villages have essentially a barter economy and little cash changes hands. IDB have found that communities can be expected to pay between 3 and 20% of the capital costs of their systems, averaging about 10%. Water charges, set at about 3 to 5% of the income of the head of the family, cover at least operation and maintenance costs and possibly also some depreciation. Very rarely can families pay more than 5% of their income in water charges.

4.12 The systems installed in IDB projects provide a fairly high level of service, with at least 50% of families served through private connections. This suggests that, provided the level of service is carefully tailored to the villages' needs and resources, similar levels of payment could be required elsewhere even if per capita incomes are lower than in Latin America. Reasonable <u>minimum</u> levels of payment required from villages might then be (i) 10% of capital costs and (ii) all operating and maintenance costs. These levels would be applied to the "basic system" costs, with a supply through public hydrants. Where individual householders require private connections, they should normally meet the full additional costs, possibly with the assistance of some form of revolving loan fund.

4.13 While contributions to capital costs and to operation and maintenance expenses are both important, more stress should be laid on village coverage of operating expenses than on its contribution to capital costs. It is generally easier to ensure that the capital costs are provided for in a defined program, and experience shows that many rural systems break down shortly after completion due to lack of funds for operation and minor repairs.

4.14 If a village is unable to make a cash contribution to the capital costs of a scheme, labor or materials should be accepted instead. Use of village labor in this way may seem desirable because of the additional employment generated, but on a number of projects an unreliable work force has led to delays and difficulties in project execution. In particular, project work will be severely curtailed during peak agricultural seasons such as planting and harvest.

4.15 To increase the funds available to the program, the minimum levels of payment suggested in paragraph 4.12 should be reviewed in every project and raised when possible. This may be done by establishing different levels for different sizes of villages or for villages in areas with differing economic potential, provided that this is perceived by the villagers as equitable. It may even be done on a village-by-village basis, as is done in some Latin American countries, where villages vie with one another to make the maximum contribution and so get higher priority in the program.

4.16 Application of the minimum levels to each individual village enables each village to understand clearly the financial implications of installing a water system. There are, however, a number of complicating factors which may make it more desirable to establish levels for groups of villages or by some other category:

a) Other things being equal, systems for smaller (usually poorer) villages are more expensive per capita than those for larger (usually more prosperous) villages. Requiring each individual village to make payments at the predetermined level may have the result that only the larger villages qualify for new systems. This is probably desirable from the standpoint of economic growth but less desirable on social grounds.

b) Since groundwater systems are generally much cheaper than those using surface water, more villages will qualify in areas where groundwater is available, even though the need in these areas may be less.

c) The relationship between per capita costs of installing and operating a system and per capita income will vary from village to village and from country to country. The most expensive systems may be required in the villages least able to afford them.

4.17 There may also be a number of circumstances in which it may be unreasonable to expect villages to make a capital contribution, for example:

- resettlement schemes, in which people are to be attracted to new villages by the services provided;
- rural development projects in which the cash incomes of villagers will not increase markedly until crops mature, perhaps after a number of years.

In these cases the capital contribution may be largely replaced by higher water charges, covering not only operation and maintenance but also depreciation.

4.18 The decision on the levels of payment and the way in which they are to be applied has to be taken by government, since it will be responsible for funding the program. It is extremely difficult to draw up general pricing rules when the ability to pay and the system costs may vary widely from village to village, and when "social" objectives are an integral part of the concept of the program; each decision will have to fit the specific case. Whatever decision is taken, it should be reviewed periodically and the targets altered if necessary, to reflect changes in village economic conditions and water

consumption patterns. Frequently the basic data on which to base such a decision -- for example, sector needs, estimates of capital and operating expenses, villagers' ability to pay -- is not available; the use of sector surveys to supplement sector information is discussed in Chapter 8.

Collection

4.19 The financial performance of village water supply programs will almost invariable be well below that normally required on urban projects. The reasons for accepting lower standards are pragmatic, based on experience. The typically low incomes of villagers, and the existence of some alternative source of water -- however inconvenient and unsafe -- simply makes it impossible in most cases to charge the full cost of the service. The real problem will be to collect any charges.

4.20 Urban systems with a high proportion of house connections can base charges on metered consumption, with a rigorous disconnection policy to enforce payment. This cannot be used in villages where the majority of consumers are dependent on public hydrants. Charges in these cases are usually unrelated to individual consumption, although, by metering the pipeline serving the village, they can be made to reflect the total village consumption. 1/ Typical methods used are individual or family fees, head taxes, use of part of the state revenues received by the village, a water

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1/ In some urban systems, water from public hydrants is sold by the measure, either by the water undertaking or by a subcontractor. The complication and expense of such a system would not normally be justified in a village. The effect of this system is usually to make water very expensive; even if only 1¢ is charged for a 20-liter container (a typical size in many countries), this is equivalent to $\$0.50/m^3$, probably several times the cost of supply. Stated another way, a family of six with a daily consumption of 25 lcd would pay about $5/person/year for water bought in this way.

tax or assessment on property, etc. Charges to commercial or industrial (if any) consumers and to domestic consumers with private house connections should normally be based on metered consumption at rates which approximate the full cost of service. Charges for some house connections for poorer families might be fixed, based on estimated consumption, with a flow-limiting device in the supply line to reduce wastage. In general, charges related to consumption are the most equitable and the easiest to collect. The choice between the other methods is largely dictated by local conditions, and should normally be made on the grounds of administrative simplicity and likely effectiveness.

V. ORGANIZATION AND MANAGEMENT

5.01 Institutional weakness is probably the most important single problem in rural water supply. This weakness manifests itself in various ways, in particular a lack of any central policy for rural water supply, and a multiplicity of ineffective and understaffed ministries and agencies with responsibilities in the sub-sector. Much of the efforts of development agencies in urban water projects over the past 10-15 years has been directed at creating strong, competent and financially viable institutions. Little effort has been made to bring any order to the rural sub-sector, which is inherently more dispersed and heterogenous, and where the problems are far greater.

5.02 This chapter discusses some of the common institutional problems in the rural water sub-sector, and then examines the implications for various alternative ways of executing village water programs.

Common Institutional Problems

5.03 In most countries there is no national policy for rural water supply. Although overall national objectives such as the UNDD targets may nominally have been adopted, these have usually not been translated into actual objectives for the various agencies responsible, and their financial and other implications, both for the government and the agencies, have not been assessed. As a result, the objectives are unlikely to be achieved.

5.04 A major factor contributing to this situation is the numerous agencies responsible for rural water. Typically, the Ministries of Health and Agriculture may be responsible for supplies to small villages or the

dispersed population, and the Ministry of Works for larger villages and small towns. Where they exist, national or regional water authorities or rural development agencies will also be involved. Approval for the development program for new projects may have to be obtained from the Ministry of Planning, and funds for both construction and, in many instances, operation and maintenance, released through budgets agreed with the Ministry of Finance. In larger countries the situation may be further complicated by the existence of both national and state governments. In most countries an effort should be made to reduce the number of agencies involved in the sector, and to improve coordination between them. Sector surveys, discussed in Chapter 7, may be needed to identify areas of inefficiency and duplication in the sector organization and propose improvements.

5.05 In almost every country there is <u>inadequate staffing</u> of the agencies responsible for rural water. In most, this is a reflection of a general lack of suitably qualified staff in government service, accentuated by a number of factors which make rural water supply particularly unattractive: low prestige; low salaries; poor living conditions in outback areas; low technological standards affording little stimulus to engineers and other professionals; little scope for career development. If a government wishes to achieve its rural water objectives it must either have adequate staff in its own institutions to perform the task or must sub-contract part of the work to consultants or other organizations in the private sector. Since the need may persist for several decades it would usually be advantageous to increase capability in the public sector and use consultants and outside organizations only for specialized tasks. For this to be possible, the salary

structure for rural water supply personnel in the public sector must be made competitive with that in the private sector.

5.06 Few countries make adequate provision for training rural water supply personnel, and most village water programs should include a substantial training element. Ideally, and whenever possible, this should be integrated into a national training effort for the sector as a whole; few countries can afford separate training facilities for urban and rural water supply personnel. In assessing training needs, the whole range of skills must be considered: local staff such as plumbers, operators and mechanics; tradesmen such as bricklayers, pipe layers and well drillers; supervisory staff such as foremen and sanitary inspectors; technical professionals such as engineers, chemists and bacteriologists; accountants and their support staff; administrators and community organizers. A careful inventory should be made of the extent to which the required skills are already available in the country; often civil or sanitary engineers are found working in other fields because of better salaries, career opportunities or conditions of service. These qualified staff should be attracted back to the sector if possible. Preparation of training programs is a specialized skill, and, since the programs will need to fit local circumstances, local experts should be used as far as possible.

5.07 In the early stages of rural water projects there may not be a need to establish large training centers, since facilities may not be constructed at a rate sufficient to absorb the newly-trained personnel. In these circumstances demonstration projects providing on-the-job training in fundamentals are probably the most useful and flexible means of training, so long as they are carefully designed to provide adequate instruction. In integrated rural development projects advantage can be taken of training and education facilities established for other components of the project, which may in many cases also involve instruction in the operation and maintenance of unsophisticated mechanical systems.

5.08 The general lack of methodology for project selection, discussed further in Chapters 6 and 7, combined with the multiplicity of agencies, has the result that the rural development program actually carried out tends to be an aggregation of projects selected by individual agencies, with little overall regard for sector objectives, needs, or development potential. Institutional strengthening and better coordination in planning are necessary to improve the situation.

5.09 **Operation and maintenance of rural water supplies is one of the most neglected responsibilities of rural water agencies.** **Often funds are allocated for construction without** any assessment of the costs and manpower requirements of running the completed project. This seems particularly likely in rural development and similar multi-sectoral projects, where the water supply component is sometimes regarded as only an accessary to the other developmental objectives of the project. This is an important defect, since the Bank survey showed that operation and maintenance is by far the weakest aspect of most village water programs. Poor or non-existent administrative and technical support and lack of operating funds were cited as the most frequent causes of failure. In one country, 69 out of 79 systems had had difficulties in operations. In another, village systems were failing almost as fast as new ones were being built.

5.10 The administrative framework adopted for a village water program must, therefore, have adequate vertical links. Planning, and to some extent construction, can be administered from the top, but to ensure continuing operation, support for the village systems must be readily available. This support must cover technical advice, operator training, water quality supervision, keeping a stock of spare parts, etc. It may also need to cover

recruitment of staff and supervision of operations. The cost of establishing and maintaining this support structure will be substantial, and is frequently overlooked when planning a program. In Chapter 4 it is emphasized that governments, when they first embark on village water supply programs, must make a commitment to meet these initial costs and also any operation and maintenance costs that cannot, in the early years of operation, be recovered from the villages themselves.

Alternative Formats for Village Water Programs

5.11 Village water programs can be undertaken in various ways, each requiring a different administrative approach:

- as part of a national or regional water supply program, including both urban and rural elements;
- as a rural water supply program; or
- as part of a regional integrated rural development project, or similar multi-sectoral project.

In most countries several ministries and national agencies are active in rural water supply, using some or all of these various formats. The situation is even more complex in countries where there is a considerable amount of local autonomy, with little direction and support from central bodies. However, in every case the basic requirement is the same: that the three stages of project implementation -- planning, construction and operation -- be efficiently carried out. In the following paragraphs each of these formats, and its institutional implications, is discussed.

5.12 If village water programs are included in national or regional water supply development programs with both urban and rural elements, an institutional framework such as a national water agency probably already exists, which needs to be expanded and extended to the new areas to be served. This approach is likely to make the best use of scarce technical and administrative talent and to ensure a consistent application of sector

policies. Tunisia, Brazil and Ghana are typical of the countries using this approach. Brazil, in fact, uses an effective two-tier approach: broad policies and financing arrangements are decided at national level, while state water companies are responsible for detailed planning, construction and operation.

5.13 Where village water supplies are constructed under a rural water supply program administered by an agency with no responsibility for urban water activities, projects involving a large number of villages usually require a major effort in institution building, which must begin with manpower development. This is time-consuming and places a heavy burden on existing staff. The arrangement is perhaps most successful when it deals with a large number of low-technology systems.

In other cases there may be a considerable overlap in the technological requirements of the larger village systems and the smaller urban ones, particularly where surface water is used, and so this arrangement can lead to duplication of effort by the separate agencies.

5.14 The third format for executing village water supply programs is as part of a multi-sectoral project such as integrated rural development. The problem in these cases is that the water supply component has to be completed in accordance with the main project schedule, which may typically call for disbursements to be completed within four years. This is feasible provided that institutions for administering village water projects already exist, need little change and can be called upon for assistance. Where these

institutions do not exist or are very weak, design and construction can be contracted out and expatriate personnel employed to supervise construction and later assist with operation. However, four years may not be sufficient time to build the regional water organization, make proper arrangements for village participation, agree on financial policy and introduce satisfactory operation and maintenance procedures. This problem applies primarily to the water component of the project, where individual villages may have responsibilities for operation, maintenance and collection of charges; other components such as roads, rural electrification, education and irrigation can go forward with existing centralized organizations, since they require much less local input.

5.15 If a competent national agency with responsibility for rural water supply exists, it should be entrusted by the main project agency (for example, a rural development agency) with responsibility for execution of the water supply components of the integrated project. This should ensure that, after completion, the new water supply systems are properly operated and maintained. It will also make best use of existing expertise, ensure consistent application of sector policies, and share experience gained from the project with projects in other parts of the country.

5.16 If a national agency does not yet exist or is incompetent to undertake the project, there are two alternatives:

- create or strengthen the national water agency;
- establish a water supply unit within the main project agency.

The former is preferable, not only for the reasons given in paragraph 5.15 above, but also because it avoids proliferation of the number of agencies

with responsibilities in the sector. However, the water supply component of the main project may be too small to provide sufficient leverage to improve the water sector institutions to the necessary extent, and in such cases the second alternative may have to be adopted. If this is done, this unit would work in as close cooperation as possible with the national agency responsible for rural water supply; in particular, the unit would be responsible for ensuring that the water pricing policy adopted for the program would be consistent with the national pricing policy, so that the villages' decision on the level of service they can afford is based on a realistic assessment of what it would cost them. The unit's exact responsibilities and affiliations would have to be determined for each individual case, but with any arrangement of this sort, particular care has to be taken to ensure proper continuing operation and maintenance of the water supply component.

VI. THE JUSTIFICATION FOR INVESTMENT IN VILLAGE WATER SUPPLY

6.01 Governments have to take two sorts of decisions on village water supply investment. The first is inter-sectoral -- why invest in village water supply rather than in other sectors of the economy? - and the second intra-sectoral -- for a given total investment, in what order should individual village projects be executed? This chapter discusses the first aspect, and Chapter 7 examines factors affecting project ranking.

6.02 The most important direct benefits from improving the quality and quantity of water available from village water supplies are improved public health and greater convenience, both of which may increase productivity. Indirect benefits commonly cited are slowing down of rural-urban migration; redistribution of real income in favor of the rural poor; and the development of village institutions. Each of these is discussed in this chapter. However, in common with other sectors such as education, it is not yet possible to measure these benefits adequately. Inter-sectoral allocation cannot, therefore, be done on the basis of precise cost:benefit analyses, but is essentially a matter of public policy, reflecting the prevailing sense of national priorities.

6.03 This chapter does not attempt to define what those national priorities should be. The comparison between past investment in all sectors and the investment needed to meet the 1981 UNDD goals for rural water supply shows great differences between various countries, and each country must assess its own investment priorities. This chapter confines itself to describing the benefits of village water supply investments so that these

and the corresponding costs (see Chapter 3) may be compared with those in other sectors.

6.04 A distinction must be drawn between the justifications for investments in urban and in village water supply systems. Investment in urban water supply is relatively easy to justify even though not all the benefits can be determined precisely: an adequate supply is essential for industry and commerce; in most urban areas there are no satisfactory alternatives to a public system; and there is a risk of major epidemics if a proper supply is not provided. In addition, revenues from water charges in urban systems, which can be used as a minimum approximation of economic benefits, are usually sufficient to meet all costs and provide a reasonable rate of return. However, these factors are progressively less applicable as the size of the service area decreases: in smaller villages there is little commercial activity and almost no industry; other sources of water, of varying degrees of reliability, safety and convenience, usually exist; and an outbreak of disease, should one occur, is likely to be confined to fewer people. In addition, as discussed in Chapter 4, few villages will be able to meet more than the costs of operation and maintenance, so that the financial rate of return on the project will be zero or negative. Attempting to increase these charges in order to obtain a financial performance comparable to urban systems will be extremely difficult in most cases and could cause villagers who have not yet appreciated the benefits of a safe water supply to return to their traditional polluted sources. Justification of village water supply projects therefore must depend largely on non-quantifiable factors.

6.05 This chapter continues with a discussion of various commonly cited benefits of investment in village water systems, and examines the validity of each.

Public Health Benefits

6.06 Numerous epidemiological studies have identified contaminated water as the principal agent in the transmission of typhoid and cholera. Lack of safe water for drinking and washing is also an important factor in the spread of diarrheal diseases, which are possibly the most important single disease group throughout the developing world: half the deaths in the developing world occur in children under five, with diarrheal diseases being the most common cause. Numerous other diseases are also linked to poor water supply or sanitary conditions. 1/

6.07 It would therefore be expected that improving community water supply would result in measurable increases in public health. However, health impact studies so far have often failed to demonstrate this link conclusively. One obvious difficulty is that diseases such as cholera are epidemic in character; if cholera is present in a village its effects are so rapid and so severe (mortality ranging up to 75%) that it is usually not feasible to control it solely by improving water supply -- case isolation and immunization are also needed. If it is not yet present, the contribution of better water supply in preventing an epidemic is difficult to estimate.

1/ The relationship between water and health is discussed at greater length in Warford and Saunders (Chapter III) and in Bank Report 554a: Background Paper on Health (especially paras. 41 ff).

A second difficulty is that few if any diseases are transmitted by only one medium; typhoid, cholera, some forms of dysentery, and infectious hepatitis are very frequently caused by drinking water contaminated with human wastes, but may also be due to contaminated food, milk, and to a lesser extent to other vectors such as flies. Despite these difficulties in exact measurement, the strongly held opinion of public health officials is that provision of safe water is of prime importance to public health and, in combination with other sanitation measures, is an essential pre-requisite to eradicating many endemic diseases.

6.08 The effect on community health of providing a safe water supply depends on the extent to which the community makes use of the supply, and this in turn depends on social customs, understanding of health implications, and on the level of service provided. If water has to be carried from distant wells or public standpipes, the quantity fetched is usually small. Use of this safe water for drinking and cooking substantially reduces water-borne diseases such as typhoid, cholera and amoebic dysentery, but there may be insufficient supply for proper personal hygiene, so that "water-washed" diseases such as trachoma, some skin diseases, and bacillary dysentery cannot be effectively controlled. There is also the risk that the safe water obtained from the source is contaminated in transit or while being stored prior to use. Moreover, continuing use of ponds and streams for laundry and personal hygiene means that the villagers are still vulnerable to parasytic infections such as schistosomiasis and dracontiasis (Guinea worm). Making water more readily available -- ideally through house connections, but, if these cannot be afforded, by providing community laundry

and ablution facilities -- will help reduce the water-related diseases including those resulting from water contact.

6.09 If villagers have frequent contact with polluted water (for example, for laundering, bathing, fishing or paddy cultivation), improving water supply will only have a limited effect on reducing diseases such as schistosomiasis (bilharzia); in these cases additional means must be found to break the chain of transmission. The studies cited by Saunders and Warford suggest that improving both water supply and methods of excreta disposal may be more effective and less expensive than controlling the snail vectors by molluscicides, and similarly, for long-term control, may be more efficient than immunization for cholera and typhoid. Excreta disposal systems (usually of a very simple type, such as pit latrines) should be considered as counterparts of village water supply programs in improving public health, and executed at the same time where resources permit.

6.10 Often villagers do not appreciate the benefits that can be derived from improved water and sanitation systems. Health education programs are necessary to instruct them on the dangers of drinking or coming in contact with contaminated water, and on elementary hygiene. Health educators should make a preliminary visit to villages at an early stage of project preparation in order to stimulate interest in improved systems, and as part of the effort to organize the villages. Health education programs need to be ongoing and should begin early, continuing on for several years after the project is completed. This will help to ensure that full health benefits are obtained. 1/

1/ Health education is, however, both expensive and demanding on trained manpower. For a four-year program of rural water supply in one State of India, planned to serve 500,000 people, it was estimated that health education would add 10% to project capital costs and require about 1,200 trained staff.

6.11 It is sometimes argued that increasing the quantity of water available to villagers is more important than ensuring its quality. However, it is obvious that an unsafe supply (that is, one that is not adequately safeguarded against possible contamination) not only will fail to protect consumers against waterborne diseases but also may serve to transmit these diseases more widely than would have been the case had consumers still been dependent on their own private sources. The net health benefits of an unsafe source may therefore be negative. Moreover, the "quality vs. quantity dilemma" is often more apparent than real. Groundwater supplies, properly designed, are usually safe without additional expenditure on treatment. Surface water supplies frequently need treatment such as filtration to make them acceptable to consumers and prevent clogging of pipes by silt, and the extra cost of disinfection is a small proportion of system costs (see Chapter 3). Throughout this paper it is assumed that all new systems are designed to provide safe water.

6.12 At present it is not possible to predict with sufficient accuracy the physical, let alone the economic consequences of improved water supplies. However, the Bank is currently employing a high-level panel of medical experts to help to determine whether refinement of health-impact studies to precede or accompany village water supply projects is feasible or desirable, and whether such studies will lead to a mechanism for a more accurately predicting the extent of disease reduction resulting from improved water supplies.

Productivity Benefits

6.13 Improving village water supply may be an essential step in the development of village industries such as fish processing and freezing, fruit and vegetable production, or cloth dyeing. The benefits from these activities can be measured directly. It can also increase individuals' productivity in two ways which are readily identifiable but which are difficult to quantify: reduction in the time and effort spent fetching water 1/, and increasing individuals' output through improved health. The latter effect is two-fold; absenteeism is reduced, and workers' strength, stamina and ability to concentrate is increased (however, in the absence of growth potential, it may not be possible to achieve very much real increase in output; as discussed below, the effects may be only to increase under-employment and possibly encourage migration). Reduction in enteric and parasytic disease also results in better utilization of food, and so avoids waste of scarce resources. 2/

Slowing of Migration

6.14 Most developing countries are experiencing a high rate of migration from rural to urban areas, which strains their social and economic infrastructure. If this flow could be reduced, the cities would be better able to absorb immigrants, generate employment, and cope with internal development problems. However, whether or not a slowing of migration is

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1/ White, Bradley and White, in "Drawers of Water" estimate that for some rural African settlements over one quarter of one person's daily energy requirement is used in fetching water; for individual households the figure could be as high as 80 to 90%.

2/ For a fuller discussion of this type, see Bank Report No. 554a, "Background Paper on Health," paras. 63 ff.

desirable, in the sense that it would represent a net gain in national productivity or improve income distribution, depends upon many factors, in particular upon the relative marginal productivity of human resources in urban and rural areas and upon the rate of rural population growth. Moreover, there is little evidence on the effect of improved rural water supplies on migration, and that which exists is contradictory. At the individual level, better water supply reduces the "push" component of migration from the villages to the towns; on the other hand it does nothing to reduce the "pull" component (better jobs, higher incomes, greater educational opportunities). Improvements in health, in particular reduction in infant mortality, associated with better water supply may (at least in the short term) aggravate the problem of rural underemployment and lead to more migration rather than less. At the community level, good water supply is only one among many infrastructure components (roads, schools, markets, etc.) essential for the development of village growth centers; by itself it is unlikely to have a significant effect, but on the other hand its absence will prevent, or at least greatly hinder, development.

6.15 Another difficulty is in assessing the contribution of local growth centers to slowing migration, since some studies suggest that the typical migration pattern is from the dispersed rural population to the nearest large village and then, after an interval, to a larger urban area. If this is correct, creation of village growth centers, by making the initial transition from dispersed rural life less difficult, might actually increase migration. This effect might be prevented if the development of

the growth center were part of an integrated rural development program which, by providing more agricultural opportunities, encouraged workers to stay on the land.

Income Redistribution Effects

6.16 Income redistribution from more prosperous urban areas to less prosperous rural areas is a common feature of rural water supply projects, since most are not financially viable and need support, whether from central government revenues or from a national water authority. However, unless a water supply development helps associated agricultural or other development, it represents a diversion of the country's limited external and internal resources from investments that would maximize economic growth (which might require concentrating infrastructure investment in urban areas). The extent to which this should be done in order to achieve essentially social objectives needs most careful examination as part of the decision on inter-sectoral allocation discussed above.

6.17 It should be noted that the income redistribution effect of rural water supply schemes is not always as simple as it may appear. In many countries it is the wealthier villages which receive priority in obtaining water supply becuase they are most pressing in their demands and also most closely meet the criteria for selection discussed in Chapter 7. The population of these villages may actually be in less need of support than the inhabitants of the urban slums; if this is the case income redistribution can more effectively be achieved within urban water projects, by cross-subsidies from higher income urban consumers to those living in the fringe areas.

Improvements in Village Institutions

6.18 Many villages in developing countries lack an organization of community leaders capable of dealing with present-day problems. It is sometimes argued that a community water supply project is one way to encourage the emergence of such leadership, which would be able subsequently to deal with other community problems. It is also argued that, because the village is required to pay for a valued service such as water supply, it will develop a "habit of payment" for other worthwhile goods, and that this willingness to pay will signal to planners that the village should be selected for further development. Both of these arguments are intuitively reasonable, but there is as yet little evidence to support them.

Serving More People for a Given Investment

6.19 It is often argued that village water systems maximize the population served per unit of investment. This is true to some extent, primarily because village systems normally provide a lower standard of service than urban ones. Urban systems are normally designed to provide continuous high-pressure piped service, with adequate reserve capacity for emergencies such as fire-fighting, and a number of urban consumers will have private house connections. Rural systems, on the other hand, may be quite satisfactory if they provide a safe supply of a few liters per person per day from springs or through protected wells fitted with hand pumps. This lowering of the standard of service can more than offset the economies of scale and density in the construction, operation and administration of water supply systems which normally favor concentrated urban populations.

It is, however, unwise to generalize; if ground water is not readily available, a rural system which needs a new dam and impounding reservoir may, despite lower standards, be more expensive per capita than an urban system. 1/ It may also be relatively inexpensive to extend urban services to low income areas where the supply is to be given through public standpipes. The problem in determining the true per capita cost in these cases is in valuing the investments already made (in dams, treatment plant, transmission and primary distribution pipelines) which make this cheap extension possible. However, as discussed in paragraph 6.04, investment in urban systems may be essential to serve commerce and industry and to provide water to areas where there is no alternative to a public supply. For more countries than not, the urban vs. rural choice does not really exist; the question is rather how much additional resources can they devote to rural systems after meeting the pressing needs of the urban areas.

1/ Of the countries responding to the WHO Survey, about one-third estimated that rural water supply was more expensive per person served than urban supply through standpipes. Since the cost estimates for rural water supply generally appear to be more underestimated than those for urban, in practice the proportion would be higher than one-third.

VII. PRIORITIES - SELECTION OF SUB-PROJECTS

7.01 The previous chapter discussed factors which could justify investment in village water supply rather than in other sectors of the economy. Whatever sums government actually decides to invest in village water programs, implementation of the programs will take a number of years. Decisions therefore have to be made on the order in which individual village sub-projects will be executed.

7.02 This chapter examines this ranking of sub-projects. It discusses the use of sector surveys to obtain data on which to base decisions on sector policy. Since, as discussed in Chapter 6, it is impossible to make rigorous cost:benefit analyses of the effects of village water programs, ranking is in practice a matter of judgment on the merits of various sector objectives and on the characteristics of individual villages. These characteristics are discussed, and it is concluded that village enthusiasm for a new water scheme, as shown by willingness to pay for it, is probably the single most important factor in deciding whether to construct that scheme. The need for a pragmatic and flexible approach to program planning is stressed.

Sector Information

7.03 A common problem is lack of even basic information about the sector. A sector survey is frequently necessary in order to acquire comprehensive information and data in reasonable depth. This survey should, in addition to data collection, identify the principal problems and constraints, analyze the strategy for development (or by examining alternatives,

help to develop such a strategy), estimate needed investments, and recommend policies, institutional improvements and other measures necessary to assure the program's success. 1/ This work is extremely important, and must be carried out by competent and experienced staff. It may be done entirely by local experts, but often some external assistance is required. 2/

Program Objectives

7.04 Typical government objectives for a village water program are:

- to provide safe water to as many people as possible;
- to reduce waterborne or water related diseases;
- to encourage rural development;
- to improve living conditions for the rural poor.

Any country-wide program will normally include all these objectives, since they are to a considerable degree inter-related. However, for a given expenditure there will always be trade-offs, for example, between maximizing the number of people served and achieving maximum public health benefits.

Factors Affecting Ranking

7.05 Ideally, ranking of village sub-projects within the overall framework of the government objectives should maximize the net social and economic benefits per unit of investment. This is difficult to do since, as discussed in Chapter 6, many of the benefits of water projects

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1/ The Bank's Public Utilities Department has prepared guidelines (Publication GAS 4) in English, French and Spanish to help governments in carrying out sector surveys.

2/ One of the main functions of the WHO/IBRD Cooperative Program is to provide this kind of assistance, without charge to the country concerned.

cannot be quantified. The use of financial criteria alone as a screening device is also unsatisfactory, since the many social benefits would be effectively ignored.

7.06 The final ranking of sub-projects is therefore dependent on a largely subjective evaluation of a number of factors. The principal factors are discussed below, divided arbitrarily into three groups: village need, village potential, and system costs. The most important group is probably the first, although since any program is likely to be subject to fairly severe budget constraints the third must also carry considerable weight.

Village Need

a) Village interest

Community interest and involvement is probably the most important single factor, and is discussed separately in paragraphs 7.08 - 7.11 below.

b) Adequacy of existing supply

Adequacy in this context covers not only quantity but also convenience, reliability during drought, and quality.

c) Prevalence of waterborne disease

Reliable statistics are usually unobtainable, but Ministry of Health and similar officials are frequently aware of areas where waterborne diseases are most common. Evaluation of the weight to be given to this factor is particularly difficult since there are a number of options on the level of service to

be provided and these have very different per capita costs and are likely to result in quite different health benefits (see discussions in Chapters 3 and 6).

Village Potential

d) Growth potential of the community

Lack of adequate water supply may prevent the development of villages' economic potential, for example, as markets, food or fish processing centers, or as local health or education centers. The villages may also be unable to obtain sufficient water for productive non-domestic use, for example, for agriculture, livestock, vegetable cultivation, preparing produce for market, or cottage industries such as cloth-dyeing.

e) Village institutions

Generally, villages with strong, competent institutions and better educational levels will be more able to participate in the drawing up of a program (see (a) above), to collect water charges, and to find operation and maintenance staff from among the villagers.

System Costs

Each sub-project must, of course, be examined to determine that it represents the least-cost means of providing the required service. In addition, certain factors have a bearing on how many least-cost sub-projects can be executed within a certain budget ceiling:

f) Population distribution

Other things being equal, the larger, more densely populated villages will need lower investment costs per capita. Systems

for a group of villages that are close together may be lower in capital cost (possibly using a common source of supply) and cheaper to operate and administer than those for more scattered villages.

g) Nature of new water source

The effects on costs of type of source and distance from the village are discussed in Chapter 3.

h) Level of service

The effect of level of service on costs is also described in Chapter 3, and the village involvement in deciding the most appropriate level is discussed in paragraph 7.08 below.

i) Accessibility

Systems for villages without good road access will be difficult and expensive to construct and maintain. Lack of access also probably indicates low development potential (see (d) above).

7.07 Many factors listed above are also factors which should be taken into account when selecting villages to benefit from an integrated rural development project. This underlines the need for the agencies responsible for rural water supply and for general rural development to maintain close liaison.

Village Involvement

7.08 The first item in paragraph 7.06 refers to village participation. Experience from many countries indicates that systems are better maintained, less abused, and have a higher level of financial performance if the villages

to be served are selected because they express a real interest in having a new or improved system. In some countries (for example, the Dominican Republic), special "promoters" visit villages to find out which are interested. The best evidence of such interest is village willingness to contribute to construction costs and to pay an adequate fee for water use once the system is in operation; possible levels of village payments are discussed in Chapter 4.

7.09 If villagers have to contribute to capital costs and have to meet operation and maintenance expenses, the level of costs obviously becomes of concern to both villagers and planners. The latter may want to limit the level of service to be provided because this affects the number of people that can be reached with a given amount of resources. On the other hand, the villagers should be given as good a system as they are willing to pay for. This is the basis for the widely held opinion that the system design of each sub-project should be decided in consultation with the villagers, who are told about the alternatives available under the program and the financial consequences of each. This policy helps to ensure that the "right" system will be provided, and also increases the participation of the villagers and so their sense of responsibility for the system.

7.10 This process of consultation requires time; where programs have to be executed to meet externally imposed timetables (for example, as part of integrated development projects), systems may have to be installed with little previous local input, no clear sectoral policies, and without a proper analysis of many of the factors listed in paragraph 7.06. This is particularly likely to be the case when a decision is taken -- whether for political, agricultural development, or other reasons -- to improve rural water supplies to all villages throughout a particular region. While such

decisions may be essential, it must be recognized that inevitably a number of these systems will fail or prove to be unsuitable, and that collection of revenue is likely to be particularly difficult.

7.11 On the other hand, approaches to villages to enlist their participation should be made only when the project can be implemented promptly thereafter. Several studies have shown that when there is an interval of months or even years after consultation before any results are apparent, the villagers become disillusioned and cooperation is severely reduced.

The Final Ranking Decision

7.12 The final ranking of sub-projects should be based on an evaluation of all the factors discussed above. The discipline of formulating alternative rankings and estimating the extent to which they are likely to meet objectives ensures that recognition is given to the subjective weightings implicit in eventual project selection. Different weightings may be found appropriate for different regions within the same country, and planners should not apply inflexible criteria. The process may also indicate that certain of the objectives are not suitable and should be changed.

7.13 The preparation of water supply programs must be very pragmatic. It will usually develop as a response to villages' obvious needs and government's desires, and what may appear to be a complex process of priority setting will in practice be a common sense approach. Frequently the original plans will need to be modified as the program unfolds. Careful monitoring, especially of the initial stages, is therefore essential, to test whether the approaches being used are sound and to change them if necessary.

VIII. IMPLICATIONS FOR THE BANK GROUP

8.01 The problems described in the preceding chapters -- weak institutions, poor financial performance, inability to expand service to meet the needs of a growing population, frequent breakdowns of existing systems -- clearly indicate the potential for Bank Group assistance to village water programs, since it has considerable experience in dealing with complex, multi-dimensional problems of this nature. The Bank's most important role would be in building up local capability for project planning, execution and operation, rather than in transfer of capital alone.

8.02 The Bank Group is increasingly concerning itself with rural development, and in particular the needs of the poorest segment of the rural community. Since better water supply is an essential part of any program to improve health and living conditions in rural areas, there is therefore the opportunity for the Bank Group to have a considerable impact on the rural water situation.

8.03 This chapter discusses the magnitude and future Bank Group lending for village water supply. It concludes that it is not at present possible to make specific recommendations on the amount of future Bank lending for these operations. In the short term lending will be largely in response to the needs of operations in other sectors, particularly intergrated rural development. Further studies, in particular sector surveys and economic missions, will be required to identify the needs and absorptive capacity in individual countries, and to establish priorities between investments

in village water systems and in other sectors of the economy. In the longer term it will then be possible to draw up country lending programs for village water systems.

8.04 The chapter also examines the way in which the Bank Group should approach village water supply programs, in particular the problems of project preparation, justification and financing. The implications for staffing are also discussed. It recommends that, because of the long lead time for project preparation, water supply specialists are called in as soon as a project with a possible water component is identified; that, while every effort should be made to maximize user charges, it should be accepted that the financial performance of projects will be poor; that it should similarly be accepted that it will be difficult or impossible to demonstrate the economic justification of projects; and finally, that an expansion of water supply staff will be needed to achieve the Bank Group's objectives and that, until needs can be more exactly assessed, one or two additional staff should be recruited for the Public Utilities Department to support the present regional staff.

8.05 The Bank has not yet had enough experience in rural water supply to establish firm policies on the criteria to be adopted in deciding whether or not to finance a particular rural water supply project. The Public Utilities Department proposes to follow the development and implementation of projects and to issue periodically a summary "state of the art" paper. Meanwhile, suggested guidelines are set out in Annex 5; these are in effect tentative policies, subject to change as necessary in the light of experience.

Amount of Bank Group Lending for Village Water Supply Programs

8.06 The methods by which the Bank Group assists village water supply programs can be divided into two principal categories:

Type A - loans for projects in other sectors such as agriculture, integrated rural development, fisheries, etc., where water supply forms part of the project infrastructure;

Type B - sector loans, either for rural water supply alone or for part of a national program with both urban and rural elements.

So far, the principle Bank emphasis has been on Type A operations, but no consistent approach to the water supply component of these operations has been developed.

8.07 One of the objectives of this paper was to recommend the magnitude of future Bank Group lending, through these two methods, to help countries achieve the UNDD targets for rural water supply set out in Chapter 2. This objective has not been achieved. As far as the future lending program is concerned, it has not been possible to establish the number of Type A projects that might have a water component, nor the number of people who would benefit from such projects. This information will only become available when the projects in the program are more clearly identified. The "early warning" system proposed in paragraph 8.11 below will greatly assist this analysis. It has also not been possible to determine how many Type B projects are likely to be submitted for Bank appraisal, but the number will probably be small in the near future; the great majority of countries have limited local capacity for project preparation, and UNDP has only recently begun to place more emphasis on assistance for this work.

8.08 An order of magnitude estimate of future Bank lending for rural water supply, based on the November 1974 revision of the FY75-79 lending program, is that it may be about $80 million per annum. This figure, which is extremely approximate, is based on the following assumptions:

- 25% of the 425 programmed agricultural projects (total loans $9,330 million) will have a water component equal to 10% of total project cost;
- 10% of the 74 water sector loans (total $1,785 million) will be for rural water.

Even if this figure is substantially in error, it is evident that the Bank contribution presently planned is likely to be extremely small compared to requirements to meet the UNDD targets, which averaged over the decade are probably about $2,000 million per annum /current $ (see Chapter 2)/, or possibly over $3,000 million per annum for the remainder of the decade because of low expenditures during 1971-74.

8.09 This leads to the question whether these planned lending levels should be substantially increased in order to approach more nearly the expenditures necessary to meet the UNDD targets. No general answer to this question can be given with the Bank's present knowledge. It is important to note that the UNDD targets are arbitrary, in the sense that they take no account of the ability of each individual country to expand its water services at the required rate or to finance such expansion, and they also ignore the question whether this expenditure would be better spent in sectors other than water supply. The amount that the Bank Group should lend is therefore

related more to the country's absorptive capacity and development strategy than to the UNDD goals. 1/

8.10 Sector surveys (see para. 7.03) will be needed in many countries to obtain better information on country needs, institutional capabilities, and investment program. The countries to be studied cannot be identified until the proposed future Type A loans are more clearly specified; it is, however, likely that this activity will need to be increased above the present level of six or seven surveys each year carried out through the WHO/IBRD Cooperative Program, and that the surveys will need to place more emphasis than at present on the rural aspects of the sector. Means will need to be found to improve the efficiency and effectiveness of the Program before any substantial expansion could be contemplated. This improved sector information should then, in conjunction with input from other sectors into the Country Program paper, enable a village water supply investment program to be developed.

Project Development

8.11 Whether projects are executed under Type A or Type B arrangements, a long lead time is necessary for project preparation. This means that water supply staff must be involved in Type A projects as soon as any project is identified which may have a village water component. An "early warning" system should be developed so that it is possible to determine, at an early

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1/ This is illustrated by the Bank report on its Agriculture and Rural Development Sector Study in Tanzania (Report 541a-TA of December 10, 1974), which recommends a slowing of the establishment of "ujamaa" villages, with their high infrastructure costs, and a concentration on increasing agricultural production from existing settlements. A water supply investment program linked only to the "ujamaa" plan and not to overall development aims would therefore be inappropriate.

stage of a Type A project, what its objectives are and what its principal components are likely to be, so that the need for, and extent of water supply specialist involvement can be estimated.

8.12 Since the key to success in rural water projects is that it should be undertaken by a strong, competent organization, the Bank Group has a particularly important role in identifying and establishing the optimum institutional arrangement for each project. The leverage that the Bank Group can exert may be critical in resolving problems of inter-ministerial division of responsibility. The Bank Group should not finance a project until it is assured that adequate institutions either exist or will be established in accordance with an agreed timetable appropriate to the project. In general these institutions should follow the principles set out in paragraphs 5.12 - 5.16.

8.13 As early as possible in project development, water supply staff should review the proposed water component, in particular:

- the adequacy of existing institutional arrangements (paras. 5.03-5.10);
- the available data, especially relating to hydrogeology;
- the suitability of the technology and standard designs proposed (paras. 3.02, 3.04);
- the levels of service proposed (para. 3.04);
- that least-cost solutions are proposed;
- pricing policy (paras. 4.09 - 4.18);
- village organizations;
- health education requirements (para. 6.10);

- the desirability of including excreta disposal or other sanitation components in the project (paras. 3.19, 6.09); and
- training requirements (para. 5.06).

8.14 The initial review may also show that the detailed preparation of the water component is unsatisfactory and that further pre-investment studies should be undertaken. In cases where the project entity is in the process of being established, or where sector responsibility is divided between a number of organizations, it may not be easy to obtain finance for these studies from within the country itself. Funds can be obtained in such cases by application to agencies such as UNDP or UNICEF, and the Bank Group is also prepared to finance pre-investment studies either as a "piggy-back" operation on another loan or under a loan especially for this purpose, as has been done in Colombia, Chile and Indonesia, /and is proposed for Algeria.

8.15 An initial Bank loan for a Type B water supply project (excluding loans solely for pre-investment studies discussed above) could include a wide variety of elements: rehabilitation of existing systems; demonstration projects; pre-investment studies; sector data improvement such as water resources investigations, particularly groundwater evaluation; institution building; development of methodology and criteria; and training. Similar elements might be included in a Type A project, except there would normally be less emphasis on rehabilitation and more on the construction of new systems within the project area.

8.16 Most loans would tend to be on a sector loan basis: the Bank would agree with the executing agency the criteria to be applied to the

selection and design of sub-projects, but would not necessarily participate in the decision to invest in particular schemes. (The Minas Gerais, Brazil, project is being executed along these lines, and other similar projects are being prepared.)

Project Justification

8.17 As discussed in Chapter 6, it will rarely be possible to demonstrate the economic justification of investments in village water supplies by direct quantification of benefits. Moreover, the determination of project justification by consumers' willingness to pay -- a reasonably reliable approach in urban areas -- is often not feasible due to lack of perception of benefits on the part of consumers, political unwillingness to enforce payment, and lack of ability to pay. In the short term the Bank Group will have to accept this situation. However, Public Utilities Department is attempting to improve its evaluation technique, with special reference to health benefits.

8.18 These difficulties apply to both Type A and Type B rural water projects. Thus the fact that a Type A project may show an overall economic rate of return that exceeds the opportunity cost of capital does not convey anything about the merits of the water supply component. As in the case of entirely separate water supply projects (Type B), the costs of the water supply component should be made explicit and weighed against the associated benefits -- quantative or qualitative, tangible or intangible -- in the context of national priorities for public health and social services. Nevertheless, Type A water supply projects have certain advantages over Type B: for example, the characteristics of the target population will

probably be better understood, and complementary investments such as in health education and in agriculture will help to ensure that potential health and productivity benefits are realized.

8.19 A parallel situation exists for Type B village water supply projects which are part of a regional scheme, which perhaps involves some cross-subsidization from urban to rural consumers. Here it is desirable to estimate economic rates of return (according to the principles set out in Economic Evaluation of Public Utility Projects) separately for the urban and rural components, so that a judgment can be exercised about the legitimacy of expanding the network to increasingly high-cost and/or low-income areas.

Financial Performance

8.20 Only in exceptional cases will village water systems meet the financial standards normally expected by the Bank Group for public utilities -- full coverage of costs together with a return on the investment. The Bank Group should accept this situation, while trying at the same time to ensure that the pricing policy takes full advantage of consumers' ability to pay.

8.21 The reasons for maximizing user charges are discussed in Chapter 4; the most important are establishing the general principle of payment for services received and limiting the burden imposed on public finances by non-viable schemes. It is proposed in that chapter that villages should be required, as a minimum, to cover all operation and maintenance expenses and to make a contribution to capital costs wherever they are able. It is recommended that full coverage of operation and maintenance costs should be a minimum requirement for all projects financed by the Bank Group.

8.22 This level of payment should be achievable provided that villages are carefully selected according to the criteria proposed in Chapter 7, systems are tailored to suit their needs and resources, and villagers are given basic health education so that they perceive the benefits of better water supply and are willing to pay for it.

8.23 Since village water programs will not be financially viable, the Bank Group must obtain from the government concerned, before commencement of the project, a clear undertaking to provide both initial capital and any subsequent financial assistance necessary to ensure satisfactory continuing operation.

Bank Staffing

8.24 Operational responsibility for Type A projects will lie with the appropriate Rural Development, Agriculture or other division, and for Type B projects with the regional Public Utilities division. It is recommended that the water component of Type A projects be handled by the regional Public Utilities divisions acting in support of the division with operational responsibility. This should ensure efficiency, flexibility of staff assignments, consistent application of Bank Group policies in the water sector, and make best use of the Bank Group's knowledge of the water sector in any particular country.

8.25 The regional Public Utilities divisions are not now adequately staffed to provide this support. However, at present their needs for additional staff cannot be precisely assessed, since it is not clear how many Type A projects will be developed in the next few years. On the basis

of the very approximate assessment in paragraph 9.08, there will be 100 operations in FY75-79, with the cost of the water supply components totalling about $250 million. For comparison, in the same FY75-79 lending program there are 74 water sector operations with loans forecast to total $1,785 million.

8.26 Because of the problems discussed throughout this paper, the water supply components of Type A projects are likely to require a staff input out of all proportion to the components' cost. From the figures above, it appears likely that the workload of the water supply staff will be greatly increased -- perhaps doubled.

8.27 As discussed in paragraph 8.11, it is essential to develop an "early warning" system as soon as possible, so that Type A projects likely to require Public Utilities support can be identified; the Public Utilities divisions can then make appropriate staffing provisions, or in consultant budgets if staff are not available or cannot be recruited in time. If this cannot be done in sufficient detail to assess needs and recruit staff for FY76 on a region-by-region basis, it is recommended that one or two additional staff be recruited to the Public Utilities Department of Central Projects Staff, to give support to the regions as necessary.

Implications for the International Community

8.28 Assistance to governments provided by multilateral and bilateral agencies for rural water supplies over the past two decades has been widespread and has taken many forms ranging from short-term technical advice, to projects which have provided supplies, equipment and technical assistance, extending over several years. Among the agencies which have been associated

with rural water supplies are WHO, UNICEF, UNDP, FAO, IDB, ODA, FED, PAHO, CARE, Rockefeller Foundation and numerous bilateral agencies such as USAID, SIDA, CIDA, KFW, etc. Aside from data obtained from IDB, statistical information on the amounts and extent of assistance provided for rural water and sanitation has not been in a form which could be evaluated, either because it is mixed with other activities, or records have been retired or never collected from the field. Post project evaluations have almost never been done.

8.29 In view of the increasing attention given to the plight of the poorer segments of society in the developing countries, the multilateral and many bilateral agencies are becoming concerned that the poor, both in rural and fringe urban areas, are currently deprived of a fundamental need, namely, access to a safe and reasonably convenient source of water. Some of the questions being raised are: why, after a rather lengthy experience, are accomplishments so small; what are the ways by which the international community can best assist in overcoming the problems; and how should the community proceed?

8.30 In early 1974 an ad hoc working group was set up by UNDP and IDRC (Canada) on which IBRD was invited to be represented, and to which the Bank has given financial support. Other agencies represented, and also giving financial support, were WHO, UNDP, UNICEF and OECD. Two task forces were created to look into technical and research needs: information transfer, training, institutional and management aspects; and the financial implications. The reports of these two groups will be presented at a meeting of the ad hoc panel in February 1975. At that time, decisions will have to be taken in the light of the implications for the international community and based on

the recommendations contained in the reports.

8.31 It is premature to speculate too far on the recommendations to come out of the ad hoc group. However, to serve as a guide on future decisions which the Bank may have to take on the recommendations, certain general points can be made. Among these are the following:

(a) There is undoubtedly a need for a mechanism to better concentrate and coordinate the resources of the international community in the field of rural water supply;

(b) There are already many agencies involved in rural water supply. It will likely prove unproductive to create still another, and it would seem better to strengthen the resources of one or more of those now in existence;

(c) While some research at central facilities may be identified, it is likely that most of the work will best be undertaken in demonstration projects where the combined problems of institution building, village organization, training, and appropriate technology can be addressed under the cultural and economic characteristics particular to each country. There is a very distinct difference between the actions required for research and development in the field of agriculture from those in rural water. This suggests a limited role for centers of this type employed in agricultural research, and a need to decide on the approach which will be most effective and the least costly in manpower and money; and

(d) A final consideration needs to be whether centers, if created, should confine their activities to rural water supply or whether the needs of the entire water sector should be a part of their function.

8.32 In view of the existing cooperative programs between the Bank, FAO, and WHO, and the good working relationship already established with the Office of the Water Advisor in UNICEF, it is believed that a mechanism already exists whereby the Bank can work with the more important multilateral agencies concerned with rural water. The extent to which a broader framework should be stimulated, which includes the other agencies leading to a more aggressive rural water program, should be decided when the ad hoc committee report becomes available.

DATA DERIVED FROM WHO SURVEY

Contents

Note: Due to rounding errors, values in these tables may not agree exactly with those published by WHO.

Table 1: Population of Countries Surveyed

Region	Population (millions) Urban	Rural	Total	% Rural Population
Africa	31	152	183	83
Latin America & Caribbean	156	118	274	43
Eastern Mediterranean	65	169	234	72
Europe *	24	42	66	63
South East Asia	158	693	851	88
Western Pacific	38	75	113	66
Total	472	1,249	1,731	72

* Three countries only: Algeria, Morocco and Turkey

Table 2: Percentage of Population With Reasonable Access to Safe Water

Region	Urban			Rural	Total
	House Connections	Public Hydrants	Total		
Africa	29	39	68	11	21
Latin America & Caribbean	59	17	76	24	54
Eastern Mediterranean	58	26	84	18	33
Europe	50	23	73	44	55
South East Asia	36	17	53	9	17
Western Pacific	65	10	75	21	40
Total	49	19	68	14	29

Table 3: Population Without Reasonable Access to Safe Water

(millions)

Region	Urban	Rural	Total
Africa	10	135	145
Latin America & Caribbean	33	89	122
Eastern Mediterranean	10	138	148
Europe	7	23	30
South East Asia	74	632	706
Western Pacific	10	59	69
Total	144	1,076	1,220

Table 4: Forecast 1980 Populations

Millions

(in parentheses - % increase since 1970)

Region	Urban	Rural	Total
Africa	53 (72)	188 (24)	241 (32)
Latin America & Caribbean	235 (51)	131 (11)	366 (34)
Eastern Mediterranean	103 (59)	216 (28)	319 (36)
Europe	42 (71)	48 (15)	90 (36)
South East Asia	240 (52)	874 (26)	1,114 (31)
Western Pacific	61 (26)	90 (19)	151 (22)
Total	734 (52)	1,547 (24)	2,281 (32)

Table 5: Target Populations to be Served by 1980

Region	Total population to be served, millions			Increase over 1970 millions /a			1980 population served as % of 1970 /a		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Africa	52	47	100	32	31	63	260	300	270
Latin America & Caribbean	213	60	273	96	31	127	180	210	180
Eastern Mediterranean	102 /b	54	156	49	37	86	190	320	220
Europe	42	12	54	24	3	27	230	130	200
South East Asia	240	218	458	157	163	320	290	400	330
Western Pacific	61	22	83	32	8	40	210	160	190
Total	710	413	1,124	390	273	663	220	300	240

/a There are some apparent discrepancies between Tables 3 and 4 of the WHO statistics. The figures given here for absolute increase have been taken from the WHO tables without resolving the inconsistencies, and the percentage figures are therefore only indicative.

/b Less than 100% of population (of Table 4). No reason given.

Table 6: Per Capita Cost of New Supplies

US$ /a

Region	Urban		Rural
	House Connection	Public Hydrant	
Africa	53	28	20
Latin America & Caribbean	40	-	24
Eastern Mediterranean	30	11	13
Europe	12	25	20
South East Asia	16	9	8
Western Pacific	22	20	6
Weighted Average	35	14	12
Range	6(Bahrain)--300(Mauritania)	1(Somalia) - 280(Mauritania)	1(Madagascar, Afghanistan, Bangladesh) - 150(Barbados)

/a Basis not stated (i.e., whether 1970 or current $).

Table 7: Estimated Investment to Meet Development Decade Goals

US$, millions

Region	Urban			Rural	Total
	House Connections	Public Hydrants	Total		
Africa	1,200	300	1,500	600	2,100
Latin America & Caribbean	3,900	- /a	3,900	700	4,600
Eastern Mediterranean	700	300	1,000	500	1,500
Europe	1,500	300	1,800	100	1,900
South East Asia /b	1,400	600	2,000	1,200	3,200
Western Pacific	300	400	700	- /c	700
Total	9,000	1,900	10,900	3,100	14,000

/a As policy, public hydrants not provided.

/b Totals for South East Asia differ from WHO published tables due to typographical errors in the latter.

/c $50 million; shown as nil due to rounding.

Table 8: Progress Between 1962 and 1970

Region	Urban Population Served -------millions------- 1962	1970	increase	% Urban Population Served 1962	1970	1970 Population Served as % of 1962
Africa	9	20	11	50	67	220
Latin America & Caribbean	85	116	31	86	76	150
Eastern Mediterranean	29	53	24	71	86	180
Europe	12	18	6	74	73	150
South East Asia	33	81	48	31	53	250
Western Pacific	13	27	14	49	75	200
Total	181	315	134	59	69	170

Table 9: Water Supply Investments in 1970

US$ millions

Region	Urban	Rural	Total
Africa	72	20	92
Latin America & Caribbean	263	46	309
Eastern Mediterranean	198	36	234
Europe	27	67	94
South East Asia	142	44	186
Western Pacific	63	4	67
Total	765	47	932

Economies of Scale and Cost of Facilities*

The following comparison of two villages, one of 10,000 population and one of 1,000 population will serve to show the effects on cost of economies of scale. In the two examples, it is assumed that the levels of service, per capita water consumption, and source of water are the same for each village. The cost estimates are based on data assembled from actual projects but are not applicable for purposes other than broad comparison.

	Village A[1] (10,000 population) 1,000 m^3/day	Village B[1] (1,000 population) 100 m^3/day	Village B (Public Hydrants) 40 m^3/day
	$	$	$
30 cm. well complete with development, screen and pump	5,500	2,800	2,800
Transmission 20 cm.	8,000	3,600	-
Storage	20,000	6,000	3,500
Distribution	80,000	8,000	5,000
Total	113,500	20,400	10,500
Per Capita Cost:	$11.35	$20.40	$10.50

1/ Assumptions: Service Level - 50% house connections and 50% public hydrants.
Water Source - Adequate groundwater at 30 m depth.
Dependability - Conditional on use of one well and one pump.
Distribution - US$8.00 per capita for each village.

It will be noted that the economy of scale is particularly evident in the source works, transmission and storage elements. In fact, there would be some economy of scale for the distribution facilities also, but for purposes of this example it was assumed that the per capita costs were the same for each village.

* The cost figures in this Annex are based on 1973 data and are to be updated before the paper is finalized. Meanwhile, although the absolute levels of cost may be too low, it is thought that the relative levels are reasonably typical.

The effect of dependability of supply and its cost may be noted in the above example where only one well is provided for each village. If the well pump fails, the village will be out of water until it is repaired. Normally, two wells should be provided. If this were done, the following figures might be typical:

Village A			Village B		
One	30 cm	$5,500	One	15 cm	$2,800
Two	20 cm	$7,600	Two	15 cm	$5,600

For Village A, the cost of greater dependability would be $2,100 or $0.21 per capita. For Village B, it would be $2,800 or $2.80 per capita.

But economies of scale are not automatic. This may be demonstrated by a further expansion of the above example. Two of the more important variables are transmission costs and source works. If Village A is unable to find additional water from wells nearby, it may have to go to a river. This means some form of treatment. If the river flow is irregular, a small dam may be required to store water for the dry periods. What began as a well source costing, with limited transmission and no treatment, around $11 per capita, may increase to $30 or $50 per capita depending on how far the river is, what pumping is required, and how complex the dam construction may be. In other words those two factors could triple the cost. Many urban areas are now facing the fact that the accessible sources are fully committed and new sources farther away must be employed. This means that incremental costs of new investment may be equal to, or exceed per capita costs for village systems.

The table to this Annex shows some further figures or the effects of size, level of service, and nature of the source or per capita costs. It will be noted that for a community of 1,000 population which is served by public hydrants, the cost per capita may be less, or no more than for a community of 10,000 with the same level of service if the latter has to use a more expensive source of water because groundwater is not available in the quantities needed. The effects of treatment or costs can also be noted.

Cost Implications of Service Levels and Treatment (Capital Costs)[1]

Village Population	Service Level[2]	Per Capita Water Use Assumed LCD	Daily Village Water Use m^3/d	Water Source	Treatment	Typical Cost of Facilities per m^3	Typical Cost of Source Works per m^3	Typical Cost of Storage and Distribution Facilities per m^3	Typical Total Cost of System	Per Capita Cost[3]
1,000	PH	40	40	Well	None	0	$70.00	$195.00	$265.00	$10.00
10,000	PH	40	400	Well	None	0	$14.00	$176.00	$190.00	$ 8.00
1,000	50% PH 50% HC	100	100	Well	None	0	$28.00	$176.00	$204.00	$20.00
1,000	PH	40	40	Clear surface water	Chlorination	$ 7.50	$10.00	$195.00	$205.00	$ 8.00
1,000	50% PH 50% HC	100	100	Clear surface water	Chlorination	$ 8.00	$10.00	$176.00	$194.00	$19.00
1,000	PH	40	40	Contaminated, turbid surface water	Filtration chlorination	$200.00	$10.00	$195.00	$405.00	$16.00
1,000	50% PH 50% HC	100	100	"	"	$150.00	$10.00	$176.00	$336.00	$34.00
10,000	PH	40	400	"	"	$ 40.00	$ 5.00	$158.00	$203.00	$ 8.00
10,000	50% PH 50% HC	100	1,000	"	"	$ 18.00	$ 4.00	$108.00	$130.00	$13.00

ANNEX 2 TABLE 1

1/ The above figures are comparative and are not intended as the basis for cost estimation on particular systems.
2/ HC = House connections: PH = Public hydrants.
3/ Costs are for illustration only and will undoubtedly be higher in 1974 dollars because of price escallation or construction and equipment items.

Excreta Disposal for Rural Communities

1. The excreta disposal facilities required for a village will be determined by its size, density of housing, soil and drainage conditions, cultural patterns and level of development. This annex describes some typical installations. For a full discussion of excreta disposal for rural areas, see WHO Monograph No. 39: "Excreta Disposal for Rural Areas and Small Communities," 1958.

2. Vault and bore hole latrines are the least cost solution to disposal of body waste in uncongested areas. When properly located, constructed and maintained, latrines meet all public health requirements. Costs may range from $10 per unit where labor and the shelter are provided by the household, to around $200 if vault, slab and a reasonably good structure are supplied. Provided that the slab and vault are properly constructed, the shelter structure is of little importance from the public health standpoint. Depending on size of vault and the care given, frequency of cleaning may vary from one to ten years.

3. Householders in smaller villages who wish to install water-flushed toilets will usually need individual sewage disposal facilities. In areas with sand and gravel soils, and with no water wells in the vicinity, simple leaching pits curbed with rock, brick, or concrete blocks can be constructed at costs ranging from a few dollars up to $200, depending on labor and materials used. Where soils are less pervious, or where larger volumes of sewage must be disposed of, septic tanks are employed, discharging either to leaching pits or to tile fields (a network of buried drainpipes, allowing the effluent

to soak away). Costs range from $100 to $1,000 depending on the tank size and material and on the type of soil absorption system required. The higher figures apply where a tile field of substantial length is required and where no labor or materials are contributed. Disposal of septic tank effluents to road ditches, while a common practice, is not satisfactory because of the public health and environmental problems it causes. It is sometimes possible to discharge into systems serving some other purpose, such as storm drains. This is not generally recommended, but it may be used for a limited number of houses until there are enough to warrant construction of a sewer system.

4. For large villages where density of housing is high, where the space surrounding houses is insufficient to permit construction of latrines, or where soils are impervious, there will be need to consider a community sewer system. Such systems are expensive and will function only if a sufficient number of houses have water-flushed toilets so as to ensure a flow in the sewers adequate to scour the piping and prevent clogging. Considerable problems can arise if materials such as coconut husks or corn cobs are used for personal cleansing. Because only a few houses usually have water flush toilets, and these will frequently be widely dispersed, few villages will find it technically feasible to construct sewer systems.

5. Where a sewer system is provided, the means of effluent disposal has to be considered. In some communities adjacent watercourses provide sufficient dilution to allow direct discharge, but in many countries with a monsoon-type climate, stream beds are empty during the dry season and

some form of treatment is desirable. In most developing countries waste-stabilization ponds will be found to be the simplest, cheapest and most reliable treatment process. Details of their design and construction are given in WHO Monograph No. 60: "Waste Stabilization Ponds", 1971.

6. Because of their high cost and problems with operation and maintenance, sewer systems should not be used in villages except in the rare cases when no cheaper alternative can be found.

7. Community toilets, while not uncommon, are not a suitable facility for village use except to serve market areas and places of assembly. Often they are not maintained in a hygienic condition, and because of this and their distance from individual households they may not be used by many of the people they are designed to serve.

Inter-American Development Bank Rural Water Projects

1. From 1961 to February, 1973, IDB made fifteen loans for rural water supply and five other loans which had rural water components. These loans were made to national water supply agencies and Ministries of Health in eleven countries. The total amount of loans for rural water supply in these projects was US$69.9 million for a total project cost of US$130 million. As a result of experience obtained from these projects, general criteria and policies were developed.

2. The individual country definition for rural communities was accepted. The size of the community generally ranged from 300 to 2,000 inhabitants. The rural water supply projects included the design, construction, and placing into operation within a stated period of time, water systems to serve a large number of rural communities. These systems could serve individual communities, or under favorable circumstances, several villages. The projects also inlcuded the investigation and development of water sources, engineering, community development, and technical assistance for institution building, training and planning.

Design Criteria and Level of Service

3. Each country has developed criteria which include the type of materials to be used, the per capita consumption by house connections and public standpipes, service pressure, service storage requirements, design period, and estimates of future growth. The trend from the early loans has been to move from systems having a predominance of hydrants to systems with numerous house connections. This trend in policy has occurred because of the demands of the communities and the difficulties of charging for the water and ing waste where only public hydrants are installed. The systems are now generally designed and built with at least 50% of the houses provided with house connections and financing covers up to as much as 70% of the total project cost including house connections. In some countries a few water meters have been installed for the larger consumers with flow-control devices for the others. All rural water projects have been concentrated on communities rather than the dispersed populations.

Water Quality

4. Preference is given to gravity supplies from safe sources that require no treatment such as springs and infiltration galleries and then deep wells with pumps. Sources that require filtration or special treatment are used as a last resort. Disinfection by chlorination is practiced where there is technical support from a regional or district office and chemicals are not difficult to obtain.

5. The physical and chemical standards employed are those of the country and are similar to those of the WHO International Standards. In some areas where it is difficult to obtain water, such as parts of Argentina, higher concentrations of chemicals are allowed. Bacteriological standards such as those of WHO are used as a basis for the initial selection of the sources but infrequently monitored once the systems are built.

Criteria for Selection of Communities

6. In the initial loans the basic country criteria for selecting the communities were accepted but some refinements have been added over a period of years. The essential factor is that community desire and participation be demonstrated before undertaking the water system.

7. Recently attempts have been made to develop a priority rating system for the villages. Many factors such as accessibility of water, density of population, accessibility of village, cost of the system, nearness to other villages, health conditions and population growth of the village are given relative weights, and a rating for each village is obtained. From these ratings a list is worked out.

Community Participation

8. Community participation includes the decision to have a system, the formation of a group to operate the system, the contribution to construction, and the payment for receivng service from the system.

8. The contribution to the construction of the system has been found to be the equivalent of 3-20%. Generally 10% is now accepted as the average amount of community contribution. The contribution has been in the form of services such as storage areas, transportation of materials (materials such as sand, gravel, rock, bricks and lumber), labor, and cash.

Range of Conditions for Rates and Charges

10. For each project a system of rates and charges is established that takes into account the socio-economic level of the villagers and usually does not exceed 3-5% of the head of the family's income and usually produces a revenue sufficient to pay at least operation and maintenance costs.

11. The 5% can be expected to produce revenues sufficient to cover the cost of operation, maintenance and depreciation for average cost systems.

12. Experience on these projects has shown that in very few cases have the communities been able to pay rates exceeding the 5% level.

Costs

13. Per capita costs on IDB projects show a wide range reflecting differences in water sources, varying levels of technical assistance, and

organizational efforts required to prepare communities. On 20 projects the per capita cost range has been from about $30 to $50 with an average of about $40. 1/ These systems have generally been designed to serve about 50% of the houses with connections, meaning either water to a tap in the house or to a point on the property, usually not further than 3m in distance from the main.

1/ Source: Humberto Olivero, Sanitary Engineering Advisor, IDB.

be defined, and appropriate arrangements made. A substantial training component should be included in the project. In the initial stages of a national program model installations may prove useful for in-service training; some additional facilities might be provided for group instruction, demonstration and practice.

e) The Bank Group should recognize that village water programs will not be able to achieve the same standard of financial performance as urban projects. The pricing policies of the program should be designed to ensure that all consumers who are able to pay the full cost of service do so, and that those who are not able to pay the full cost should pay as large a proportion as possible. At least, the village should make a capital contribution (in cash or kind) and agree to pay operation and maintenance costs. These operation and maintenance costs may either be determined village by village or averaged over all villages in a region. Local conditions and customs will determine which is more acceptable. The basic facilities to be provided in a village would be wells or public hydrants reasonably accessible to all inhabitants; house connections should be encouraged, but provided only where the villages are prepared to meet a substantial proportion of the extra costs. Subsidies may be necessary to assure the financial viability of the organization responsible for the program, or may be included in the pricing structure as part of national social policy; the Bank should be prepared to accept such subsidies provided that they do not adversely affect the distribution of income within the country. Programs financed by the Bank Group should have a clear financing plan which recognizes the financial implications of strengthening an existing organization or creating a new one and also the probable necessity of meeting debt service.

If the plan includes government contributions, firm understandings should be obtained on their timely availability.

f) Demonstration projects should be encouraged, for developing or improving various approaches; improving the basis for cost estimates; developing larger projects; and training. Even though financial requirements may be relatively small, the Bank Group should be prepared to make loans for project preparation and for initial demonstration projects in cases where the country itself is unable to do so and where provision of funds by other agencies 1/ would cause undesirable delay. Subsequently, demonstration projects would be included in "piggy-back" type of operations, in which the Bank Group would fund a package of preparation work, demonstration projects, and project execution.

g) Demonstration projects also provide an opportunity for field trials of new or improved components. Bank Group projects could include funding for applied research, where frequently only a few thousand dollars are needed to assist local workers in adapting established approaches to local conditions.

h) Bank Group finance should be on a "program loan" basis, financing a package of village systems which either form a "time slice" of

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1/ e.g., UNDP, UNICEF, CIDA, or SIDA, all of which have been active in rural projects.

the program or are concentrated in a particular region. Since so many existing systems are inoperative for various reasons, the first Bank loan to any country might well be for system rehabilitation and institution building. The method of selecting villages and the general principles of the designs to be used would be agreed during loan negotiations, with final decisions being taken during project execution. Detail design of the systems will therefore not normally be undertaken before the loan is made. 1/ Cost estimates will therefore be based on standard designs and preliminary visits to villages. A substantial contingency item (25-35%) should be included. The number of villages to be served should be adjusted in the light of actual costs.

i) The foreign currency component of village water projects will usually be low. 2/ Local currency financing should therefore be considered.

j) All projects, particularly those in the first Bank Group loan to any country, require careful monitoring, initially to check the appropriateness of the assumptions, design criteria and method of approach, and subsequently to determine their impact and to identify problems in operation and maintenance.

k) Basic public health education should usually be associated with any village water supply program, both during its preparation, to

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1/ The final approach to the village to determine the system it wants should not be made until shortly before commencement of construction (para. 8.11). The design will therefore be made final only at that time.

2/ 15-50%, averaging 35%, according to the WHO Survey, but this may refer only to the percentage of materials costs. The percentage of total costs would then be much lower.

stimulate village interest, and during implementation, to ensure full benefits are derived from the new systems.

1) The Bank Group should consider including funds for other sanitary facilities, particularly latrines and public bathing and laundry facilities. Village sewerage systems are not likely to be feasible of justified in the great majority of cases, and should only be installed if villages show a real willingness to pay for them, and if a sufficient number of houses have water-flush toilets to ensure proper operation.

FORM NO. 678
(7-73)

CONFIDENTIAL

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

POLICY REVIEW COMMITTEE

PRC/s/M/75-1a

February 11, 1975

VILLAGE WATER SUPPLY

STAFF REVIEW - MINUTES

Attendance:
Messrs. van der Tak (Chairman), Bose, Burki, Miss Di Tullio, Freedman, Gulhati, Golladay, Hablutzel, Haq, Howell, Jennings, Karaosmanoglu, Koch-Weser, Knox, Lerdau, Middleton, Panagides, Rajagopalan, Ribi, Rovani, Saunders, Shipman, Stern, Voorhoeve, Warford, Weiss, Yudelman, Vibert (Secretary)

1. A staff review of the issues paper on village water supply was held on January 29, 1975.

2. The Chairman proposed the discussion focus on four main issues raised by the paper: (i) the feasibility of reaching the rural poor given the cost estimates of village water supply; (ii) cost recovery guidelines; (iii) project selection criteria; and (iv) the Bank's program.

Reaching the Rural Poor

3. There was general support for the view that the cost of village water supply per caput should be kept as low as possible in order to reach the largest possible numbers of rural poor. Against the estimates in the paper that investment costs for rural water might lie in the range of $20-60 per caput, discussants questioned how such costs could be reconciled with reaching the target rural poor. It was suggested it would be useful to compare costs of village water supply with income levels in the major poverty areas of South Asia and Africa, and in the context of overall costs for rural development projects of perhaps $80-100 p.c. It was also suggested that it would be useful to analyze further the relationship between cheap, low-service systems for many beneficiaries, and the additional economic benefits that would accrue from higher but costlier service levels for fewer people. However, it was said that system costs varied so much depending on local circumstances and factors affecting design that it was very difficult to give typical cost estimates. Nor, in fact, was much known about the additional economic benefits associated with incremental costs.

Cost Recovery Guidelines

4. It was suggested that given the apparently high costs of village water supply, the paper's proposal that operation and management expenses should be fully recovered plus a contribution to capital cost would again tend to make water unaffordable for the rural poor. Rather than a single cost recovery rule, it was suggested that the paper might propose a more flexible policy in which cost recovery would also reflect equity considerations and the income levels of beneficiaries. Subsidization of operations would not necessarily be excluded if there were possibilities for cross subsidy within a project or where the financial capacity of the authorities allowed it. Some other participants, however, felt that the financial position of the project authorities was in fact likely to be such that in general the Bank should not support subsidies and that the proposed guideline was a reasonable minimum if water supply systems were to be properly maintained.

Project Selection

5. Those participants favoring the guidelines that operation and management costs should be recovered in full also supported the paper's position that the main criteria for project selection should be the degree of village involvement as measured by willingness to pay for water supply. Others felt that this would mean that projects would be confined to the larger villages and higher income areas and that the first priority should be to attempt to reach the rural poor.

Bank Program

6. Most discussants agreed that the indicated annual Bank Group program of roughly $80 million a year was only a small contribution. The authors stressed the speculative nature of the scale of lending which had to be estimated from the rural component of water supply sector loans and the water supply component of rural development projects. It was suggested that a more precise estimate be included of village water supply lending in FY75 and FY76 based on the latest estimates of rural development projects in the pipeline.

7. The meeting supported the recommendation that additional staffing would be required to support the lending and sector studies proposed.

Conclusions

8. The Chairman concluded that the village water supply paper be revised:

: to bring out more clearly the problem of affordability for the Bank's target population;

: to reconsider the cost recovery guidelines in conjunction with proposed project selection criteria;

: to indicate more specifically which beneficiaries should receive priority, and to what extent village water systems be subsidized.

Frank Vibert
Secretary
Policy Review Committee

cc: Those Attending
IBRD Department Directors

FORM NO. 678
(7-73)

CONFIDENTIAL

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

POLICY REVIEW COMMITTEE

PRC/C/75-1

March 31, 1975

VILLAGE WATER SUPPLY

The attached paper 'Village Water Supply,' prepared by the Public Utilities Department, Central Projects Staff, is distributed for information.

The paper was reviewed at a Staff Level Review on January 29, 1975; minutes of the meeting are attached (PRC/s/M/75-1a dated February 11, 1975). Any comments should be sent directly to Mr. Yves Rovani, Room D-750.

Frank Vibert
Secretary
Policy Review Committee

Distribution:

PRC Members
Vice President - IFC
IBRD Department Directors

DRAFT-CONFIDENTIAL
March 27, 1975

ISSUES IN VILLAGE WATER SUPPLY

Public Utilities Department
Central Projects Staff

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SUMMARY AND CONCLUSIONS

I. Introduction

i. Probably over 1,000 million people in rural areas do not have an adequate water supply, and the rate at which access to safer water is being provided is too slow to keep pace with population growth. The majority of people without safe water live in developing countries of Asia, which also contain the largest numbers of the rural poor.

ii. In these countries waterborne or water-related diseases are among the top three causes of sickness and death, and the strongly held opinion of public health experts is that the provision of safe water is of prime importance to public health. The World Health Organization, in particular, considers that provision of a safe and convenient water supply is the single most important activity that could be undertaken to improve the health of people living in rural areas.

iii. Governments of developing countries are becoming increasingly concerned with improving living conditions in rural areas. The Bank, too, has been shifting the emphasis of its lending program to have greater impact on the rural population through projects in agriculture and integrated rural development. Rural water supply and sanitation should be a significant component of these projects. In addition, the Bank's 14-year involvement in the financing of the water supply and sanitation sector, which so far has been predominantly for urban projects, will be progressively extended into the rural subsector.

iv. The paper examines the implications for the Bank of expanding lending for village water supply. Because many countries, and the Bank itself, have hitherto largely neglected the rural water supply subsector, experience and knowledge are lacking to set specific targets for action in the next few years. As a first step, therefore, this paper concentrates on the problems peculiar to this subsector and suggests ways to begin to overcome its current state of neglect.

II. Background

v. There are no internationally accepted definitions of "urban" or "rural" communities. The paper is concerned with communities with populations in the 300 to 10,000 range, and with water systems ranging from simple protected springs to surface water systems with piped distribution of treated water. It considers the needs of all the population in these communities, including, but not limited to the poor -- who form the vast majority.

vi. The principal sources for the paper, besides the experience of the Bank, its staff, and the Inter-American Development Bank (IDB), are a survey of water supply and sewage disposal in developing countries in December 1970

carried out by the World Health Organization (WHO),[1] and a research project carried out by the Bank's Public Utilities Department.[2] In addition, the Bank is participating in an Ad Hoc Working Group on rural water supply and sanitation, established in 1974 by a number of international agencies. Most of the statistical data obtained from the WHO survey should be regarded only as indicative, due to unreliable data, lack of common definitions, and wide variations between countries.

vii. In 1970 only about 15% of the rural population in developing countries had reasonable access to safe water. In these areas over 1,000 million people, nearly one third of the world population, had no proper water supply. In urban areas the situation in 1970 appeared far better: about 70% of their inhabitants had access to a piped water supply. Even so, about 150 million people, usually those in the lower income brackets, were not served (and in many areas which were nominally served, the quality of service was extremely low).

viii. To improve this situation, the United Nations set goals for the global improvement of water supply in the Second Development Decade (1971-80). These, referred to as the UNDD goals, are: to supply safe water to 100% of the urban population and to 25% of the rural population. 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%. 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%. It should be noted that, even if the UNDD goals were achieved, there would still be more rural inhabitants without proper water supply in 1980 than there are today.[3] As impressive as they are, these facts do not reveal the dimensions of the problem as fully as one example: one rural water program in India covers 65,000 square kilometers, with a population of 6.4 million in 16,000 villages. Providing water to 2,000 of these villages, to serve 0.8 million people, will involve constructing 1,000 new water systems.

1/ WHO: World Health Statistics, Vol. 26, No. 11, 1973. Special subject: Community Water Supply and Sewage Disposal in Developing Countries, 1970. (Referred to in the remainder of this paper as "the WHO survey".)

2/ Village Water Supply and Sanitation in Less Developed Countries: R. J. Saunders and J. J. Warford (first issued as RES 2 on March 15, 1974; now being revised for outside publication).

3/ For the 91 countries included in the WHO survey, 1,076 million rural inhabitants were without proper water supply out of a total of 1,259 million in 1970. By 1980, even with the UNDD goals reached, the corresponding figures are 1,134 million out of 1,547 million.

ix. The investments required to meet the UNDD goals are estimated in the WHO survey to be about $11,000 million for urban water supplies and $3,000 million for rural water supplies (at 1970 prices). Bank experience suggests that these estimates may be low, but the estimated costs of extending water service vary so widely -- from a low of $1 to a high of $300 per capita, depending on local conditions -- that no firm estimate can be made. In current dollars the investments will, of course, be very substantially higher than in 1970 terms.

x. The probability of achieving the UNDD goals differs greatly from country to country. In some, continuation of existing water development progress will probably be sufficient. In others, particularly the larger and poorer countries, expenditure on water supply would have to be expanded 10-fold or even 100-fold, and would require a disproportionate share of total future investment. In these countries the goals are almost certainly unattainable. In any case, it is evident that the poorer countries can afford only very simple systems in rural areas -- typically shallow wells with handpumps -- if they are ever to achieve a significant increase in coverage. In general, countries are more likely to achieve the urban targets than the rural ones, since past investment has been concentrated heavily in the urban sector,[1/] and reasonably competent institutions have been built up. In contrast, investment in rural water supply has been relatively low,[2/] and the success record is poor, with many systems breaking down soon after commissioning.

xi. In common with most programs in the developing countries, the major problems in rural water supply programs are in financing, securing suitable personnel and developing adequate institutions. The most important problems are:

- lack of government rural water policies;
- undefined or overlapping responsibilities of numerous agencies;
- institutional weakness at all levels;
- lack of trained manpower at all levels;
- low village incomes;

1/ For example, 77% of total water supply investment in 1970 was urban, according to the WHO survey.

2/ WHO estimate that rural water supply coverage increased only from 10% to 12% of the rural population in the decade 1961-71. Only in Latin America, where the corresponding percentages are 7% and 24% was there significant improvement.

- failure to collect adequate charges from water users, due either to lack of financial policies or to ineffective means for collection;

- lack of public health education, resulting in a lack of appreciation of the advantages of safe water supply;

- frequent system failures, due to poor operation and maintenance procedures or lack of spares; and,

- considerable communication difficulties between widely dispersed rural systems and their support agencies.

III. Technical Aspects and Costs

xii. Various factors affect the type of village water system to be constructed -- level of service, water quality and quantity, and nature and location of sources. Each of these also has an effect on costs.

xiii. The level of service provided may range from a simple protected spring or a well with a hand pump to a fairly elaborate distribution system serving most consumers through private house connections. Both capital and operating costs increase with the level of service, and increased complexity makes mechanical failure more likely. Nevertheless, since higher levels of service result in greater health benefits, their use should be encouraged whenever villages want them and are able to pay for them.

xiv. Quality standards should be set to ensure that the water supply does not contain any chemical or biological constituents that could affect its safety or acceptability. A number of chemical characteristics and substances which affect the design of urban systems (e.g., hardness, chlorides, iron and manganese content) can be disregarded in village water system design unless they affect acceptability or could cause technical problems through corrosion or encrustation.

xv. Water quantity requirements depend largely on the level of service provided. They also vary widely from country to country, depending on climatic and cultural factors. Daily consumptions reported in the WHO survey range from 3 to 340 liters per capita per day (lcd). However, about half the countries report consumptions of 40 lcd or less, and as a rough guide 20 lcd might be adequate for simple systems which employ public hydrants. Where a high proportion of house connections is proposed, 100 lcd would be more realistic. Even more will be required in the rare cases where waterborne sewage disposal is to be provided. Because of these wide variations, sampling and demonstration projects are important means for determining likely demands on new water systems.

xvi. The source of water has a major effect on system design and hence on costs. Properly constructed and operated groundwater systems will, in almost every case, yield water which is safe to drink without any form of treatment. Surface water sources will normally require disinfection (usually by chlorination and storage) and, depending on the degree of turbidity or contamination, may also require filtration, possibly preceded by sedimentation for very turbid waters. To reduce costs and operation and maintenance problems, surface water systems should usually be based on simple processes such as sedimentation lagoons, slow sand filters, or infiltration galleries making use of the natural filtration capacity of alluvial material. Four general principles can be applied to most village water programs:

- groundwater, which requires little or no treatment to make it safe, is preferable to surface water; in particular, in the poorest countries shallow wells with handpumps should be used whenever possible;

- systems must be rugged, designed for simple, trouble-free operation and maintenance by local technicians;

- replacement parts must be readily available; and,

- standard designs, which can be slightly modified to meet local conditions, should be developed and used for cost estimation, procurement and construction. These designs should employ, as far as possible, local materials and technology.

xvii. System costs vary widely. Estimated costs for rural services shown in the WHO survey vary from $1 to $150 per capita for individual countries. Averages for the WHO regions were from $6 to $24 per capita (1970 prices). Because of this variation, cost estimates have to be prepared for each particular project; generalizing from "typical" figures can lead to substantial errors.

xviii. The following general conclusions can be drawn concerning the effects of scale, levels of service and water source on costs (see Annex 2):

- In areas where groundwater is readily available, shallow wells with handpumps are by far the cheapest means of providing a good water supply.

- Use of surface water which requires full treatment may be several times as expensive as using groundwater.

- Providing a high level of house connections may more than double the per capita cost of the system, because of the additional system capacity required.

- Distribution system costs are a high proportion of total system costs, and to reduce costs, it may be desirable to provide only a few central water points.

- There are very considerable economies of scale in village water systems.

xix. Additional public health benefits to rural areas can be achieved by provision of other sanitation measures which should usually be taken at the same time that water is provided. Pit latrines, which can be constructed at very low cost on a self-help basis, would be the usual means of excreta disposal; septic tanks may be required where houses have individual water connections and use water-flushed toilets. Piped sewerage systems are expensive and unlikely to function effectively where only a few houses have inside toilets; they should not be installed except in the rare cases where no cheaper alternative can be found.

IV. Financial Aspects

xx. At the present time it is most uncommon for the full costs of village water systems to be recovered from the villages served. This may be due to a number of reasons -- a government attitude that water is a social service and should not be charged at its full cost; unwillingness of villagers to pay, either because they regard water supply as their natural right or because they do not appreciate the benefits of improved water systems; or inability of villagers to pay because of poverty. It is important that these attitudes be changed since, as discussed above, a considerable increase of resources will be required in many countries in order to maintain, let alone improve, access to service in rural areas. Especially in the poorest developing countries, where the problems are greatest, these increases will be beyond the means of government budgets. Realism and consistent social policies require that the more privileged consumers, particularly those in urban areas, no longer be subsidized, and that all consumers contribute towards the cost of service to the extent that their circumstances permit. Villages should, therefore, be required to pay as much as they can towards the costs of constructing and operating their systems. Nevertheless, in most cases government funds will be necessary to cover a large part of initial construction costs and also some of the recurrent costs, and governments will have to recognize this implied commitment when they first embark on village water programs.

xxi. There are five potential sources of funds for village water programs: central or local government budgets; foreign assistance; institutional lenders within the country; cross-subsidies from urban systems; and the villages themselves. The first two are generally determined on the basis of perceived

national priorities. The third, local lending institutions, is frequently undeveloped or alternatively the institutions are unwilling to lend to the non-creditworthy agencies responsible for rural water. The fourth source -- cross-subsidies from urban water systems - is unlikely to have any major impact, since in many developing countries the urban systems themselves are having difficulties in meeting demands. The fifth source, the villages, therefore has an important effect on the size of program that can be undertaken, but is frequently not fully exploited at present.

xxii. There are a number of strong reasons for requiring payment by villages towards construction and recurrent costs:

- it is desirable that beneficiaries should contribute towards the cost of services received;
- it makes more funds available to the program and, by reducing the use of government funds to meet recurrent costs, allows more to be spent on extending new systems to other rural areas;
- it will help ensure that funds are available to meet operating expenses and the cost of minor repairs;
- it increases sense of responsibility on the part of the villagers for new systems; and,
- it will help to ensure that the level of service to be provided is appropriate to the needs and desires of the village.

xxiii. The WHO survey showed that 20% of the countries require villages to make a contribution to capital costs, and 70% to pay all or part of operation and maintenance expenses. However, in the Bank's experience, enforcement of these policies is irregular.

xxiv. Determining the ability and willingness of villages to pay is a problem, because of lack of data on rural incomes and because many villages have essentially a barter economy in which little cash changes hands. As a general rule, it appears realistic to require villages to meet at least all operation and maintenance costs, and to contribute about 10% of initial construction costs (either in cash or in kind, by providing labor or materials).[1/]

1/ Payment at this level would in many cases result in water charges not exceeding about 5% of total annual income, a level frequently adopted as a guideline for setting charges to poorer urban consumers.

These charges would be for a basic system, supplying water through public hydrants; where villages desire a higher level of service, with a number of private house connections, they should normally meet the full additional costs.

xxv. Payment should be set above these levels wherever possible. For example, in a number of development projects villagers' cash incomes may rise substantially as the project matures, and in these cases water charges might also be increased with time so as to recover depreciation. However, decisions on targets and the way in which they are to be applied have to be tailored to suit the individual circumstances of each case: ability to pay; system costs; and the social objectives of the program.

xxvi. Collection of water charges from villages is usually a problem. Larger domestic consumers with individual house connections, and any commercial or industrial customers can be metered and charged accordingly, supplies being disconnected if payment is not made. Most supplies, however, will be given by public hydrants or through house connections whose small consumption would be uneconomical to meter. For these, flat rate charges, unrelated to consumption, will generally be used, raised through head taxes, individual or family fees, water tax or property assessments, or other methods. In some countries water is sold from the public hydrants; this may ensure better operation and maintenance of the system, but raises the price to the consumer and so may discourage proper use of the supply. The most important thing is that the method chosen should be simple and effective.

V. Organization and Management

xxvii. Institutional weakness is probably the most important single problem in rural water supply. In many countries there is no national policy. No coordinated objectives are set for the various agencies responsible, and there is no clear government financial commitment to meet the overall needs of the subsector.

xxviii. Numerous agencies are normally responsible for rural water supply. These agencies include various national and state ministries, national and regional water authorities, and rural development agencies. This leads to uncoordinated or inefficient planning and execution of projects, and unnecessary duplication of demands on the limited pool of available trained manpower. It also results in an extremely complex legislative framework, which needs review and improvement when any change is made in the sector organization; this work demands specialist knowledge and is very time-consuming.

xxix. Most agencies suffer from inadequate staffing, usually because their conditions of service are unattractive compared with those in private sectors or in organizations working in metropolitan areas. To attract better staff in

sufficient numbers, salaries and other benefits should be improved where possible, and the government should make clear the priority it attaches to this subsector, giving it more prestige than at present. In addition, training is required at all levels, from village operators and technicians to professional staff. In the early stages of a program, this training can be provided on the job, using demonstration projects. Later, a more formal training program will be required, preferably combined with that for urban water supply personnel.

xxx. The need for proper operation and maintenance is frequently ignored. Schemes are constructed without any clear assessment of the funds and manpower needed to keep them running, or of the logistical problems involved. As a result, a high percentage breakdown soon after being brought into service. For success, stores, technical assistance, etc., must be available locally; operation and maintenance cannot be done by a centralized unit.

xxxi. A village water program can be undertaken in various ways, with varying institutional implications:

- as part of a national or regional water supply program, including both urban and rural elements;
- as an independent rural water supply program; or
- as part of a multi-sectoral project such as a regional integrated rural development project.

The first approach, i.e., a rural water supply program as part of a national water program, will probably be the responsibility of an existing central body such as a national water agency, and will benefit from the available manpower and consistent application of the sector policies of the national agency. In many countries the second approach, pure rural water projects, has been employed for a number of years and a competent executing agency exists. In others the rural water agency is so weak that extensive institution-building would be necessary to strengthen the agency before it could successfully undertake the program; in these countries it may be preferable to amalgamate the urban and rural agencies.

xxxii. The third approach, a rural water supply program as a part of integrated rural projects, may be administered either by the rural water agency or by a water unit within the rural development project agency. The rural water agency is preferable, mainly because it makes best use of sector expertise, avoids proliferation of sector agencies, and provides a long-term institutional framework. However, the project may not afford sufficient leverage to strengthen or reorganize a weak rural water agency. In this case there is no alternative but to administer the project through a water unit in the rural development agency. However, liaison should be maintained between the water unit of the rural development agency and the rural water organization, particularly on sector issues such as pricing policy. Care must also be taken to reconcile as far as possible any conflicts between objectives of the rural development project agency and of the rural water agency, which often do not coincide;

for example, in a rural development project one may aim at rapid development of the whole of a geographic area, the other at extending service to selected villages, keeping pace with institution building.

VI. The Justification for Investment in Village Water Supply

xxxiii. Ideally, investment decisions should be based on cost/benefit analyses in which both costs and benefits are quantified. However, despite considerable research, no satisfactory method has yet been developed for quantifying all the benefits of improved water supply. Nevertheless experts in the field, in particular WHO, have little doubt that safe water is essential to good health, and is a prerequisite to the control of those diseases most common to the rural areas of developing countries.

xxxiv. In urban areas good water supply is essential to the existence of the city, and to protect public health. There is usually no alternative to a public water system. In these areas projects can normally be supported by consumers' willingness to pay for the service provided. In rural areas the justification becomes far more tenuous: the threat of epidemic due to waterborne disease lessens as population density decreases, but there is a greater number of prevalent diseases. Alternative sources frequently exist but are polluted, inconvenient or unreliable. Willingness to pay declines, due to poverty or to lack of appreciation of the possible benefits of improved supply. Direct benefits which are readily quantifiable -- for example, the development of agro-industries, fish freezing and the like which had been inhibited by the lack of sufficient safe water -- may accrue in some cases but are unlikely to be sufficient, on their own, to justify the investment.

xxxv. In most cases it is therefore impossible to present a rigorous economic justification for village water projects. Instead, justification must rest on a qualitative assessment of the benefits anticipated from the investment. The most important direct benefits from improving the quality and quantity of water available from village water supplies are improved public health, greater convenience and some fire protection. The first two of these may also increase productivity. Indirect benefits commonly cited are slowing down of rural-urban migration; redistribution of real income in favor of the rural poor; better standard of living, and the development of village institutions. These are discussed below.

xxxvi. Numerous epidemiological studies have clearly identified contaminated water as the principal agent in transmitting typhoid, cholera and shigellosis (bacillary dysentery). Lack of safe water for drinking and washing is also an important factor in the spread of other diarrheal diseases, the most common cause of death in infants in the developing world. A number

of other diseases, especially the debilitating parasitic diseases, are linked to inadequate and contaminated water supply and poor sanitary conditions.1/ It is nevertheless difficult to predict the exact impact of improving water supply on disease reduction, partly because alternative vectors exist and partly because some of the diseases are epidemic in nature and may be temporarily absent in project areas.

xxxvii. The effect of water on health will depend on many factors, especially the prevalence of various diseases, and the extent to which villages use the water. To break the chain of transmission of certain diseases improved excreta disposal methods must be provided together with improved water supply; the combination of these two measures will frequently be found to be the most effective means of control. Public health education will almost always be necessary to achieve full health benefits.

xxxviii. Provision of a safe and convenient water supply should bring about improved productivity through improved health and through a reduction in time and effort spent fetching water. In addition, the new water supply could help directly such agro-industrial activities as fruit and vegetable processing or fish freezing. However, whether potential productivity benefits are realized depends on individual cases. In some villages ill-health of the labor force is a serious constraint on agricultural development, whereas in others there is underemployment and the benefits may not be realized unless the water supply project forms part of an integrated rural development project or similar project providing increased employment opportunities.

xxxix. It is often argued that better rural water supply should reduce migration to urban areas, relieving their severe housing and other social problems. Even if a slowing of migration were desirable, which is a matter of debate, there is little evidence that better water supply cuts the rate of migration. It is possible that improved rural health and lower infant mortality could actually increase migration, unless efforts to secure these benefits are coupled with rural development to encourage people to remain in their villages.

xl. Rural water projects, which usually require subsidies from central government revenues or possibly from more prosperous urban consumers, often lead to income redistribution. However, care must be taken that richer rural farmers do not benefit at the expense of the poor of the urban areas.

1/ For a detailed discussion on the relationships between water supply and health see Chapter III, or Bank Policy Paper 554a: "Background Paper on Health".

xli. Although no supporting data are available, it seems likely that community involvement in the construction, operation and funding of a water system would strengthen village institutions, and help villagers in dealing with other development decisions.

VII. Priorities - Selection of Sub-projects

xlii. As the benefits described above are for the most part unquantifiable, they do not provide a clear guide for setting priorities in a rural program covering a number of years. This must be done after considering the merits of various sector objectives and the characteristics of particular villages. Financial criteria alone are not adequate, as they ignore too many important social benefits.

xliii. In many countries, a sector survey is necessary, because basic information about the sector is lacking. This survey should identify the principal problems and constraints in the sector, analyze the strategy for development (or by examining alternatives, help to develop such a strategy), estimate needed investments, and recommend policies, institutional improvements and other measures necessary to assure the program's success. This important and difficult work must be carried out by competent staff. It can be done entirely by local experts, but often some external assistance may be required.

xliv. Typical sector objectives are:

- to provide safe water to as many people as possible;
- to reduce waterborne or water related diseases;
- to encourage rural development; and
- to improve living conditions for the rural poor.

Any selected program will have to compromise to some degree between these various inter-related objectives, which cannot normally be achieved fully at the same time.

xlv. Village characteristics which affect the choice of which villages should be served first:

Village need and demand -

village involvement and interest, including willingness to contribute labor and money for the improved supply;

adequacy of existing supply and distance from village;

prevalence of water-related disease;

Village potential -

growth potential;

village institutions;

System costs -

nature of sources;

population density;

level of service;

accessibility.

xlvi. Of these, village participation is most important. Systems in villages expressing a real interest in having improved water supply are far more likely to remain in working order than systems installed regardless of village opinion. The systems can also be tailored to meet the needs and desires of the village, and prompt collection of water charges is more likely. Sufficient lead time should be allowed in project preparation to obtain this village participation.

xlvii. Whatever ranking is adopted, it will require review as projects are implemented, to determine whether the weights given to the various objectives and characteristics are appropriate. Careful monitoring, especially of the initial stages of programs, is therefore essential.

VIII. Implications for the Bank Group

xlviii. The potential for Bank Group assistance to village water programs is considerable, since it already has experience in dealing with the complex problems of weak institutions, such as poor financial performance, inability to extend service to keep pace with population growth, and frequent breakdown of existing systems. The Bank Group's most important role would be in building up the capabilities of local institutions for sector and project planning, execution and operation. The Bank should make clear to borrowers that it is prepared to consider loans for well-conceived village water supply projects, since many countries have the impression that the Bank's role in water supply is confined to urban systems.

xlix. The UNDD goals do not take account of country factors and do not provide a basis for Bank planning of future lending to this subsector. For this to be done, rural projects already in the pipeline need to be more clearly identified. Priorities and absorptive capacity in various countries should be examined, and better sector information should be obtained through

surveys more specifically oriented towards the problems of the rural subsector.1/ Bank planning should be improved by the introduction of project information briefs which, at an early stage in each project, set out its objectives and likely components.

1. The Bank's future lending program will contain a considerable number of integrated agricultural or rural development projects which should contain a village water supply component. In addition, within the currently projected lending targets and manpower resources for the water supply sector, there will be a certain number of sector loans for village water supply as part of national or regional programs. A limited number of subsector projects for village water only may develop. A very approximate estimate of future Bank lending for rural water supply is that it might average $120 million per annum in 1975 dollars during fiscal years 1975-79, predominantly through agricultural or integrated rural development projects. If the Bank contribution to project financing averages 50%, the total cost of the projects in which the Bank would be involved would be $240 million per annum, possibly 20% to 25% of the expenditures necessary to meet the UNDD goals.

1i. All these projects will usually need a long lead time for project preparation. Early involvement of water supply staff in project preparation is therefore essential, to make a preliminary review of proposed institutional arrangements, technology, health education requirements, training needs, etc. This review may show the need for a sector survey or for further preinvestment studies. The former can be carried out under the IBRD/WHO Cooperative Program, the latter, if government funds are not available, can be financed by international agencies such as UNDP or UNICEF, by bilateral sources or by the Bank Group itself (as in Colombia and Chile).

1ii. Initial projects are likely to contain many components: rehabilitation of existing systems; demonstration projects; pre-investment studies; socio-economic surveys; sector data improvement; institution building at national, regional and local levels; development of methodology and criteria; research into adapting technology to local conditions; and training. Follow-up projects, except those in which the water supply project forms only a part of a larger rural development or similar project, could be on a sectoral basis: the Bank Group would be involved to a minimum in the actual investment decisions, turning over increasing responsibility to the executing agency in project selection, following criteria agreed between the agency and the Bank Group (as is now being done in Minas Gerais, Brazil).

1/ Sector surveys undertaken through the IBRD/WHO Cooperative Program in FY75, for example those in Korea, India and Indonesia.

liii. For the reasons noted above, justification of village projects will not normally rest on quantified benefits nor on consumers' willingness to pay -- often used as a proxy in urban projects. Combining the costs of the water component with the other costs of an integrated project conceals but does not remove the difficulty. An explicit assessment should be made of the costs and, as far as possible, of the likely benefits, in particular improved health, better standard of living and increased productivity. In general, integrated projects are likely to show better returns since the target population is clearly identified and the other investments (for example in agriculture or education) may enable potential benefits of the water project to be more fully realized.

liv. The financial performance of projects will usually be poor, measured by the Bank Group's normal standards for public utilities. A minimum target should normally be that villages should make a contribution (in cash or kind) to initial construction costs and that user charges at least cover operation and maintenance. This should be feasible provided that villages are carefully selected, systems are designed to minimize costs and maximize self-help, consistent with the countrys' and villages' resources, and health education is given so that facilities are properly used and the benefits are appreciated.

lv. Preliminary guidelines for the Bank Group in assessing water programs are given in Annex 5.

lvi. Water supply staffing in the Bank needs to be increased to deal with the village water projects forming part of integrated agriculture or rural development projects. The regional Public Utility divisions should be strengthened to provide the necessary support to the divisions responsible for these types of projects. As an interim measure, until the water supply component of projects in the lending program can be more clearly identified and their implications for each region assessed, it is recommended that one or two additional staff should be recruited for the Public Utilities Department of Central Projects Staff, to complement the resources of the regional Public Utility divisions.

I. INTRODUCTION

Purpose of the Paper

1.01 Sanitary of public health conditions in many developing countries are extremely bad. Probably over 1,000 million people living in rural areas do not have an adequate water supply, and waterborne or water-related diseases are usually among the top three causes of sickness and death. The rate of extending water supplies to these people is slow, and does not keep pace with population growth. Even when new systems are provided, they frequently become inoperable in a short time due to the lack of proper operation and maintenance.

1.02 Governments of developing countries are becoming increasingly concerned with improving the lot of the people living in rural areas. Many health experts and, in particular, the World Health Organization believe that the provision of a safe and convenient water supply is the single most important and cost-effective activity that could be undertaken to improve the health of people living in these areas. As the Bank responds to governments' needs and shifts the emphasis of its lending program so as to have greater impact on rural areas (through agriculture and integrated rural development as well as through infrastructure projects such as water supply) it will have to face the problems which have hitherto prevented successful development of rural water supply. The purpose of this paper is, therefore, to describe the characteristics and problems of village water supply, to suggest ways of improving the present situation, and to examine the implications of expanding lending for village water supply on Bank policies, operations and staffing.

1.03 A major problem is that in many developing countries rural water supply has received little attention from the central government, and has been developed piecemeal. These countries lack centralized policies and adequate information on the sub-sector. The Bank as an institution has itself little experience so far in rural water projects, since past Bank lending for water supply has concentrated heavily on urban schemes (although many have also served adjacent villages and some, forming part of national or regional programs, have included quite large rural components). On this poor base, developing targets for future Bank lending for village water supply is not possible. This paper is, therefore, intended as an interim paper, to be revised and updated periodically as more information becomes available and as the Bank gains more experience in the sub-sector.

Definitions

1.04 There is no generally accepted distinction between "urban" and "rural" communities; each country selects the division most appropriate to its needs, and statistics are compiled on this basis; as a rough guide, this

paper is concerned with communities with populations in the 300 to 10,000 range. It considers the needs of all the populations in these communities including, but not limited to, the rural poor.

1.05 The water supply systems considered in this paper may range from wells or protected springs, from which villagers fetch water, to quite elaborate systems with piped distribution of treated water. One common characteristic assumed for each of these systems is that they provide safe water, that is, water free from disease-carrying organisms and toxic substances, and protected against accidental contamination.

Source of Data

1.06 The principal source of the statistics in this paper is a special survey carried out by the World Health Organization to obtain data on water supply and sewage disposal in developing countries in December 1970. Ninety-one countries, with an estimated 1970 population of 1,700 million, responded to part or all of the survey. So far only the statistical results of the survey have been published; 1/ an analysis of the results is expected shortly.

1.07 Because the WHO survey used the definitions employed by each individual country, its consolidated statistics on the division between urban and rural population, reasonable access to safe water, etc., may be rather misleading. Apparent large differences between countries may be due partially to the use of different definitions, and WHO cautions that the survey figures are only indicative. Spot checks of data for countries in which the Bank has been involved in water supply operations have shown a number of inconsistencies. However, the WHO survey contains the best global data available at present, and the picture it paints is undoubtedly broadly correct.

1.08 In addition to the WHO survey, the paper draws on:

- a research project carried out by the Bank's Public Utilities Department in 1972-74; 2/
- sector studies executed under the WHO/IBRD Cooperative Program;

1/ WHO: World Health Statistics, Vol. 26, No. 11, 1973. Special subject: Community Water Supply and Sewage Disposal in Developing Countries, 1970. (Referred to in the remainder of this paper as "the WHO survey.")

2/ Village Water Supply and Sanitation in Less Developed Countries: R. J. Saunders and J. J. Warford (first issued as RES 2 on March 15, 1974; now being revised for outside publication).

- experience gained by the Bank in its lending operations for water supply, agriculture and rural development;
- the experience of the Inter-American Development Bank, which has made some 20 loans for rural water supply in Latin America (see Annex 4);
- the experience of the Bank's water supply staff; and
- the preliminary findings of the Technical Panel of the Ad Hoc Group on Rural Potable Water Supply and Sanitation established in April 1974 by a number of international agencies. 1/

1.09 Several ongoing Bank research projects -- on measuring the impact of Bank projects on public health; on the design and operation of public hydrants; and on the nutritional effects of reducing enteric diseases -- have a bearing on this paper, and their findings will be taken into account in subsequent editions.

Contents of the Paper

1.10 Following this chapter, the paper is arranged as follows:

Chapter	II:	Background
Chapter	III:	Technical Aspects and Costs
Chapter	IV:	Financial Aspects
Chapter	V:	Organization and Management
Chapter	VI:	The Justification for Investment in Village Water Supply
Chapter	VII:	Priorities - Selection of Sub-projects
Chapter	VIII:	Implications for the Bank

All these chapters except the last are of general application irrespective of the source of finance.

1/ UNICEF, UNDP, United Nations Environment Program (UNEP), IBRD, WHO, International Development Research Centre (IDRC), and Organization for Economic Cooperation and Development (OECD).

II. BACKGROUND

2.01 This chapter gives basic background material for the remainder of the paper. The first part of the chapter is derived from the statistical material in the WHO survey and reviews the worldwide water supply situation in 1970; the United Nations Development Decade (UNDD) targets for 1980; the investments needed to meet those targets; a comparison with past achievements and with past total investment; and the level of past financial assistance. The second part of the chapter describes recent moves by the international community to coordinate their efforts in rural water supply, and the chapter closes with a list of the principal problems usually encountered in village water supply projects.

The Situation in 1970

2.02 The WHO survey (see para. 1.06) obtained information on the water supply situation in 91 developing countries at the end of 1970. WHO engineers and consultants checked the data to the extent possible, in particular those concerning the 25 largest countries which contain 75% of the total population surveyed. Nevertheless, WHO caution that the statistics are order-of-magnitude figures rather than precise data. The population of the countries surveyed was 1,700 million, of whom over 70% lived in rural areas (a breakdown by WHO regions is given in Annex 1, Table 1).

2.03 The percentage of this population with reasonable [1] access to safe [2] water varied widely between countries and regions; a summary is shown in Annex 1, Table 2. In every region rural areas are very much worse served than urban -- overall, only 14% of the rural population had reasonable access to safe water, compared with 68% of the urban population. [3]

2.04 Expressed in numbers, the results are even more disturbing. In urban areas 144 million people had no service, but in rural areas 1,076 million people -- about one-third of the total world population -- were

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1/ "Reasonable access" is defined as follows: in urban areas, within 200 m of a public hydrant; in rural areas, sufficiently close that family members do not spend a disproportionate part of the day in fetching water.

2/ "Safe water" includes treated surface water or untreated but uncontaminated water such as that from springs, protected boreholes or sanitary wells. Other waters of doubtful quality are classified as unsafe.

3/ This latter value is probably too high since in many cities the population is technically "served," but the quality of service (a few hours a day) and the quality of water badly need improvement. This is particularly true of fringe slum areas, the usual destinations of poor rural migrants.

without reasonable access to safe water (for details see Annex 1, Table 3). Two-thirds of these were in South East Asia and the Western Pacific, which also contain the largest numbers of the rural poor. 1/

Targets for 1980

2.05 The UNDD goals call for the extension of water supplies to serve 100% of the urban population (60% through house connections, and 40% through public hydrants) and 25% of the rural population. For Latin America and the Caribbean region slightly different goals were adopted by a conference of the various public health ministers in Santiago (Chile) in 1972: to reduce the percentages of population not served in 1970 by at least 50% for city dwellers and 30% for the rural population. These are useful as broad goals, but are necessarily arbitrary with respect to individual countries, which will need to determine their own priorities and their own urban-rural mix.

2.06 By combining these goals with a forecast growth of population 1971-80 (Annex 1, Table 4), the WHO survey estimated the additional numbers of people to be served by 1980 (Annex 1, Table 5). On the basis of these figures, several conclusions can be drawn:

- The urban population growth rate (averaging 4.5% per annum) is substantially higher than the rural (2.2%).2/ This is particularly marked in Africa, where it is 5.6%, 2.5 times higher than the rural rate.

- Because of this high urban growth rate, to meet the UNDD goals urban supplies would need to be expanded even more than rural. Worldwide, about 400 million new consumers would have to be served in urban areas, compared with about 250 million in rural. 3/

- To meet the goals usually involves at least doubling, and in some cases tripling or quadrupling, the number of persons served, taking 1970 as the base year.

1/ See IBRD Report No. 588: Rural Development and Bank Policies: A Progress Report, in particular Tables 1-3, 13.

2/ In Latin America, several countries (Argentina, Chile, Uruguay) anticipate a decrease in rural population in this period.

3/ The lower rural figure is, of course, due to the lower rural goals: if 100% of the rural population were to be supplied, service would have to be extended to about 1,400 million people by 1980, instead of 250 million.

Investments to Meet UNDD Targets

2.07 The WHO survey presented estimates of the investments needed to meet the UNDD goals, prepared by combining estimates of the number of additional people to be served (Annex 1, Table 5) and of per capita costs (Annex 1, Table 6). The results are summarized in Annex 1, Table 7, which shows that a total of US$14,000 million may be required, $11,000 million for urban and $3,000 million for rural supplies. Spot checks using data from World Bank projects in individual countries suggest that these estimates are low; however, in view of the wide country variations described below, it would be unwise to increase these estimates across the board on the basis of a few samples. Actual expenditures to meet the goals in current dollars will, of course, need to be very much higher than WHO figures, which are in 1970 dollars, but are probably based on data from 1969 or earlier.

2.08 Annex 1, Table 6 shows the assumed per capita costs for extending water service. These costs, averaged by WHO region, vary widely: $12 to $53 for urban supplies through house connections, $9 to $28 for urban public hydrant supplies, and $6 to $24 for rural supplies. Even wider variations occur between countries, ranging from $1 to $300 per capita. This underlines the possible errors from using "typical" system costs for estimating.

Comparison of UNDD Targets with Past Achievements

2.09 The WHO survey was a rather more extensive version of an earlier survey in 1962, in which urban supplies in 77 countries were covered. This permits a comparison of past achievements in urban water (summarized in Annex 1, Table 8) with the UNDD targets. Comparing Tables 5 and 8 in Annex 1, it will be seen that, whereas the rate of growth of urban population served in 1962-70 was comparable with that needed to meet the UNDD goals, the numbers of new urban consumers to be served in 1971-80 are about three times those served in 1962-70 (390 million compared with 134 million).

2.10 Unfortunately there has been no comparable detailed study of the achievements in rural water supply. One informed estimate is that rural water supply coverage increased only from 10% of the rural population to 12% between 1961 and 1971. 1/ Only in Latin America was there a dramatic increase in coverage, from 7% to 24% in the same decade. 2/ In most countries, past investments have been predominantly for urban systems, and meeting the rural goals will call for a very considerable expansion of effort.

2.11 The global needs, $3,000 million investment (1970 dollars) to serve 250 million people, are misleadingly simple. For the difficulty of the task to be fully comprehended, the needs should be expressed in terms

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1/ WHO "Community Water Programme - Progress Report by the Director General to the 25th World Health Assembly," April 1972 (Document A25/29).

2/ PAHO "Annual Report of the Director" (Official document No. 116) August 1972.

of the enormous number of villages to be served and of small sub-projects to be developed. The rural water supply program in Uttar Pradesh, India, illustrates the scale of the problem. One particular project area is 65,000 square kilometers, with 16,000 villages and a population of about 6.4 million. At present only 25% of the villages (17% of the people) have adequate water. The project, estimated to cost $30 million, will involve the construction of over 1,000 water systems, grouped into 300 sub-projects, to serve an additional 2,000 villages with a population of 800,000, so that by 1981 40% of the villages and 35% of the people will have service.

2.12 Accurate figures for investment in water supply are difficult to obtain because of the many sources of funds and, particularly in the rural sub-sector, because of the many agencies responsible. The WHO survey estimated that in one year, 1970, a total of US$982 million was spent, $765 million (77%) in urban areas and $217 million (23%) in rural. A regional breakdown is given in Annex 1, Table 9. An examination of these figures for some countries where the Bank made loans for water supply in that year suggest that actual expenditures were probably considerably higher.

2.13 The WHO estimates of expenditures required to meet the UNDD goals average $1,100 million per annum for urban supplies and $300 million for rural. Worldwide, a substantial increase in real terms over the reported 1970 investment levels will therefore be needed to meet the UNDD goals. Regionally, by far the greatest increases will be needed in Africa and South East Asia (in each case, approximately a threefold increase). However, it is not advisable to make generalizations, and assessments must be made for each country. In some developing countries, for example Mali, Ethiopia, Zaire and Pakistan, the calculated increases are so great (approximately 140-, 145-, 70- and 25-fold respectively) that, even allowing for under-reporting of 1970 investment levels, the UNDD goals appear unattainable. In others the 1970 investment level, if sustained throughout the decade, appears adequate to meet the goals.

2.14 Nearly two-thirds of the additional rural population to be served by 1980 will live in the developing countries of Asia, where per capita incomes are generally low. There must be some doubt whether the economies of these countries can sustain the investments necessary to meet the UNDD goals. Table 10, Annex 1 compares the public expenditure component of gross domestic fixed investment (GDFI) in selected countries in 1970 with the annual average rural water supply investments derived from the WHO survey; it will be seen that even with per capita water supply investments under $10, 2.5% to 3.0% of public GDFI would have to be devoted to rural water supply in India, Indonesia and Pakistan. In Sri Lanka (per capita cost $21) the percentage rises to 9.4. In practice these percentages would probably have to be even higher, because of low investments in the first half of the development decade.

2.15 Remembering that the UNDD goals are modest, in that they only aim at serving 25% of the rural population, it is evident that every effort must be made in these countries to keep down the per capita costs of supply if an

appreciable proportion of their populations are ever to have adequate water. Details of various alternative forms of water systems and of their comparative costs are given in the next chapter (particularly paragraph 3.14) and in Annex 2. From these, it is clear that for the rural supplies in the poorest countries, groundwater sources should be used wherever possible, either by using handpumps for shallow wells or, where the water is at greater depth, motorized pumps supplying a central water point, with no distribution system. Selection of more elaborate systems providing a better service would increase costs to a level where the villages could not be expected to meet running costs and where their capital contribution could be only a small proportion of project cost (see paragraphs 4.09 - 4.18). The burden on the central economy of extending rural water supplies would then increase, and the pace of extension would necessarily slow.

Actions by the International Community

2.16 Assistance provided by multilateral and bilateral agencies to governments for rural water supplies over the past two decades has been widespread and has taken many forms, ranging from short-term technical advice to projects which have provided supplies, equipment and technical assistance extending over several years. Among the agencies which have been associated with rural water supplies are WHO, UNICEF, UNDP, FAO, IDB, OECD, FED, PAHO, and numerous bilateral agencies such as Cooperative for American Relief Everywhere (CARE), Rockefeller Foundation, United States Agency for International Development (USAID), Swedish International Development Agency (SIDA), Canadian International Development Agency (CIDA), Kreditanstalt fur Wiederaufbau (KfW) (West Germany), and Overseas Development Ministry (ODM) (United Kingdom).

2.17 Apart from data obtained from IDB, statistical information on the amounts and extent of assistance provided for rural water and sanitation has often not been in a form which could be evaluated, either because water supply has been mixed with other activities, or because records have been retired or never collected from the field. 1/ Only very rarely have post-project evaluations been done.

2.18 In view of the increasing attention given to the plight of the poorer segments of society in the developing countries, the multilateral and many bilateral agencies are becoming concerned that the poor, both in rural and fringe urban areas, are currently deprived of a fundamental need, access to a safe and reasonably convenient source of water. Some of the questions being raised are: Why, after a rather lengthy experience, are accomplishments so small?; What are the ways in which the international community can best assist in overcoming the problems?; How should the community proceed? To find answers to these questions and to explore ways

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1/ External financial assistance for water supply projects reported in the WHO survey totalled $711 million in 1966-70, averaging $140 million annually. Some Bank loans were not reported in the survey, so the true total should be higher.

by which a coordinated international effort might be launched to stimulate action, an Ad Hoc Working Group was established in 1974 at the initiative of UNDP and IDRC.

2.19 The Working Group consists of representatives from WHO, UNDP, UNICEF, UNEP, IDRC, OECD and IBRD. Its second meeting was convened in February 1975 to review the recommendation of two expert panels, commissioned at the first meeting. The results of the panels' work was presented in two reports, one on the technical aspects and one on the institutional aspects of rural water and sanitation. After consideration of these reports, the consensus of the Ad Hoc Working Group was that there should be a substantially enlarged international effort in the field of rural potable water supply and sanitation in the developing countries. Specifically, it was agreed that a network of international, regional and national centers should be created, based as far as possible on existing institutions restructured or strengthened as necessary, to carry out the following five principal functions:

1) Technological investigation and applied research programs, including review and adaptation of "obsolete" 1/ technology, carrying out of demonstration projects, etc., taking into account the availability of the other inputs necessary for support of the technology.

2) Training of staff of regional, national and subnational centers and programs and of expatriate technical assistance personnel, including training in the fields of organization and management, and the development of appropriate training materials.

3) Education, in the sense of developing techniques and materials for promoting community motivation and involvement in rural potable water and sanitation programs, and instilling greater community awareness of the health aspects of such programs.

4) The creation of a system for the collection, evaluation and dissemination of information on all matters which might assist the developing countries to deal effectively with their rural potable water supply and sanitation problems.

5) Assistance in the strengthening of national and regional institutions in this field and in the creation of any new national or regional institutions which are found to be necessary.

1/ That is, technology which has been superseded in the developed countries by more sophisticated systems, but which may be appropriate to the needs of developing countries.

2.20 It was further agreed that the enlarged program should include support for national activities that are a part of the program of an international or regional institution, or are sponsored by such an international or regional institution, or which are of a character that they have international implications.

2.21 Finally, it was agreed that, as a background for the enlarged international effort, provision would have to be made for special studies on rural water supply and sanitation projects undertaken in the past or under way, and on numerous special problems in this field.

Common Problems in Rural Water Programs

2.22 Sector characteristics change markedly as one progresses from large urban centers, through medium-sized cities, small towns and villages, to the dispersed population. The administrative structure becomes more diffuse, income levels decline, and per capita costs for equivalent levels of service tend to increase. Inherent in these changing characteristics are many of the typical problems encountered in rural water programs (and in most other facets of rural development). These problems may be grouped into the following broad categories, although they naturally overlap:

Institutional

- lack of a rural water supply policy forming part of a national water supply policy;
- existence of several government agencies whose lines of responsibility overlap or are ill-defined;
- lack of institutions capable of project development;
- lack of water organizations at local level;
- lack of trained manpower at every level;
- lack of criteria for project evaluation and priority selection;

Financial

- per capita costs which, for a given level of service, increase as village size decreases;
- relatively low income of villagers and limited village financial resources;
- lack of a policy to obtain maximum financial support from areas to be served;

- lack of local government infrastructure, inability to collect and retain locally collected taxes for local use, and difficulty in collecting fees from water users;

- lack of village motivation and of public health education, so that villagers are unaware of the potential benefits of improved water systems and are not willing to pay for them;

- seasonal availability of water from ponds, streams, shallow wells and other sources of questionable quality to which the rural population may return if high charges for piped water are imposed;

Technological

- a record of short operation life for equipment, poor maintenance, and of many project failures;

- lack of local capacity to fabricate simple, reliable equipment for which spares and service would be available locally;

- use of a wide variety of types and makes of equipment by the various national agencies, compounding the problem of operation and maintenance;

- severe communications problems between remote rural systems and their support organizations in areas with poor or non-existent telephone service, so that system breakdowns are not reported promptly;

- difficulty in obtaining spares due to lack of money, scarcity of foreign exchange, cumbersome procurement procedures, problems of logistics, and absence of a support agency which maintains an inventory of needed parts; and

- difficulty in providing sufficient repair staff and transport to attend promptly to breakdowns in widely dispersed rural systems with very poor road links.

By far the most crucial problems are the institutional and financial ones; if these were resolved the technological problems would largely disappear.

III. TECHNICAL ASPECTS AND COSTS

3.01 Factors affecting the type of water supply system to be constructed in a village include the level of service, water quality and quantity, and the nature and location of water sources. This chapter discusses each of these aspects, and their effect on costs is illustrated in Annex 2. The chapter ends with a brief discussion of excreta disposal systems suitable for inclusion in rural programs.

3.02 Certain general principles can be applied to most village water programs. These are:

- groundwater from springs, wells and boreholes, which requires little or no treatment to make it safe, is preferable to surface water; in particular, in the poorest countries shallow wells with handpumps should be used wherever possible;
- systems must be designed for simple, trouble-free operation, and be capable of being operated and maintained by local technicians;
- equipment must be able to withstand hard usage, and replacement parts must be readily available; and
- standard designs, which can be slightly modified to meet local conditions, should be developed and used for cost estimation, procurement and construction.

3.03 Wide variations between systems and between countries make it difficult to make generalizations applicable to all countries on quantities of water to be provided or on system types or costs. However, it may be stated that consumption is likely to be from 20 to 100 liters per capita per day (lcd) and per capita construction costs between $1 and $3 for shallow wells and $10 and $50 for piped systems.

Levels of Service

3.04 Various levels of service can be provided in village water systems:

- one or more water points, such as a protected spring or a well with a pump, but no distribution system;
- a simple distribution system with a few public hydrants, supplied with water from a single source;
- a more elaborate distribution system serving a substantial number of public hydrants and some house connections; and
- systems with a substantial number of house connections and few public hydrants.

Both capital costs of the facilities and the operating costs associated with the volume of water produced will rise with the level of service. For example, the first two levels are likely to be very simple systems, using a handpump or a gravity supply, whereas the latter two, which require larger quantities of water, will require motorized pumps and some treated water storage facilities to meet peak demands and guard against breakdown. Selection of a higher level of service may also necessitate changing to a more expensive source, for example, to poor quality surface water requiring treatment, because insufficient good quality ground water is available. Higher levels of service will probably not be affordable for the majority of the rural population presently without water, because they cannot themselves meet the additional costs, and for their governments to do so would place an excessive burden on the national economy (see paragraphs 2.14, 2.15 above). Nevertheless, systems with house connections should be encouraged whenever income levels permit, since the full health benefits are not achieved until a plentiful supply of water, free of risk of contamination, is available in the house.

Quality

3.05 Quality standards for village water supply are principally concerned with ensuring that the water does not contain any matter, either chemical or biological, which could affect its safety or acceptability. Standards which have little bearing on health (such as the amount of hardness or the presence of iron, manganese, or chlorides), can usually be relaxed unless this could cause technical problems such as encrustation or corrosion, and so long as the villagers find the water acceptable. Acceptability can be an important factor: for example, groundwater with a high iron or manganese content, which will have a distinctive taste and will discolor laundry and foods such as rice, may be rejected in favor of an alternative contaminated river or pond.

Quantity

3.06 In most villages water is primarily for personal use. The quantity consumed depends on several factors, of which the most important is convenience; if there is a supply in the house or courtyard, consumption may be five or more times greater than if water has to be fetched from a public water point. If water has to be carried a considerable distance -- say more than one mile -- consumption may fall to as low as 5 lcd, which approaches the minimum necessary to sustain life. The climate and cultural patterns of bathing, laundering and preparation of food are also important factors. The provision of public bathing and laundry facilities can increase demand considerably. Waste may be a major problem unless public hydrants are properly designed to prevent faucets from being left to run continuously, or measures are taken to supervise their use. 1/

1/ The Bank is now undertaking research (Research Project RPO 312) into possible improvements in public hydrant design and other methods for reducing waste.

3.07 The WHO survey gives the following data for average daily consumption in rural areas: 1/

	Liters per capita per day (lcd)	
	Min.	Max.
Africa	15	35
South East Asia	30	70
Western Pacific	30	95
Eastern Mediterranean	40	85
Europe (Algeria, Morocco, Turkey)	20	65
Latin America & Caribbean	70	190
World Average	35	90

3.08 The individual data for 91 countries, from which WHO's regional figures were consolidated, show a minimum use figure of about 5 lcd for 7 countries; 20 lcd or less for 24 countries; 40 lcd or less for 45 countries; and greater than 40 lcd for 15 countries. Because of the wide regional and country variations, no single consumption figure can be adopted for world-wide design of rural systems. In some villages with only public hydrants 20 lcd would be adequate, whereas if a number of houses are supplied through private connections, more than 100 lcd might be required. To obtain design data, samples should be taken either in villages within the proposed project area which already have water supply or in other villages with similar cultural, economic and climatic conditions. Allowances should be made for the growth of demand for water for productive purposes such as livestock watering, irrigation of small gardens, preparation of produce for market and, in some instances, establishment of small industries and food processing plants. Demonstration projects or initial programs will give reliable design data for planning subsequent stages.

Sources

3.09 The requirement that the water supplied be safe to drink has an important bearing on design and costs, since different sources of water require different degrees of treatment. Where groundwater is available, springs and wells which are properly located, constructed and maintained will normally yield water which, without any treatment, will meet the most stringent standards for biological purity. An exception is in areas of fissured limestone, where groundwater may be contaminated by surface water.

1/ Judging from Bank experience, certain of these figures appear to be overestimated. Possible reasons for this include the use of design criteria or production data rather than true consumption figures, and not weighting consumption figures according to population when calculating regional and world averages.

3.10 Where groundwater is polluted, or where surface water has to be used, some treatment will be required because of the possibility of contamination of the source by humans or animals. Introducing treatment will increase the likelihood of breakdown and may increase the cost of the system, so wherever possible safe groundwater sources should be used. The degree of treatment will be determined by the nature and degree of possible contamination and by the raw water characteristics. Where the water has little turbidity and is unlikely to be contaminated by parasitic cysts and ova, simple chlorination and storage will usually be sufficient. Some storage will normally be required in the system in any case, so the additional cost of treatment is that of a chlorinator and of hypochlorite powder. Solution-feed chlorinators, which are comparatively trouble-free and easy to operate, can be fabricated locally. Careful organization will be necessary to ensure that the villages receive a reliable supply of fresh hypochlorite powder.

3.11 For water with moderate turbidity, chlorination alone is not effective, and some type of filtration will be required. This may be done at the source, using well points or simple sand and gravel infiltration galleries, constructed mainly with local materials and labor. Slow sand filters may also be used; they are labor-intensive both in construction (especially in obtaining suitable sand) and in operation, and are ideally suited for self-help schemes. Costs are mainly determined by the extent of works needed to connect the river, lake or irrigation canal to the infiltration gallery or filters; the topography; the availability of sand and gravel; and required output.

3.12 Where high turbidities occur regularly, adaptations of standard water treatment plants will be required. Most installations can be fabricated from local materials but are still expensive. Since these plants show considerable economies of scale, and since they also require fairly skilled operation, the possibility should always be considered of constructing one large plant to serve a group of villages. Where sufficient sand is available, settling basins followed by slow sand filters should always be considered, since their use could reduce costs significantly even for turbid raw waters. They have the further advantage of providing comparatively safe water even if the chlorination system fails. 1/

3.13 Transmission costs vary significantly with the source of water. They are zero for a well within a village with no distribution system, small for a gravity supply from a neighboring protected spring, but may be thousands of dollars for a river source at some distance and where both raw and treated water have to be pumped. Annex 2 contains an example of transmission costs for typical surface water systems, which range from $1 to $11 per capita, depending on village size, distance to the source, and height through which the water has to be lifted.

1/ The most-quoted example of this is the 1892 Hamburg cholera outbreak. Both Hamburg and neighboring Altona drew water from the River Elbe, the former treating it by settlement only, the latter by settlement and slow sand filtration. When the river became infected from an upstream immigrant camp, Hamburg suffered an epidemic which affected one person in 30 and killed 7,500; Altona was almost unaffected.

Typical Costs

3.14 Annex 2 illustrates the effects on system costs of various levels of service, sizes of community, and types of source. The following conclusions can be drawn:

- In areas where groundwater is readily available at moderate depth, constructing a number of wells fitted with handpumps is by far the cheapest means of providing a good water supply.

- Use of surface water which requires full treatment may be several times as expensive as using groundwater.

- Providing a high level of house connections may at least double the per capita cost of the system, since the capacities of the source works, treatment, transmission, storage and distribution facilities have all to be greatly increased.

- Distribution system costs are a high proportion of total system costs. For systems serving power regions, considerable savings may be made by omitting the distribution network and delivering the water through overhead storage tanks to a few central public hydrants.

- There are considerable economies of scale in piped village water systems. For similar systems, per capita costs for a project in Tanzania fell from $27 to $16 as the population served increased from 1,750 to 5,000, and for a project in Peru the per capita cost for a village of 1,500 inhabitants was estimated at $27, only one third of that ($86) for one of 150. In another illustrative example, the per capita cost of a system for a village of 10,000 is only about 40% of that for a village of 1,000.

3.15 As will be seen from the wide variation in the per capita costs quoted in the annex, these values, while based on actual projects, are illustrative only and should not be used for estimates. The WHO survey showed capital costs ranging from $6 to $24 per capita (at 1970 prices), taking the average for the WHO regions. Individual country costs varied much more widely, extending from $1 to $150 per capita. For Inter-American Development Bank projects, where over 60% of houses are supplied through private connections, per capita construction costs on projects financed up to 1974 averaged about $40. These variations emphasize the need for a careful review of project estimates.

Standard Designs

3.16 To reduce both project preparation time and engineering costs, sets of standard designs should be developed with corresponding standard costs. These standard designs must be carefully considered initially, and

modified as necessary in the light of field experience. It is essential that they are tailored to suit local conditions. For example, voltage fluctuations or supply outages in the electricity system may mean that electric pumps can only be used satisfactorily if extra pumping capacity and treated water storage are provided to compensate for reduced hours of pumping, and if extra protective measures are incorporated. Pumps ordered "off the shelf" to meet the nominal duty will not meet the full demand and will suffer early motor failure. Alternative sources of power (diesel, gasoline, local hydro) may, therefore, be more economical even in areas with an electricity supply.

3.17 The technology involved should be kept as simple as possible, so that local operators will be able to operate and maintain the system for long periods of time without the assistance of a trained operator from a central agency or of a qualified engineer. Sufficient attention must be given to the cost-effectiveness of the designs and materials selected; too often cheap materials are used to minimize initial costs, leading to early failure in service and a loss of supply for protracted periods while replacements are obtained and installed. These failures are not confined to the more complex systems with motorized pumps; throughout the developing world thousands of handpumps are unserviceable and research is being carried out to find out the reason and to improve designs. 1/

3.18 Each individual system will then comprise a number of standard design units, amended as necessary to suit the particular conditions. Careful engineering review will still be necessary to ensure that the standard designs and cost estimates have been correctly adjusted to reflect conditions in the project area.

3.19 To the greatest extent possible, the standard designs should use local materials and technology and be suitable for construction with unskilled village labor. Block-work and masonry can be substituted for concrete, locally-fabricated asbestos-cement or polyvinyl chloride pipes for imported cast iron or steel, etc. Simple components such as handpumps may also be made locally, although difficulties with quality control in foundries may lead to early failure in service. Local improvisation may also lead to import-substitution (e.g., simple well-jetting rigs developed in Thailand). However, in many developing countries the specialized technology does not exist to fabricate equipment for deep wells (such as drilling rigs, well casing, submersible pumps and prime movers) and the small local market would often not justify setting up factories to produce such equipment.

1/ For example, by the USAID - Battelle Columbus Laboratories program, and by the Water Resource Center of the Accelerated Rural Development Organization, Thailand.

Excreta Disposal

3.20 As discussed in Chapter VI, provision of safe water is the most important contribution to improving public health, but proper excreta disposal facilities also play a significant part. However, if waterborne sewerage is required, its per capita cost may be more than double that of the water system. It is clear that lack of finance will limit the rate of expansion of village water supplies, and if these other facilities are included the financial problem will become even more serious. Many villages see little need for sewage disposal and are much less willing to pay for it than for water supply. There is also the technical problem that, unless a sufficient number of houses can afford water-flushed toilets and connect to the sewer system, the flow in the sewers will not be enough to prevent them from becoming clogged. Fortunately, the population density of many villages is low enough to accommodate traditional excreta disposal methods such as pit latrines, which can be constructed at low cost and with a large self-help component. Typical installations are discussed in Annex 3.

IV. FINANCIAL ASPECTS

4.01 Increasingly, national or urban water supply utilities aim to achieve and maintain financial viability. This policy has four objectives:

- to encourage the development of financially responsible management and thus better investment decisions at the utility level, better financial planning and more cost-effective operations;
- to ensure the availability of adequate funds for operation and maintenance;
- to mobilize resources for the development of the sector by generating internally a cash flow enabling the utility to service borrowings and helping to finance part of its expansion program;
- to make consumers aware of the financial consequences of their use of the service.

4.02 In a number of countries, however, both governments and consumers have the attitude that good water supply is a social service, for which charges should be kept to a minimum. This attitude must be changed, at least so far as it is applied to higher income areas, if resources are to be freed for extending service to the poorer and rural areas; consistent social policies require that, as a first step, anyone able to pay should be charged at least the full cost of service.

4.03 In villages relatively high unit costs and relatively low consumer incomes make inability to pay a further problem in recovering a reasonable proportion of total costs. Moreover, the existence of some alternative source of water -- however inconvenient and unsafe -- and a general lack of appreciation of the benefits of using a safe water supply makes the imposition of high user charges undesirable. The problem is, therefore, how to achieve these objectives -- which remain applicable even at low levels of financial performance 1/ -- in these circumstances.

4.04 Changing government and public attitudes towards water charges takes time and education. As a general principle, user charges should be set at as high a level as possible because the size of the program, and

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1/ Where a water undertaking is heavily dependent on government funding to meet debt service and serve recurrent costs, the third objective clearly cannot be achieved in the form it is expressed in paragraph 4.01. However, the underlying concept behind the objective can still be realized if the undertaking makes proper financing plans and obtains clearly defined government contributions towards these plans, rather than proceeding on the basis of an ad hoc annual budget.

to some extent its continuing operation, depend on this source of funds as well as on general public revenues. However, the level of these charges must take account of village income levels, and the method of assessing them -- by region, by individual village, or on some other basis -- will need careful adjustment to the characteristics of each particular program. Whatever pricing policies are adopted, village water supply programs in many countries are likely to require continuing support from national revenues. Government funds will be necessary to cover not only the initial costs of construction, but also the costs of establishing and running the administrative unit, and of initial and continuing training; it would also be prudent to allow for covering part of the operation and maintenance expenses, at least in the early stages of a program. Governments should recognize this implied commitment when they first undertake such programs; failure to look beyond first costs has been the cause of severe problems in the operating stages of many programs.

4.05 This chapter discusses the possible sources of funds for village water programs, minimum targets for the payment by the villages, and methods of collection. It concludes that the village payment should be as high as possible in the circumstances of each case, covering normally at the least all operating and maintenance costs, and preferably including a contribution toward the capital cost of the scheme. For this to be possible, the system's capital and operating costs must be reduced to a level compatible with villages' willingness and ability to pay; factors affecting costs have already been described in Chapter III, and consultation with villages on the system to be provided is discussed in Chapter VII. Moreover, as discussed in paragraph 2.14 above, the levels of service to be provided in many of the poorer countries will have to be minimal if water supply is to be extended to a reasonable proportion of their rural inhabitants without placing an intolerable strain on the national economy.

Sources of Funds

4.06 There are five potential sources of funds for village water programs: the government budget, foreign loans, institutional lenders within the country, subsidies from urban water systems, and the villages themselves. The amount of funds allocated to village water supply from the first two sources is usually determined by the government on the basis of national priorities and the needs of other sectors of the economy.

4.07 The third source of funds, the institutional lenders of the country (insurance companies, banks, etc.) has been largely untaped so far, either because the lending institutions themselves are relatively undeveloped or because the institutions responsible for rural water are not acceptable as borrowers. One of the objectives of improving rural water institutions should be to enable them to attract funds from these sources.

4.08 The fourth potential source of funds, subsidies from urban water systems, is a natural extension of internal cross-subsidization already occurring within the urban systems (typically, industrial and commercial

consumers pay a relatively high tariff, while only a nominal charge, if any, is made for water distributed through public hydrants). However, many urban systems, particularly those where migration has greatly increased the numbers of urban poor, are already having difficulty in maintaining an adequate service. Urban dwellers naturally strongly resist any large increase in their tariffs in order to subsidize supplies to other areas. The extent to which urban systems will be able to make any sizeable contribution to the needs of smaller communities is therefore questionable. In these circumstances, total amount available to meet initial and recurrent costs is therefore dependent to a large degree on the contribution from villages. It seems clear that, if the needs for village water supply are to be met in a reasonable time, the targets for collecting capital and operating costs from the villages must be as high as possible. The more that government funds have to be used to cover operating costs, as is now usually the case, the fewer new systems will be built.

Level of Villages' Payment

4.09 It is widely held that villages in general are so poor that they are unable to pay anything toward the costs of a water supply system. While this view may be correct in the case of the smallest and poorest villages, the prospects for collecting a reasonable proportion of the costs are probably better than is generally thought if the following conditions are fulfilled: the standard of service is carefully tailored to the needs of the individual village; villagers are given basic health education so that they appreciate the benefits of improved water supply; and a policy of maximizing user charges is vigorously enforced. 1/

4.10 There are several good reasons for asking villages to pay part of the costs, both of construction and of operation and maintenance, of their water supplies:

- it is desirable that beneficiaries contribute towards the cost of the services they receive;
- as discussed above, it will enable the program to be larger;
- it will help to ensure that funds are available to meet operating expenses and the costs of minor repairs;
- it will increase the villagers' sense of responsibility for the system, and so encourage good maintenance and careful use of facilities;

1/ For example, villages in the Republic of Korea are now contributing, through the saemaeul (village renewal) movement, over half the construction costs of simple piped water supplies.

- since villagers should participate in the decision on the level of service to be provided (see Chapter VII), the requirement that they make a capital contribution (whether in money, materials or labor) will ensure that this decision is carefully considered;

- it will establish the principle of payment for services received; this will become more important if, at a later stage of development, a higher level of service is desired.

The WHO survey showed that of the 84 countries giving details of charges for rural water supplies, 24 (29%) of the countries studied required villages to make some payment towards capital costs, and 61 (73%) some payment towards operating expenses. Many countries showed various degrees of cost recovery; only 23 (27%) said that they made no charges at all for rural water. However, the Bank's experience is that in many countries charging policies are not consistently enforced, and arrears may be extremely high.

4.11 Even with a decision in principle that villages should meet part of the costs, determining their ability and willingness to pay remains a serious problem, because of lack of reliable data on rural incomes, and because many villages have essentially a barter economy and little cash changes hands. IDB, whose projects provide a fairly high level of service and correspondingly have a relatively high per capita cost, have found that communities can be expected to pay between 3 and 20% of the capital costs of their systems, averaging about 10%. Water charges, set at about 3% to 5% of the income of the head of the family, cover at least operation and maintenance costs and possibly also some depreciation. Very rarely can families pay more than 5% of their income for water charges. 1/

4.12 Similar levels of payment could probably be required elsewhere, provided that the level of service provided is carefully tailored to village needs and resources. For the poorest areas, supplied by a shallow well fitted with a handpump, a capital contribution of 10% would probably not amount to more than $0.30 per capita, and would probably be given in the form of one day's labor per family, in helping to dig the well. Operation and maintenance costs for handpump systems are a few cents per person per year, and even in poor villages with a non-cash economy should be affordable.

4.13 With more elaborate systems both capital and operating costs naturally rise, but attempts to establish guidelines on the proportion of these costs that the beneficiaries should be expected to pay have not been successful; the Bank does not have sufficient data to take a position. In many countries of Asia per capita rural incomes are $50 per annum or lower, but only a small proportion of this is in cash. In these cases, if a

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1/ For example, guidelines being developed for the PIDER rural development program in Mexico suggest that the monthly water tariff should not exceed the equivalent of one day's pay at the prevailing minimum wage.

village is unable to make a cash contribution to the capital costs of a scheme, labor or materials should be accepted instead. Use of village labor in this way is desirable because it generates additional employment, but it has one serious drawback: on a number of projects an unreliable work force has led to wasteful use of material and to delays and difficulties in project execution, particularly curtailment of project work during peak agricultural seasons such as planting and harvest because the labor force was fully employed in the fields. With system costs in the range $20 to $40 per capita, it should not be difficult to identify a suitable local contribution in kind (digging of pipe trenches, collecting sand for filters or concrete, etc.) equivalent to 10% of project costs. A greater problem may be in deciding how villagers can best contribute to operation and maintenance costs. Since they may have some difficulty in making cash payments for chemicals or energy, they should be given the opportunity to contribute labor (e.g. for cleaning filters or sedimentation basins, or for regular operation of the scheme). As a first approximation, levels of payments on many projects might be set so as to cover 10% of capital costs and all operating and maintenance costs. These levels would be applied to the "basic system" costs, with a supply through public hydrants. Where individual householders require private connections, they should normally meet the full additional costs, probably with the assistance of some form of revolving loan fund.

4.14 While contributions to capital costs and to operation and maintenance expenses are both important, more stress should be laid on village coverage of operating expenses than on its contribution to capital costs. It is generally easier to ensure that the capital costs are provided for in a defined program, and experience shows that many rural systems break down shortly after completion due to lack of funds for operation and minor repairs.

4.15 To increase the funds available to the program, the minimum levels of payment suggested above should be reviewed in every project and raised when possible. This may be done by establishing payment levels according to village size or potential income, provided that the villagers accept the rates as equitable. It may even be done on a village-by-village basis, as is done in some Latin American countries, where villages vie with one another to make the maximum contribution and so get higher priority in the program.

4.16 Application of the minimum levels to each individual village enables each village to understand clearly the financial implications of installing a water system. There are, however, complicating factors which may make it more desirable to establish levels for groups of villages or by some other category:

a) Other things being equal, systems for smaller (usually poorer) villages are more expensive per capita than those for larger (usually more prosperous) villages. If the systems to be provided have already been reduced to the cheapest possible,

requiring each individual village to make payments at a predetermined level may have the result that only the larger villages qualify for new systems. This is probably desirable from the standpoint of economic growth but less desirable on social grounds.

b) Since groundwater systems are generally much cheaper than those using surface water, more villages will qualify in areas where groundwater is available, even though the need in these areas may be less.

c) The relationship between per capita costs of installing and operating a system and per capita income will vary from village to village and from country to country. The most expensive systems may be required in the villages least able to afford them.

4.17 There may also be circumstances in which it may be unreasonable to expect villages to make a substantial capital contribution, for example:

- resettlement schemes, in which people are to be attracted to new villages by the services provided;

- rural development projects in which the cash incomes of villagers will not increase markedly until crops mature, perhaps after a number of years, and where it may be prudent to allow in the design for an eventual high proportion of house connections, even though these are not desired by the villagers initially and could not be afforded by them.

In these cases the initial capital contribution may be kept low and largely replaced by higher water charges, covering not only operation and maintenance but also depreciation. (This, however, increases the strain on government finances during the early years of the program.) Alternatively, fairly large contributions, financed from a short-term revolving fund, may be required later in the program as villagers request house connections.

4.18 The decision on the levels of payment and the way in which they are to be applied has to be taken by government, since it will be responsible for funding the program. It is extremely difficult to draw up general pricing rules when the ability to pay and the system costs may vary widely from village to village, and when "social" objectives such as improved health or income redistribution are an integral part of the concept of the program; each decision will have to fit the specific case. Whatever decision is taken, it should be reviewed periodically and the targets altered if necessary, to reflect changes in village economic conditions and consumption patterns. Frequently the basic data on which to base such a decision -- for example, sector needs, estimates of capital and operating expenses, villagers' ability to pay -- is not available; the use of sector surveys to supplement sector information is discussed in Chapter VIII.

Collection

4.19 The financial performance of village water supply programs will almost invariably be well below that normally required on urban projects. The reasons for accepting lower standards are pragmatic, based on experience. The typically low incomes of villagers, and the existence of some alternative source of water -- however inconvenient and unsafe -- simply makes it impossible in most cases to charge the full cost of the service. The real problem will be to collect any charges. 1/

4.20 Metering of individual supplies, the usual and most equitable basis for charging in urban systems, will not generally be justified in villages, where consumptions are small and where only a few houses may have individual connections. As a rule, revenue meters should only be used in villages for commercial or industrial consumers (if any) and possibly for a few large house connections; other house connections would be charged at a flat rate, with a flow-limiter in the supply line to reduce wastage.

4.21 People dependent on public hydrants for their supplies will normally pay a flat rate, for example, through individual or family fees, head taxes, a water tax or an assessment on property. Part of the state revenues received by the village may be used to meet the charges for hydrant supplies. In some countries (Kenya, for example) water from public standpipes is sold by a sub-contractor, who purchases it from the water undertaking. Because the unit charge cannot be less than the smallest coin, the effect of this system is to make the water expensive: even if only one cent is charged for a 20-liter container (the typical size in many countries) the effective rate is $0.50 per cubic meter, possibly over twice the cost of supply. On the other hand, because quantities used are small the total monthly bill per family is not excessive -- about $2.30 for a family of six using 25 lcd -- and the consumers receive a reliable service because the sub-contractor has an interest in maintaining the hydrant in good order. (Since the selling price of water cannot be reduced, this raises the possibility of the water undertaking raising its price to the sub-contractor in cases where he would make excessive profits, and returning the profit thus made by the undertaking to general village revenues.) On the other hand, in other countries this system may greatly reduce consumption; in Ethiopia, when charges for standpipe water were waived during a cholera outbreak in order to encourage greater use, consumption increased several times. The strict control over dispensing of water from sales points means that users are unlikely to wash out the containers adequately, or to wash themselves, so contamination of the containers from soiled hands becomes a health problem.

1/ Experience on IDB projects shows that charges for water are more readily collected where house connections are provided; this may be a factor in deciding whether to incur the higher costs of installing a system with a high proportion of such connections.

4.22 The choice between various charging methods is largely dictated by local conditions, and should normally be made on the basis of administrative simplicity, acceptability and likelihood of effectiveness. The Bank research project referred to above (para. 3.06) will be concerned with, inter alia, methods of charging for public hydrant supplies.

4.23 Where one system serves a group of villages, the individual village consumptions can be assessed from bulk meters on supply pipelines, records of the number of hours pumps have run, etc., which will usually be necessary for operational control of the system. On this basis system operation and maintenance costs can be fairly allocated.

V. ORGANIZATION AND MANAGEMENT

5.01 Institutional weakness is probably the most important single problem in rural water supply. This weakness manifests itself in various ways, particularly in a lack of any central policy for rural water supply, and a multiplicity of eneffective and understaffed ministries and agencies with responsibilities in the sub-sector. Much of the efforts of development agencies in urban water projects over the past 10 to 15 years have been directed at creating strong, competent and financially viable institutions. In general, much less effort has been made to bring any order to the rural sub-sector, which is more dispersed and heterogenous, and where the problems are far greater.

5.02 This chapter discusses some of the common institutional problems in the rural water sub-sector, and then examines the implications for various alternative ways of executing village water programs.

Common Institutional Problems

5.03 In most countries there is no national policy for rural water supply. Although overall national objectives such as the UNDD goals may nominally have been adopted, these have usually not been translated into actual objectives for the responsible agencies, and their financial and other implications, both for the government and the agencies, have not been assessed. As a result, the objectives are not likely to be achieved.

5.04 A major factor contributing to this situation is the existence of numerous agencies responsible for rural water. Typically, the ministries of health and agriculture may be responsible for supplies to small villages or the dispersed population, and the ministry of works for larger villages and small towns. Where they exist, national or regional water authorities or rural development agencies will also be involved. Approval for the development program for new projects may have to be obtained from the ministry of planning, and funds for both construction and, in many instances, operation and maintenance, released through budgets agreed with the ministry of finance. In larger countries the situation may be further complicated by the existence of both national and state governments. In most countries an effort should be made to reduce the number of agencies involved in the sector, to improve coordination between them and to establish small inter-agency policy-setting units. Sector surveys, discussed in Chapter VII, may be needed to identify areas of inefficiency and duplication in the sector organization and to propose improvements.

5.05 In almost every country there is inadequate staffing of the agencies responsible for rural water. In most, this is a reflection of a general lack of suitably qualified staff in government service, accentuated by a number

of factors which make rural water supply particularly unattractive: low prestige; low salaries; poor living conditions in outback areas; low technological standards affording little stimulus to engineers and other professionals; little scope for career development. If a government wishes to achieve its rural water objectives, it must itself have adequate staff in its own institutions to perform the task; consultants or other organizations in the private sector should normally be used only for specialist investigations such as groundwater surveys. Obviously benefits for rural water supply personnel should be brought into line with the benefits in other sectors of the government civil service, but it is impractical and inequitable to increase them beyond this point. Perhaps the most effective step to attract better staff into rural water supply would be for the government to declare it to be a key development sector, and pay greater attention to the motivation of personnel.

5.06 Few countries make adequate provision for training rural water supply personnel, and most village water programs should include a substantial training element. Ideally, and whenever possible, this should be integrated into a national training effort for the sector as a whole; few countries can afford separate training facilities for urban and rural water supply personnel. In assessing training needs, the whole range of skills must be considered: local staff such as plumbers, operators and mechanics; tradesmen such as bricklayers, pipe layers and well drillers; supervisory staff such as foremen and sanitary inspectors; technical professionals such as engineers, chemists and bacteriologists; accountants and their support staff; and administrators and community organizers. A careful inventory should be made of the extent to which the required skills are already available in the country; often civil or sanitary engineers are found working in other fields because of better salaries, career opportunities or conditions of service. These qualified staff should be attracted back to the sector if possible. Preparation of training programs is a specialized skill, and, since the programs will need to fit local circumstances, local experts should be used as far as possible.

5.07 In the early stages of rural water projects there may not be a need to establish large training centers, since facilities may not be constructed at a rate sufficient to absorb the newly-trained personnel. In these circumstances demonstration projects providing on-the-job training in fundamentals are probably the most useful and flexible means of training, so long as they are carefully designed to provide adequate instruction. In integrated rural development projects advantage can be taken of training and education facilities established for other components of the project, which may, in many cases, also involve instruction in the operation and maintenance of simple mechanical systems.

5.08 Operation and maintenance of rural water supplies is one of the most neglected responsibilities of rural water agencies. Often funds are allocated for construction without any assessment of the costs and manpower

requirements for running the completed project. This is an important defect, since the Bank survey showed that operation and maintenance is by far the weakest aspect of most village water programs. Poor or nonexistent administrative and technical support and lack of operating funds were cited as the most frequent causes of failure. In one country, 69 out of 79 systems had had difficulties in operations. In another, village systems were failing almost as fast as new ones were being built.

5.09 The general lack of methodology for project selection, discussed further in Chapters VI and VII, combined with the multiplicity of agencies, has the result that the rural water program actually carried out tends to be an aggregation of projects selected by individual agencies, with little overall regard for sector objectives, needs, or development potential. Institutional strengthening and better coordination in planning are necessary to improve the situation.

5.10 The administrative framework adopted for a village water program must, therefore, have adequate vertical links. Planning, and to some extent construction, can be administered from the top, but to ensure continuing operation, support for the village systems must be readily available, and this implies decentralization. This local support must cover technical advice, operator training, water quality supervision, keeping a stock of spare parts, etc. It may also be necessary to cover recruitment of staff and supervision of operations. The cost of establishing and maintaining this local support structure will be substantial, and is frequently overlooked when planning a program. It has been emphasized earlier in the paper that governments, when they first embark on village water supply programs, must make a commitment to meet these initial costs and also any operation and maintenance costs that cannot, in the early years of operation, be recovered from the villages themselves.

Alternative Formats for Village Water Programs

5.11 Village water programs can be undertaken in various ways, each requiring a different administrative approach:

- as part of a national or regional water supply program, including both urban and rural elements;
- as a rural water supply program; or
- as part of a regional integrated rural development project, or similar multisectoral project.

In most countries several ministries and national agencies are active in rural water supply, using some or all of these various formats. The situation is more complex in countries where there is a considerable amount of local autonomy, with little direction and support from central bodies.

The administrative arrangements have to be tailored to suit the situation in each country, and there is no universal solution. However, the basic requirements are always the same:

- efficient execution of the three stages of project implementation (planning, construction, and operation);
- consistent application of sector policies, design criteria, etc.; and
- avoidance of unnecessary proliferation of agencies with sector responsibility.

In the following paragraphs each of these formats, and its institutional implications, is discussed.

5.12 If village water programs are included in national or regional water supply development programs with both urban and rural elements, an institutional framework such as a national water agency probably already exists, which needs to be expanded and extended to the new areas to be served. This approach is likely to make the best use of scarce technical and administrative talent and to ensure a consistent application of sector policies. Tunisia, Brazil and Ghana are typical of the countries using this approach. Brazil, in fact, uses an effective two-tier approach: broad policies and financing arrangements are decided at national level, while state water companies are responsible for detailed planning, construction and operation.

5.13 Where village water supplies are to be constructed under a rural water supply program, independently of urban water supply developments, the choice of agency to be responsible depends on previous experience in the country. In some countries rural water agencies have been operating successfully for a number of years and have built up their own staff and have their own facilities. In these cases the agency (strengthened, if necessary) is obviously the first choice to run the program, even though this may mean some overlap with the work carried out by the urban water supply agency. In other countries rural water has received little attention, and the rural water agency is weak and understaffed. To undertake a major project successfully would require considerable institution-building, beginning with manpower development. This would be time-consuming and would place a heavy burden on existing staff. In these circumstances, a careful study has to be made of the relative merits of building up the rural agency, on the one hand, or amalgamating it with the urban agency and strengthening the combined organization, on the other.

5.14 The third format for executing village water supply programs is as part of a multisectoral project such as integrated rural development. The problem in this case is that the water supply component has to be completed in accordance with the main project schedule; this is feasible provided that

institutions for administering village water projects already exist, need little change, and can be called upon for assistance. Where these institutions do not exist or are very weak, design and construction can be contracted out and expatriate personnel employed to supervise construction and later assist with operation. However, there may not be sufficient time to build the regional water organization, make proper arrangements for village participation, agree on financial policy and introduce satisfactory operation and maintenance procedures. This problem applies primarily to the water component of the project, where individual villages may have responsibilities for operation, maintenance and collection of charges; other components such as roads, rural electrification and irrigation can go forward with existing centralized organizations, since they require much less local input.

5.15 If a competent national or regional agency with responsibility for rural water supply exists, it should be entrusted by the main project agency (for example, a rural development agency) with responsibility for executing the water supply components of the integrated project. This should ensure that, after completion, the new water supply systems are properly operated and maintained. It will also make best use of existing expertise, ensure consistent application of sector policies, and share experience gained from the project with projects in other parts of the country.

5.16 If a national or regional agency does not yet exist or is incompetent to undertake the project, there are two alternatives:

- create or strengthen the national or regional water agency;
- establish a water supply unit within the main project agency.

The former is preferable, not only for the reasons given above, but also because it avoids proliferation of the number of agencies with responsibilities in the sector. However, the water supply component of the main project may be too small to provide sufficient leverage to improve the water sector institutions to the necessary extent, and in such cases the second alternative may have to be adopted. If this is done, this unit would work closely with the national or regional agency responsible for rural water supply; in particular, the unit would be responsible for ensuring that the water pricing policy adopted for the program would be consistent with the agency's pricing policy, so that the decision of the villagers on the level of service they can afford is based on a realistic assessment of what it would cost them. The unit's exact responsibilities and affiliations would have to be determined for each individual case, but with any arrangement of this sort, particular care has to be taken to ensure proper continuing operation and maintenance of the water supply component.

VI. THE JUSTIFICATION FOR INVESTMENT IN VILLAGE WATER SUPPLY

6.01 Governments have to take two types of decisions on village water supply investment. The first is intersectoral -- why invest in village water supply rather than in other sectors of the economy? - and the second intrasectoral -- for a given total investment, in what order should individual village projects be executed? This chapter discusses the first aspect, and Chapter VII examines factors affecting project ranking.

6.02 The most important benefit from improving the quality and quantity of village water supplies is improvement in public health. Although this cannot easily be quantified or expressed in economic terms, the strongly held opinion of public health officials, and in particular of WHO, is that provision of safe water is of prime importance to public health and, in combination with other sanitary measures, is an essential prerequisite to eradicating many endemic diseases.

6.03 In some cases, the benefits may be directly measurable and quantifiable; for example, improvement of water supply may allow processing of produce, fish freezing or yarn dyeing. However, in most cases the benefits are difficult to measure adequately, and in this respect investment in village water supply resembles investments in many other "social" sectors such as education. The most important of these unquantifiable benefits are improved public health and greater convenience, both of which may increase productivity. Indirect benefits commonly cited are slowing down of rural-urban migration; redistribution of real income in favor of the rural poor; and the development of village institutions. Each of these is discussed in this chapter. Because it is not yet possible to measure these benefits adequately, intersectoral allocation cannot be done on the basis of precise cost/benefit analyses, but is essentially a matter of public policy, reflecting the prevailing sense of national priorities.

6.04 This chapter does not attempt to define what those national priorities should be. The comparison between past investment in all sectors and the investment needed to meet the 1981 UNDD goals for rural water supply shows great differences between various countries, and each country must assess its own investment priorities. This chapter confines itself to describing the benefits of village water supply investments so that these and the corresponding costs (see Chapter III) may be compared with those in other sectors.

6.05 A distinction must be drawn between the justifications for investments in urban and in village water supply systems. Investment in urban water supply is relatively easy to justify even though not all the benefits can be determined precisely: an adequate supply is essential for industry and commerce; in most urban areas there are no satisfactory alternatives to a public system; and there is a risk of major epidemics if a proper supply is not provided. In addition, revenues from water charges in urban systems,

which can be used as a minimum approximation of economic benefits, are usually sufficient to meet all costs and provide a reasonable rate of return. However, these factors are progressively less applicable as the size of the service area decreases: in smaller villages there is little commercial activity and almost no industry; other sources of water, of varying degrees of reliability, safety and convenience, usually exist; and an outbreak of disease, should one occur, is likely to be confined to fewer people. In addition, as discussed in Chapter IV, many villages will be unable to meet much more than the costs of operation and maintenance, so that the financial rate of return on the project will be small. Attempting to increase these charges in order to obtain a financial performance comparable to urban systems will be extremely difficult in most cases and could cause villagers who have not yet appreciated the benefits of a safe water supply to return to their traditional polluted sources. Justification of village water supply projects, therefore, must depend largely on nonquantifiable factors.

6.06 This chapter continues with a discussion of various commonly cited benefits of investment in village water systems, and examines the validity of each.

Public Health Benefits

6.07 Numerous epidemiological studies have identified contaminated water as the principal agent in the transmission of typhoid, cholera and shigellosis (bacillary dysentery). Lack of safe water for drinking and washing is also an important factor in the spread of other diarrheal diseases, which form possibly the most important single disease group throughout the developing world: up to half the deaths in the developing world occur in children under five, with diarrheal diseases being the most common cause. Numerous other diseases are also linked to poor water supply or sanitary conditions.1/

6.08 It would therefore be expected that improving community water supply would result in measurable increases in public health. However, to date health impact studies have not usually been pursued sufficiently far to demonstrate this link conclusively. One obvious difficulty is that some endemic diseases such as cholera have epidemic characteristics; during an outbreak the protection afforded by safe water supply has been clearly demonstrated in many epidemiological studies, but at other times the role of safe water in preventing the spread of the disease is less easily demonstrated. A second difficulty is that few if any diseases are transmitted

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1/ The relationship between water and health is discussed at greater length in Saunders and Warford (Chapter III) and in Bank Report 554a: Background Paper on Health (especially paras. 41 ff).

by only one medium; typhoid, cholera, dysentery, and, more rarely, hepatitis may be causes by drinking water contaminated with human wastes, but may also be due to contaminated food, milk, and to a lesser extent to other vectors such as flies.

6.09 The effect on community health of providing a safe water supply depends on the extent to which the community makes use of the supply, and this in turn depends on social customs, understanding of health implications, and on the level of service provided. If water has to be carried from distant wells or public standpipes, the quantity fetched is usually small. Use of this safe water for drinking and cooking reduces water-borne diseases such as typhoid, and cholera, but there may be insufficient supply for proper personal hygiene, so that "water-washed" diseases (for example, trachoma and some skin diseases) cannot be effectively controlled. There is also the risk that the safe water obtained from the source is contaminated in transit or while being stored prior to use. Moreover, continuing use of ponds and streams for laundry and personal hygiene means that the villagers are still vulnerable to parasitic infections such as schistosomiasis and dracontiasis (Guinea worm). If it were possible to predict exactly the effects of various levels of service on the reduction in disease, it would be possible to determine what level of service should be provided in order to maximize net benefits, but this cannot be done with present knowledge. As discussed in Chapter IV, a system supplying consumers through private house connections may cost double the most basic system which only supplies public hydrants, but the evidence is too limited and cannot be generalized to support a conclusion that health benefits would be increased by a similar ratio.

6.10 If villagers have frequent contact with polluted water (for example, for laundering, bathing, fishing or paddy cultivation), improving water supply will only have a limited effect on reducing diseases such as schistosomiasis (bilharzia); in these cases additional means must be found to break the chain of transmission. The studies cited by Saunders and Warford suggest that improving both water supply and methods of excreta disposal may be more effective and less expensive than controlling the snail vectors by molluscicides, and similarly, for long-term control, may be more efficient than immunization for cholera and typhoid (cholera immunization, in particular, is of doubtful effectiveness). Excreta disposal systems (usually of a very simple type, such as pit latrines, which have a high self-help component) should be considered as essential counterparts of village water supply programs in improving public health, and executed at the same time.

6.11 Often villagers do not appreciate the benefits that can be derived from improved water and sanitation systems. Health education programs are necessary to instruct them on the dangers of drinking or coming in contact with contaminated water, and on elementary hygiene. Health educators should make a preliminary visit to villages at an early stage of project preparation in order to stimulate interest in improved systems, and as part of the effort

to organize the villages. Health education programs need to be ongoing and should begin early, continuing for several years after the project is completed. This will help to ensure that full health benefits are obtained. These health programs can be expensive, and in cases where water is relatively inexpensive (for example, a gravity supply from a spring) the most cost-effective solution may be to provide much better access to service (providing more hydrants, better community facilities and possibly a greater proportion of house connections) to minimize the need for intensive health education efforts in order to realize the health benefits.

6.12 It is sometimes argued that increasing the quantity of water available to villagers is more important than ensuring its quality. It is true that only a small proportion of daily water usage is actually consumed, and in theory, provided this water was safe, the remainder (used for washing, laundry, etc.) could be of a lower standard. However, experience shows that it is extremely difficult to guarantee the safety of the water used for drinking if the original supply is unsafe: very few people have the patience (or the fuel) to boil water long enough to ensure disinfection, and storing this boiled water hygienically while it cools presents problems. The likely use of the unsafe supply for cleaning cooking utensils or for foor preparation means that there is always a risk of contamination.[1/] It is obvious that an unsafe supply (that is, one that is not adequately safeguarded against possible contamination) not only will fail to protect consumers against waterborne diseases but also may serve to transmit these diseases more widely than would have been the case had consumers still been dependent on their own private sources. The net health benefits of an unsafe source may therefore be negative. Moreover, the "quality vs. quantity dilemma" is often more apparent that real. Groundwater supplies, properly located and constructed, are usually safe without additional expenditure on treatment. Surface water supplies frequently need treatment such as filtration to make them acceptable to consumers and prevent clogging of pipes by silt, and the extra cost of disinfection is a small proportion of system costs (probably 3% to 4%; see Annex 2). Throughout this paper it is assumed that all new systems are designed to provide safe water.

6.13 At present it is not possible to predict with sufficient accuracy effect of improved water supply on sickness and death, let alone its economic consequences. However, the Bank is currently employing a high-level panel of medical experts to help to determine whether refinement of health-impact studies to precede or accompany village water supply projects is feasible or desirable, and whether such studies will lead to ways of predicting more accurately the extent of disease reduction through improved water supplies.

1/ A particular problem is that many of the causative agents of major diseases survive for long periods outside the body, so that one visit by a carrier may provide a reservoir of infection for months: for example, cholera: 5 to 16 days; shigellosis: 1 month to 2 years; leptospirosis: 3 to 9 days; typhoid fever: months; ameobiosis: 1 month. (Source: Arthur P. Miller: Water and Man's Health, 1961).

Productivity Benefits

6.14 Improving village water supply may be an essential step in the development of village industries such as fish processing and freezing, fruit and vegetable production, or cloth dyeing. The benefits from these activities can be measured directly. It can also increase individuals' productivity in two ways which are readily identifiable but which are difficult to quantify: reduction in the time and effort spent fetching water,1/ and increasing individuals' output through improved health. The latter effect is twofold; absenteeism is reduced, and workers' strength, stamina and ability to concentrate is increased (however, in the absence of growth potential, it may not be possible to achieve very much real increase in output; as discussed below, the effects may be only to increase underemployment and possibly encourage migration). Reduction in enteric and parasitic disease also results in better utilization of food, and so avoids waste of scarce resources.2/

Slowing of Migration

6.15 Most developing countries are experiencing a high rate of migration from rural to urban areas, which strains their social and economic infrastructure. If this flow could be reduced, the cities would be better able to absorb immigrants, generate employment, and cope with internal development problems. However, whether or not a slowing of migration is desirable, in the sense that it would represent a net gain in national productivity or improve income distribution, depends upon many factors, in particular upon the relative marginal productivity of human resources in urban and rural areas and upon the rate of rural population growth. Moreover, there is little evidence on the effect of improved rural water supplies on migration, and that which exists is contradictory. At the individual level, better water supply reduces the "push" component of migration from the villages to the towns; on the other hand it does nothing to reduce the "pull" component (better jobs, higher incomes, greater educational opportunities). Improvements in health associated with better water supply may, at least in the short term, aggravate the problem of rural underemployment and lead to more migration rather than less (in the longer term, reduction in infant mortality may result in a reduction in desired family size, easing unemployment pressures). At the community level, good water supply is only one among many infrastructure components (roads, schools, markets, etc.) essential for the development of village growth centers; by itself it is unlikely to have a significant effect, but on the other hand its absence will prevent, or at least greatly hinder development.

1/ White, Bradley and White, in "Drawers of Water" estimate that for some rural African settlements over one quarter of one person's daily energy requirements is used in fetching water; for individual households the figure could be as high as 80% to 90%.

2/ For a fuller discussion of this type, see Bank Report No. 554a: "Background Paper on Health", paras 63 ff.

6.16 Another difficulty is in assessing the contribution of local growth centers to slowing migration, since some studies suggest that the typical migration pattern is from the dispersed rural population to the nearest large village and then, after an interval, to a larger urban area. If this is correct, creation of village growth centers, by making the initial transition from dispersed rural life less difficult, might actually increase migration. This effect might be prevented if the development of the growth center were part of an integrated rural development program which, by providing more agricultural opportunities, encouraged workers to stay on the land.

Income Redistribution Effects

6.17 Income redistribution from more prosperous urban areas to less prosperous rural areas is a common feature of rural water supply projects, since most are not financially viable and need support, whether from central government revenues or from a national water authority. However, unless a water supply development helps associated agricultural or other development, it represents a diversion of the country's limited external and internal resources from investments that would maximize economic growth (which might, for example, require concentrating infrastructure investment in urban areas). The extent to which this should be done in order to achieve essentially social objectives needs more careful examination as part of the decision on intersectoral allocation discussed above.

6.18 It should be noted that the income redistribution effect of rural water supply schemes is not always as simple as it may appear. In many countries, it is the wealthier villages which receive priority in obtaining water supply because they are most pressing in their demands and because they also most closely meet the criteria for selection discussed in Chapter VII. The population of these villages may actually be in less need of support than the inhabitants of the urban slums; if this is the case income redistribution can more effectively be achieved within urban water projects, by cross-subsidies from higher income urban consumers to those living in the fringe areas.

Improvements in Village Institutions

6.19 Many villages in developing countries lack an organization of community leaders capable of dealing with present-day problems. It is sometimes argued that a community water supply project is one way to encourage the emergence of such leadership, which would be able subsequently to deal with other community problems. It is also argued that, because the village is required to pay for a valued service such as water supply, it will develop a "habit of payment" for other worthwhile goods, and that this willingness to pay will indicate to planners that the village should be selected for further development. Both of these arguments are intuitively reasonable, but there is as yet little evidence to support them.

Serving More People for a Given Investment

6.20 It is often argued that village water systems serve more people for a given investment than urban systems. This is true to some extent, primarily because village systems normally provide a lower standard of service than urban ones. Urban systems are normally designed to provide continuous high-pressure piped service, with adequate reserve capacity for emergencies such as fire-fighting, and a number of urban consumers will have private house connections. Rural systems, on the other hand, may be quite satisfactory if they provide a safe supply of a few liters per person per day from springs or through protected wells fitted with handpumps. This lowering of the standard of service can more than offset the economies of scale and density in the construction, operation and administration of water supply systems which normally favor concentrated urban populations. It is, however, unwise to generalize; if ground water is not readily available, a rural system which needs a new dam and impounding reservoir may, despite lower standards, be more expensive per capita than an urban system.1/ It may also be relatively inexpensive to extend urban services to low income areas where the supply is to be given through public standpipes. The problem in determining the true per capita cost in these cases is in valuing the investments already made (in dams, treatment plant, transmission and primary distribution pipelines) which make this cheap extension possible. However, as discussed in paragraph 6.04, investment in urban systems may be essential to serve commerce and industry and to provide water to areas where there is no alternative to a public supply. For more countries than not, the urban vs. rural choice does not really exist; the question is rather what additional resources they can devote to rural systems after meeting the pressing needs of urban areas.

Fire Protection

6.21 If water supply is readily available, many fires can be extinguished before they cause much damage. In villages, fires are fought using water brought in containers from neighboring public hydrants; the expense of a high-pressure distribution system supplying fire hydrants will not be justified. The benefits of improved fire control depend on a number of factors including the materials used in house construction and housing density, distance to the pump or public hydrant, and are difficult to quantify. In economic terms, they may not be large, but the increased security from fire may still be an important factor in villagers' desire for an improved water supply.

1/ Of the countries responding to the WHO Survey, about one-third estimated that rural water supply was more expensive per person served than urban supply through standpipes. Since the cost estimates for rural water supply generally appear to be more underestimated than those for urban, in practice the proportion would be higher than one-third.

VII. PRIORITIES - SELECTION OF SUB-PROJECTS

7.01 Whatever sums government actually decides to invest in village water programs will fall considerably short of the needs. Decisions therefore have to be made on the order in which individual village sub-projects will be executed.

7.02 This chapter examines this ranking of sub-projects. It discusses the use of sector surveys to obtain data on which to base decisions on sector policy. Since, as discussed in Chapter VI, it is impossible to make rigorous cost:benefit analyses of the effects of village water programs, ranking is in practice a matter of judgement on the merits of various sector objectives and on the characteristics of individual villages. These characteristics are discussed, and it is concluded that village enthusiasm for a new water scheme, as shown by willingness to pay for it, is probably the single most important factor in deciding whether to construct that scheme. The need for a pragmatic and flexible approach to program planning is stressed.

Sector Policy and Information

7.03 A common problem is lack of sector policy and even basic information about the water supply sector in the country. A special survey of the sector, involving an inventory and analysis of all relevant data, is frequently necessary in order to identify and examine alternative development schemes in the light of resources that can be gathered, recommend policies, institutional improvements and other measures necessary to help deal with the constraints identified and assure the program's success.[1/] This important and difficult work must be carried out by competent and experienced staff with the government's active support. It may be done entirely by local experts, but often some external assistance is required.[2/]

Program Objectives

7.04 Typical government objectives for a village water program are:

- to provide safe water to as many people as possible;
- to reduce waterborne or water-related diseases;
- to encourage rural development;
- to improve living conditions for the rural poor.

1/ The Bank's Public Utilities Department has prepared guidelines (Publication GAS 4) in English, French and Spanish to help governments in carrying out sector surveys.

2/ One of the main functions of the WHO/IBRD Cooperative Program is to provide this kind of assistance, without charge to the country concerned.

Any countrywide program will normally include all these objectives, since they are to a considerable degree interrelated. However, for a given expenditure there will always be trade-offs, for example, between maximizing the number of people served and achieving maximum public health benefits.

Factors Affecting Ranking

7.05 Ideally, ranking of village sub-projects within the overall framework of the government objectives should maximize the net social and economic benefits per unit of investment. This is difficult to do since, as discussed in Chapter VI, many of the benefits of water projects cannot be quantified. The use of financial criteria alone as a screening device is also unsatisfactory, since the many social benefits would be effectively ignored.

7.06 The final ranking of sub-projects is therefore dependent on a largely subjective evaluation of a number of factors. The principal factors are discussed below, divided arbitrarily into three groups: village need, village potential and system costs. The most important group is probably the first, although since any program is likely to be subject to fairly severe budget constraints the third must also carry considerable weight.

Village Need

(a) Village interest

Community interest and involvement is probably the most important single factor, and will be discussed separately in paragraphs 7.07 - 7.10 below.

(b) Adequacy of existing supply

Adequacy in this context covers not only quantity but also convenience, reliability during drought and quality.

(c) Prevalence of waterborne disease

Reliable statistics are usually unobtainable, but ministry of health officials are frequently aware of areas where waterborne diseases are most common. Evaluation of the weight to be given to this factor is particularly difficult since there are a number of options on the level of service to be provided and these have very different per capita costs and are likely to result in quite different health benefits (see discussions in Chapters III and VI).

Village Potential

(d) Growth potential of the community

Lack of adequate water supply may prevent the development of economic potential of villages, for example, as markets, food or fishing processing centers, or as local health or education centers. The villages may also be unable to obtain sufficient water for productive non-domestic use, for example, for agriculture, livestock, vegetable cultivation, preparing produce for market, or cottage industries such as cloth-dyeing.

(e) Village institutions

Generally, villages with strong, competent institutions and better educational levels will be more able to participate in drawing up a program (see (a) above), to collect water charges, and to find operation and maintenance staff from among the villagers.

System Costs

Each sub-project must, of course, be examined to determine that it represents the least-cost means of providing the required service. In addition, certain factors have a bearing on how many least-cost sub-projects can be executed within a certain budget ceiling:

(f) Population distribution

Other things being equal, the larger, more densely populated villages will need lower investment costs per capita. Systems for a group of villages that are close together may be lower in capital cost (possibly using a common source of supply) and cheaper to operate and administer than those for more scattered villages.

(g) Nature of new water source

The effects on costs of type of source and distance from the village are discussed in Chapter III.

(h) Level of Service

The effect of level of service on costs is also described in Chapter III, and the village involvement in deciding the most appropriate level is discussed in paragraph 7.08 below.

(i) Accessibility

Systems for villages without good road access will be difficult and expensive to construct and maintain. Lack of access also probably indicates low development potential (see (d) above).

Village Involvement

7.07 The first item in paragraph 7.06 refers to village participation. Experience from many countries indicates that water supply systems are better maintained, less abused, and have a higher level of financial performance if the villages to be served are selected because they express a real interest in having a new or improved system. In some countries (for example, the Dominican Republic), special "promoters" visit villages to find out which ones are interested. In India, UNICEF is experimenting to find out the best media to use to explain to villagers the benefits of a good supply and to encourage the village to nominate a person or committee to be responsible for looking after the village pump, collecting water charges, etc. The best evidence of such interest is village willingness to contribute to construction costs and to pay an adequate fee for water use once the system is in operation; possible levels of village payments are discussed in Chapter IV.

7.08 If villagers have to contribute to construction costs and have to meet operation and maintenance expenses, the level of costs obviously becomes of concern to both villagers and planners. The latter may want to limit the level of service to be provided because this affects the number of people that can be reached with a given amount of resources. On the other hand, the villagers should be given as good a system as they are willing to pay for. This is the basis for the widely held opinion that the system design of each sub-project should be decided in consultation with the villagers, who are told about the alternatives available under the program and the financial consequences of each. This policy helps to ensure that the "right" system will be provided, and also increases the participation of the villagers and, consequently, their sense of responsibility for the system. In many areas of the poorer developing countries it will not be practicable to provide much more than a basic service, preferably by hand pumps drawing from shallow wells. In these areas the villagers cannot be consulted about the level of service they would like -- neither they nor the country can afford anything more elaborate -- but village motivation remains an important factor in choosing which villages to serve, and villagers should be consulted about matters such as the most convenient siting of the wells.

7.09 The process of consultation with the villagers requires time; where programs have to be executed to meet externally imposed timetables (for example, as part of rural development projects), systems may have to be installed with little previous local input, no clear sectoral policies, and without a proper analysis of many of the factors listed in paragraph 7.06. This is particularly likely to be the case when a decision is taken -- whether for political, economic, or other reasons -- to improve rural water supplies to all villages throughout a particular region. While such decisions may be essential, it must be recognized that inevitably a number of these systems will fail to prove to be unsuitable, and that collection of revenue is likely to be particularly difficult.

7.10 Rural development projects are usually designed to greatly increase villagers' cash incomes. At the commencement of the project they may be able to afford only a handpump or a public hydrant system, and regard that as adequate to meet their needs, but in a few years improved incomes may result in a demand for house connections. The dilema for the project authorities is whether to allow for this anticipated development, and install an expensive system with capacity to supply house connections in due course, or to put in only the most basic system, which will later need to be reinforced. There is no general or easy solution to this problem.

7.11 Approaches to villages to enlist their participation should be made only when the project can be implemented promptly thereafter. Several studies have shown that when there is an interval of months or even years after consultation before any results are apparent, the villagers become disillusioned and cooperation is severely reduced.

The Final Ranking Decision

7.12 The final ranking of sub-projects should be based on an evaluation of all the factors discussed above. The discipline of formulating alternative rankings and estimating the extent to which they are likely to meet objectives ensures that recognition is given to the subjective weightings implicit in eventual project selection. Different weightings may be found appropriate for different regions within the same country, and planners should not apply inflexible criteria. The process may also indicate that certain of the objectives are not suitable and should be changed.

7.13 The preparation of water supply programs must be very pragmatic. It will usually develop as a response to the obvious needs of villages and the desires of the government, and what may appear to be a complex process of setting priorities will in practice be a common sense approach. Frequently, the original plans will need to be modified as the program unfolds. Careful monitoring, especially of the initial stages, is therefore essential, to test whether the approaches being used are sound and to change them if necessary.

VIII. IMPLICATIONS FOR THE BANK GROUP

8.01 The problems described in the preceding chapters -- weak institutions, poor financial performance, inability to expand service to meet the needs of a growing population, frequent breakdowns of existing systems -- clearly indicate the potential for Bank Group assistance to village water programs, since it has considerable experience in dealing with complex, multidimensional problems of this nature. The Bank's most important role would be in building up local capability for project planning, execution and operation, rather than in the transfer of capital alone.

8.02 The Bank Group is increasingly concerned with rural development, and in particular the needs of the poorest of the rural community. Since better water supply is an essential part of any program to improve health and living conditions in rural areas, it follows that the Bank Group will, in future, become more deeply involved in rural water supply programs.

8.03 This chapter discusses the size of future Bank Group lending for village water supply. It concludes that it is not at present possible to make specific recommendations on the amount of future Bank lending for these operations. In the short term, lending will develop gradually in the water supply sector primarily as a means of building up experience, and will respond to the needs of operations in other sectors, particularly integrated rural development. For longer-term planning of country lending programs for village water systems, more emphasis needs to be placed on this subsector in the course of country economic work and of sector studies, in particular on determining the needs and absorptive capacities of individual countries and on establishing priorities between investments in village water systems and in other sectors of the economy. This increased emphasis on village systems is already apparent in water sector surveys being carried out in FY75, such as those in Korea, Kenya, India and Indonesia.

8.04 The chapter also examines the way in which the Bank Group should approach village water supply programs, in particular the problems of project preparation, justification and financing. The implications for staffing are also discussed. It recommends that, because of the long lead time for project preparation, water supply specialists are called in as soon as a project with a possible water component is identified; that, while every effort should be made to minimize costs and maximize user charges, it should be accepted that the financial performance of projects will be poor; that it should similarly be accepted that it will be difficult or impossible to demonstrate the economic justification of projects; and finally, that an expansion of water supply staff will be needed to achieve the Bank Group's objectives and that, until Bank planning improves and needs can be more exactly assessed, one or two additional staff should be recruited for the Public Utilities Department to support the present regional staff. As a means of improving Bank planning for the subsector, project information briefs should be prepared for all projects likely to contain a water supply component.

8.05 The Bank has not yet had enough experience in rural water supply to establish firm policies on the criteria to be adopted in deciding whether or not to finance a particular rural water supply project. The Public Utilities Department proposes to follow the development and implementation of projects and to issue periodically a summary "State of the Art" paper. Meanwhile, suggested guidelines are set out in Annex 5; these are in effect tentative policies, subject to change as necessary in the light of experience.

Amount of Bank Group Lending for Village Water Supply Programs

8.06 The methods by which the Bank Group assists village water supply programs can be divided into two principal categories:

Type A - loans for projects in other sectors such as agriculture, integrated rural development, fisheries, etc., where water supply forms part of the project infrastructure;

Type B - sector loans, either for rural water supply alone or for part of a national program with both urban and rural elements.

So far, the principle Bank emphasis has been on Type A operations, but no consistent approach to the water supply component of these operations has been developed.

8.07 It is necessary to improve the Bank's planning procedures, so that the Bank's planned contribution to rural water supply programs can be clearly identified and its adequacy assessed. For both types of projects it is recommended that a system of project information briefs be set up, clearly defining the objectives and principle components of the project; at present this information is not available on a consolidated basis.

8.08 The greater part of the rural water supply program carried out under Type A projects will probably be through projects in agriculture and rural development. On the very approximate assumption that the 425 agricultural and rural development projects planned for fiscal years 1975-79 will have a water supply component equivalent to 5%[1] of the total forecast loans of $9,557 million[2] rural water supply lending through these projects might average $95 million per annum over this period (in 1975 dollars).

1/ An analysis by Agricultural Projects Department of the FY75 lending program showed that $56.3 million was for water supply components, 5% of the total of $1.1 billion. Figures for future years are not yet available. The water supply component is relatively high in integrated rural development projects (e.g. 16% in Kigoma, Tanzania; 9% in Papaloapan, Mexico) but low in purely agricultural projects (e.g. 1% in the fifth Uruguay livestock project).

2/ 1/75 Lending Program.

8.09 Lending for Type B projects is likely to be small in the near future, since most countries have limited local capacity for project preparation, and UNDP has only recently increased its emphasis on this subsector. An important stimulus to Type B projects would be a clear statement by the Bank that it is willing to lend for well-conceived projects of this sort; since so much of the Bank's previous lending for water supply has been for urban projects, many countries believe that this is the only field in which the Bank is interested. At present, only five operations have been identified for the period 1975-79, with loans totalling $60 million, or an average of $12 million per annum. Rural water components of other sector projects might perhaps double this amount.

8.10 Based on the approximations in paragraphs 8.08 and 8.09, total Bank lending for rural water supply may average about $120 million per annum in 1975-79. In urban water supply projects Bank loans have in the past averaged 36% of total project costs, but in rural water supply projects, the proportion is likely to be higher. If it is 50%, the Bank will be involved each year in rural water supply projects costing $240 million (in 1975 dollars). The investments needed to meet the UNDD goals are $300 million averaged over the decade (see Chapter II) in 1970 dollars, or possibly as much as $1,000 million per annum in 1975 dollars, after correcting for inflation and for low expenditures in 1971-74. The Bank may therefore be involved in projects covering 20% to 25% of the needs.

8.11 When comparing planned lending levels with the expenditures necessary to meet the UNDD targets, it is important to bear in mind that the UNDD goals are arbitrary, in the sense that they take no account of the ability of each individual country to expand its water services at the required rate or to finance such expansion, and they also ignore the question whether this expenditure would be better spent in sectors other than water supply. The Bank's lending program should therefore be related more to the country's absorptive capacity and development strategy than to the UNDD goals.

8.12 Sector work (see para. 7.03) will be needed in many countries to obtain better information on country requirements, institutional capabilities, and investment programs. The project information briefs recommended above (see para. 8.07) will permit identification of the countries where sector work is necessary; it is likely that this activity will have to be increased above the present level of six or seven surveys each year carried out through the WHO/IBRD Cooperative Program, and that the surveys will have to place more emphasis than at present on the rural aspects of the sector. Measures are now being taken to improve the efficiency of the Program, but it will be some time before these take effect and before any substantial expansion could be comtemplated. This improved sector information should then, in conjunction with input from other sectors into the country program paper, enable a village water supply investment program to

be developed, and also the allocation of this lending between Type A projects, which in many cases will be designed to reach the poorest rural inhabitants, and Type B projects which, while taking account of the country's general development strategy, will be more closely directed to extending water supply as fast as possible to priority areas.

Project Development

8.13 For all projects a long lead time will be necessary for project preparation. This means that as soon as any Type A project is identified which may have a village water component water supply staff should be involved. The project information brief system will help in the assessment of the need for and extent of water supply specialist involvement. For the countries included in the lending program for Type A projects the regional Public Utilities Division should prepare sector briefs, summarizing present Bank knowledge of sector status, policies and development plans, and placing particular emphasis on the state of sector institutions.

8.14 Since the key to success in rural water projects is that they should be undertaken by a strong, competent organization, the Bank Group has a particularly important role in identifying and establishing the optimum institutional arrangement for each project. The leverage that the Bank Group can exert may be critical in resolving problems of inter-ministerial division of responsibility. The Bank Group should not finance a project until it is assured that adequate institutions either exist or will be established in accordance with an agreed timetable appropriate to the project. In general, these institutions should follow the principles set out in Chapter V.

8.15 As early as possible in project development, water supply staff should review the proposed water component, in particular:

- the adequacy of existing institutional arrangements (paras 5.03 - 5.10);
- the available data, especially relating to hydrogeology;
- the suitability of the technology and standard designs proposed (paras. 3.02 - 3.04);
- the levels of service proposed (para. 3.04);
- that least-cost solutions are proposed;
- pricing policy (paras. 4.09 - 4.18);
- village organizations;
- health education requirements (para. 6.10);
- the desirability of including excreta disposal or other sanitation components in the project (paras 3.19, and 6.09); and
- training requirements (para. 5.06).

8.16 The initial review may also show that the detailed preparation of the water component is unsatisfactory and that further preinvestment studies should be undertaken. In cases where the project entity is in the process of being established, or where sector responsibility is divided between a number of organizations, it may not be easy to obtain financing for these studies from within the country itself. Funds can be obtained in such cases by application to agencies such as UNDP or UNICEF, and the Bank Group is also prepared to finance preinvestment studies either as a "piggy-back" operation on another loan or under a loan especially for this purpose, as has been done in Colombia, Chile and Indonesia, and is proposed for Algeria.

8.17 An initial Bank loan for a Type B water supply project (excluding loans solely for preinvestment studies discussed above) could include a wide variety of elements: rehabilitation of existing systems; demonstration projects; preinvestment studies; sector data improvement such as water resources investigations, particularly groundwater evaluation; institution building; development of methodology and criteria; training; and funds for research to adapt existing technology to local conditions. Similar elements might be included in a Type A project, except there would normally be less emphasis on rehabilitation and more on the construction of new systems within the project area.

8.18 Most loans would tend to be on a sector loan basis: the Bank would agree with the executing agency the criteria to be applied to the selection and design of sub-projects, but would not necessarily participate in the decision to invest in particular schemes. (The Minas Gerais, Brazil, project is being executed along these lines, and other similar projects are being prepared.)

Project Justification

8.19 As discussed in Chapter VI, it will rarely be possible to demonstrate the economic justification of investments in village water supplies by direct quantification of benefits. Moreover, it is often not possible to determine project justification by the consumers' willingness to pay -- a reasonably reliable approach in urban areas -- due to the consumers' failure to appreciate the benefits, the government's unwillingness to enforce payment, and the consumers' lack of ability to pay. In the short term the Bank Group should accept this situation.1/

8.20 These difficulties apply to both Type A and Type B rural water projects. Thus, the fact that a Type A project may show an overall economic rate of return that exceeds the opportunity cost of capital does not convey anything about the merits of the water supply component. As in the case of entirely separate water supply projects (Type B), the costs of the

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1/ The Public Utilities Department is attempting to improve evaluation technique, with special reference to health benefits.

water supply component should be made explicit and weighed against the associated benefits -- quantitative or qualitative, tangible or intangible -- in the context of national priorities for public health and social services. Nevertheless, in this analysis Type A water supply projects have certain advantages over Type B: for example, the characteristics of the target population will probably be better understood, and complementary investments in other components such as health education and agriculture will help to ensure that potential health and productivity benefits are realized.

8.21 A parallel situation exists for Type B village water supply projects which are part of a regional scheme, which perhaps involves some cross-subsidization from urban to rural consumers. Here it is desirable to estimate economic rates of return[1/] separately for the urban and rural components to determine the legitimacy of expanding the network to increasingly high-cost and/or low-income areas.

Financial Performance

8.22 Only in exceptional cases will village water systems meet the financial standards normally expected by the Bank for public utilities -- full coverage of costs together with a return on the investment. The Bank should accept this situation, while trying at the same time to ensure that the pricing policy takes full advantage of the consumers' ability to pay, and aims at increasing recovery as consumers' incomes increase.

8.23 Among the reasons for levying maximum charges, discussed in Chapter IV, the most important are establishing the general principle of payment for services received and limiting the burden imposed on public finances by non-viable schemes. It is recommended that full coverage of operation and maintenance costs should be a minimum requirement for all projects financed by the Bank Group, and that villages should contribute as much to capital costs as they are able. Failure to make a reasonable contribution (whether in cash or in kind) to capital costs raises sufficient doubts about village interest and motivation to suggest that the village in question ought to be excluded from the program.

8.24 This level of payment should be achievable provided that villages are carefully selected according to the criteria proposed in Chapter VII, systems are tailored to suit their needs and resources, and villagers are given basic health education so that they appreciate the benefits of better water supply and are willing to pay for it.

8.25 Since village water programs will not be financially viable, the Bank Group must obtain from the government concerned, before commencement of the project, a clear undertaking to provide both initial capital and any subsequent financial assistance necessary to ensure satisfactory continuing operation.

1/ According to the principles set out in Economic Evaluation of Public Utility Projects, Publication No. GAS 10.

Bank Staffing

8.26 Operational responsibility for Type A projects will lie with the appropriate Rural Development, Agriculture or other Division, and for Type B projects with the regional Public Utilities Division. It is recommended that the water component of Type A projects be handled by the regional Public Utilities Divisions acting in support of the Division charged with operational responsibility. This should ensure efficiency, flexibility of staff assignments, consistent application of Bank policies in the water sector, and make best use of the Bank's knowledge of the water sector in any particular country.

8.27 The regional Public Utilities Divisions are inadequately staffed to provide this support. However, at present their needs for additional staff cannot be precisely assessed, since it is not clear how many Type A projects will be developed in the next few years. On the basis of the very rough estimate in paragraph 8.08, there may be 100 operations in the fiscal years 1975-79, with the cost of the water supply components totalling about $500 million. For comparison, in the fiscal 1975-79 lending program there are 74 water sector operations with loans forecast to total about $1,800 million.

8.28 Because of the problems discussed throughout this paper, the water supply components of Type A projects are likely to require a staff input out of all proportion to the components' cost. From the figures above, it appears likely that the workload of the water supply staff will be greatly increased -- perhaps doubled.

8.29 In order to determine which regional Public Utilities Divisions require strengthening, the geographic distribution of the future rural water supply projects has to be more clearly defined than it is at present. Again, the project information brief system will be a valuable aid in this planning. It is now too late to assess needs and recruit staff for fiscal 1976 on a region-by-region basis, and it is therefore recommended that one or two additional staff be recruited to the Public Utilities Department of Central Projects staff, to give support to the regions as necessary. This pooling of staff will also consolidate the "fractional" element in staff planning; one centralized staff member may serve several regions with an assessed need for, say, only 0.3 man-years of rural water expertise, which would not justify them in seeking an extra regional staff position.

DATA DERIVED FROM WHO SURVEY

Contents

Notes: - Due to rounding errors, values in these tables may not agree exactly with those published by WHO.

- The boundaries of WHO regions are not the same as those of IBRD regions; for example, both Pakistan and Ethiopia are included in WHO's Eastern Mediterranean region.

Table 1: Population of Countries Surveyed

Region	Population (millions) Urban	Rural	Total	% Rural Population
Africa	31	152	183	83
Latin America & Caribbean	156	118	274	43
Eastern Mediterranean	65	169	234	72
Europe *	24	42	66	64
South East Asia	158	693	851	81
Western Pacific	38	75	113	66
Total	472	1,249	1,721	73

* Three countries only: Algeria, Morocco and Turkey

Table 2: Percentage of Population with Reasonable 1/ Access to Safe 2/ Water

Region	Urban			Rural	Total
	House connection	Public hydrant	Total		
Africa	29	39	68	11	21
Latin America & Caribbean	59	17	76	24	54
Eastern Mediterranean	58	26	84	18	33
Europe *	50	23	73	44	55
South East Asia	36	17	53	9	17
Western Pacific	65	10	75	21	40
Weighted average	49	19	68	14	29

Table 3: Population without Reasonable 1/ Access to Safe 2/ Water

(millions)

Region	Urban	Rural	Total
Africa	10	135	145
Latin America & Caribbean	33	89	122
Eastern Mediterranean	10	138	148
Europe *	7	23	30
South East Asia	74	632	706
Western Pacific	10	59	69
Total	144	1,076	1,220

* Three countries only: Algeria, Morocco and Turkey

1/ "Reasonable access" is defined as follows: in urban areas, within 200 m of a public hydrant; in rural areas, sufficiently close that family members do not spend a disproportionate part of the day in fetching water.

2/ "Safe water" includes treated surface water or untreated but uncontaminated water such as that from springs, protected boreholes or sanitary wells. Other waters of doubtful quality are classified as unsafe.

Table 4: Forecast 1980 Population

(Million)

(in parentheses - % increase since 1970)

Region	Urban	Rural	Total
Africa	53 (72)	188 (24)	241 (32)
Latin America & Caribbean	235 (51)	131 (11)	366 (34)
Eastern Mediterranean	103 (59)	216 (28)	319 (36)
Europe	42 (71)	48 (15)	90 (36)
South East Asia	240 (52)	874 (26)	1,114 (31)
Western Pacific	61 (26)	90 (19)	151 (22)
Total	734 (52)	1,547 (24)	2,281 (32)

Table 5: Target Population to be Served by 1980

Region	Total population to be served, millions			Increase over 1970 millions /a			1980 population served as proportion of 1970 /a		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Africa	52	47	99	32	31	63	2.6	3.0	2.7
Latin America & Caribbean	213	60	273	96	31	127	1.8	2.1	1.9
Eastern Mediterranean	102 /b	54	156	49	37	86	1.9	3.2	2.2
Europe	42	12	54	24	3	27	2.3	1.3	2.0
South East Asia /c	240	218	458	157	163	320	2.9	4.0	3.3
Western Pacific	61	22	83	32	8	40	2.1	1.6	1.9
Total	710	413	1,123	390	273	663	2.2	3.0	2.4

/a There are some apparent discrepancies between Tables 3 and 4 of the WHO statistics. The figures given here for absolute increase have been taken from the WHO tables without resolving the inconsistencies, and the percentage figures are therefore only indicative.

/b Less than 100% of population (of Table 4). No reason given.

/c Excludes Bangladesh (total 1980 rural population estimated at 24 million).

Table 6: Per Capita Cost of New Supplies

US$ /a

Region	Urban		Rural
	House connection	Public hydrant	
Africa	53	28	20
Latin America & Caribbean	40	-	24
Eastern Mediterranean	30	11	13
Europe	120	25	20
South East Asia	16	9	8
Western Pacific	22	20	6
Weighted Average	35	14	12
Range	6(Bahrain)-- 300(Mauritania)	1(Somalia) - 280(Mauritania)	1(Madagascar, Afghanistan, Bangladesh) - 150(Barbados)

/a Basis not stated. Assumed to be 1970 dollars.

Table 7: Estimated Investment to Meet Development Decade Goals

US$ million /a

Region	Urban			Rural	Total
	House Connections	Public Hydrants	Total		
Africa	1,200	300 /b	1,500	600	2,100
Latin America & Caribbean	3,900	- /b	3,900	700	4,600
Eastern Mediterranean	700	300	1,000	500	1,500
Europe	1,500	300	1,800	100	1,900
South East Asia /c/e	1,400	600	2,000	1,200	3,200
Western Pacific	300	400	700	- /d	700
Total	9,000	1,900	10,900	3,100	14,000

/a Basis not stated. Assumed to be 1970 dollars.

/b As policy, public hydrants not provided.

/c Totals for South East Asia differ from WHO published tables due to typographical errors in the latter.

/d US$50 million; shown as nil due to rounding.

/e Excludes Bangladesh.

Table 8: Progress between 1962 and 1970

Region	Urban population served ---million--- 1962	1970	increase	% Urban population served 1962	1970	1970 Population served as proportion of 1962
Africa	9	20	11	50	67	2.2
Latin America & Caribbean	85	116	31	86	76	1.4
Eastern Mediterranean	29	53	24	71	86	1.8
Europe	12	18	6	74	73	1.5
South East Asia	33	81	48	31	53	2.5
Western Pacific	13	27	14	49	75	2.0
Total	181	315	134	59	69	1.7

Table 9: Water Supply Investments in 1970

US$ million

Region	Urban	Rural	Total
Africa	72	20	92
Latin America & Caribbean	263	46	309
Eastern Mediterranean	198	36	234
Europe	27	67	94
South East Asia	142	44	186
Western Pacific	63	4	67
Total	765	217	982

Table 10: Comparison of Public Investment (1970) and Necessary Rural Water Supply Investment

Country	(1) Public investment (GDFI) 1970, $ millions	(2) Annual average Rural water supply investment 1971-80, to meet UNDD goals, $ millions	(2) as % of (1)	Assumed per capita cost of rural supplies, $
ASIA				
India	3,186.7	90.0	2.8	8
Indonesia	486.0	13.1	2.7	4
Pakistan	518.1	13.3	2.6	9
Philippines	113.2	1.7	1.5	5
Thailand	490.4	7.4	1.5	10
Sri Lanka	66.9	6.3	9.4	21

Note - Figures in Column (1) derived from IBRD data, not WHO survey.

- Figures in Column (2) in 1970 dollars.
- GDFI = Gross Domestic Fixed Investment
- Ratio in Column (3) assumes uniform rural water investment during decade; however, it is unlikely that during 1971-75 these investments were actually made, and so the actual ratio will have to be significantly higher during 1976-80 if the UNDD goals are to be met.

Cost of Facilities and Economies of Scale

Introduction

1. The per capita costs of village water systems vary widely from country to country and from village to village, depending on local conditions and the type of system installed. No generalized cost figures can, therefore, be used for estimating; they need to be prepared for a specific set of conditions in each country. The cost data in this annex, although based on actual projects, are therefore presented only for the purpose of comparing the comparative costs of various types of system and the effects of economy of scale.

Rudimentary Systems, Small Communities

2. Table 1A illustrates how typical costs for a village of 1,000 inhabitants supplied through wells fitted with handpumps might range from $0.50 to $4.50 per capita, depending on the type of well required. Drilled wells are the most expensive alternative, and where such wells are needed their number may have to be reduced, at the expense of making the supply somewhat less convenient to the villagers. Table 1B considers the same village and well types as in Table 1A, but assumes motorized pumps and a rudimentary distribution system serving public hydrants; per capita costs increase to $7.00 to $9.50. Where wells have to be located at some distance from the village, additional costs will be incurred for the transmission pipeline.

3. In any planning of rudimentary systems, the possibility of using springs or of rehabilitating existing wells should always be examined, since they may provide an adequate supply at low cost. No general cost estimates can be given for sources of this type.

4. Where groundwater is not readily available, surface water will have to be used. Comparative cost estimates for surface water systems are not given because the costs of the components may vary so widely: the supply may be by gravity (diverted mountain stream), hand pumped (village by river), or pumped over a considerable distance; the intake works may be well points or infiltration galleries in alluvial gravels, or quite major weirs or similar structures; treatment may be omitted for isolated mountain streams, or full sedimentation, filtration and chlorination provided where contaminated sources must be used. Some of these factors are illustrated in later sections of this annex. As a rule, surface water systems will never be cheaper than groundwater systems, and they may be several times more expensive.

More Sophisticated Systems, larger communities

5. Table 2 gives comparative costs for groundwater and surface water systems requiring various degrees of treatment and providing various levels of service, for a community of 1,000 people. Some values are also given for a larger community of 10,000 people. The table illustrates certain general points:

- there are considerable economies of scale in village water systems; for similar systems, the per capita cost of a system for a village of 10,000 may be only 40% of that for a village of 1,000;

- use of surface water requiring full treatment may be twice as expensive as using treated groundwater;

- providing a high percentage of house connections may double the per capita cost of the system.

Economies of Scale

6. Economies of scale are further illustrated by the following figures based on estimates prepared in November 1973 for a rural development project in Tanzania, adjusted where necessary according to unit cost curves derived from other projects. They are intended solely to illustrate the economies of scale in similar systems supplying villages of varying size, and should not be used for estimating.

Typical system: Infiltration system at river, diesel-driven centrifugal pumps drawing from a well lined with concrete rings delivering water to an elevated storage tank made from concrete blocks, with distribution through public hydrants.

Basic assumptions:

Village population	1,750	2,500	3,500	5,000
Per capita consumption, lcd	30	30	30	30
Average daily consumption, m^3	52.5	75	105	150
Raw water main length, m	2,000	2,000	2,000	2,000
Elevation difference, source-village, m	100	100	100	100
Distribution mains length, m	4,000	5,500	8,500	11,300
Public hydrants	12	18	26	36
Persons/hydrant	146	139	135	139

Costs, US$:

Preparatory works	950	950	950	950
Intake	150	220	300	430
Pumphouse	1,280	1,280	1,280	1,280
Pumps	4,160	4,160	5,120	5,370
Rising main	3,310	3,720	4,670	4,700
Storage tank	1,680	2,130	2,910	3,240
Distribution system	8,760	11,970	18,540	24,820
Hydrants	380	570	820	1,140
Construction plant costs	950	950	950	950
Transportation	2,190	2,920	4,380	5,840
Subtotal	23,810	28,870	39,920	48,720
30% overhead and contingencies	7,140	8,660	11,980	14,620
TOTAL, $	30,950	37,530	51,900	63,340
Total, $ per capita	17.7	15.0	14.8	12.7

If the transmission main had been 4,000 m long and the elevation difference 120 m, calculations using data in the next section show that even greater economies of scale would apply:

Total cost, $ (including overhead and contingencies)	46,550	52,600	66,300	80,000
Total, $ per capita	26.6	21.0	18.9	16.0

7. The following figures are taken from an appraisal report prepared by the Inter-American Development Bank in 1974, for a project to supply a rural population totalling 87,000 distributed over 90 rural localities, with populations ranging from 100 to 2,000. Where possible, the systems will be fed by gravity, by diverting streams or springs, with treatment limited to chlorination. At the request of the villages, the supply will be through house connections, not public hydrants. Per capita consumptions are estimated at 50-100 lcd, depending on the community. Typical per capita costs are calculated to vary as follows:

Present population	Cost, $/inhabitant: Present population	Cost, $/inhabitant: Design (1995) population
100 - 200	137	86
201 - 400	93	58
401 - 600	79	49
601 - 1,000	58	36
1,001 - 2,000	43	27
Weighted average	59	37

Proximity to Source

8. Paragraph 4 refers to the wide variation in transmission costs that may occur with surface water systems. This is illustrated by the following figures which are also based on the November 1973 estimates for the Tanzania project referred to above. They are intended solely to illustrate the effect on capital costs of increasing the difference in elevation or the horizontal distance between the source of water and the village, and should not be used for estimating. All figures include 30% overheads and contingencies.

Village population	1,750	2,500	3,500	5,000
Flow, m^3/day	52.5	75	105	150
	Installed costs, $:			
50 m elevation difference, 500 m horizontal distance				
Pump	4,670	4,670	4,930	4,930
Pipe	900	900	900	1,230
Total	5,570	5,570	5,830	6,160
Total per capita	3.2	2.2	1.7	1.2
50 m elevation difference, 4,000 m horizontal distance				
Pump	4,930	4,930	4,930	5,730
Pipe	7,780	7,970	9,870	10,380
Total	12,710	12,900	14,800	16,110
Total per capita	7.3	5.2	4.2	3.2
120 m elevation difference, 500 m horizontal distance				
Pump	5,410	6,340	6,990	7,630
Pipe	1,580	1,610	1,610	1,610
Total	6,990	7,950	8,600	9,240
Total per capita	4.0	3.2	2.5	1.8
120 m elevation difference, 4,000 m horizontal distance				
Pump	6,340	6,340	6,990	7,970
Pipe	13,130	13,130	13,870	14,940
Total	19,470	19,470	20,860	22,910
Total per capita	11.1	7.8	6.0	4.6

9. The costs above are capital costs for the pump and pipeline, and do not include capitalized running costs. Running costs are proportional to the total lift provided by the pump, that is, the sum of the difference in elevation and the head lost due to friction in the transmission main. The latter is usually small compared to the former, as illustrated by the typical figures (which are not taken from the project estimates referred to and so are not directly related to the table immediately above):

Village population	1,750	2,500	3,500	5,000
Flow, m^3/day	52.5	75	105	150
Pumping rate, m^3/hr 1/	2.92	4.17	5.83	8.33
Assumed pipe dia, mm	80	80	100	100
Head loss, m				
in 500 m length	0.3	0.5	0.3	0.6
in 4,000 m length	2.2	4.3	2.6	5.0

1/ Assumed to be 1.33 x average rate; i.e., 18-hour pumping day.

10. In an area where electric power was available from the grid, and assuming a tariff of $0.05/kwh and a pump efficiency of 65%, the following figures can be calculated:

50 m elevation difference, 500 m horizontal distance				
Installed horsepower	0.8	1.2	1.6	2.3
Power cost, $/year	201	288	402	579
$/person/year	0.1	0.1	0.1	0.1

120 m elevation difference, 4,000 m horizontal distance				
Installed horsepower	2.0	2.9	4.0	5.8
Power cost, $/year	489	711	981	1,431
$/person/year	0.3	0.3	0.3	0.3

Security of Supply-System Storage

11. Piped water systems have to be designed to meet a peak daily demand which will be several times the average daily demand rate. The ratio between peak and average demands will vary with systems; it may be as low as 1.5 for a system giving supplies mainly through public hydrants, from which most water is drawn more or less uniformly during an 18-hour period each day, or as high as three for a system with a high proportion of private house connections. It is usually uneconomical to meet this peak demand by providing adequate capacity in the source works (pumps, transmission lines); instead, the source works are sized for a smaller flow, and the excess at times of peak demand is met from storage provided within the system. This is referred to as balancing storage. The volume of water used during peak periods is replenished once the peak has passed. The amount of balancing storage required has to be determined for each individual case by an engineering economy study, and will depend on the relative costs of pumping, transmission and storage, magnitude of the anticipated peak flow, and the number of hours each day that the source works are operated. In simpler systems, storage equivalent to one quarter of one day's average demand will often be adequate for balancing flow fluctuations.

12. In addition to this balancing storage, it is desirable to provide further storage in order to maintain supply during brief breakdowns of the source works, such as power failure or transmission main bursts. The amount of emergency storage to be provided depends on judgments on a number of factors, such as the likelihood and duration of power failure or electric grid outages; the likely time needed to repair a burst; and the minimum supply that should be maintained during an emergency. In remote areas one day's emergency storage is often the minimum desirable, but this may be too expensive for the village to afford.

13. Storage tanks show considerable economies of scale, and are also far cheaper to build at ground level than elevated on columns. This is illustrated by the following figures: 1/

Capacity m^3	Total Cost, US$		Unit Costs, US$/$m^3$	
	Elevated	Ground Level	Elevated	Ground Level
10	5,250	2,650	525	265
20	8,000	3,500	400	175
40	11,250	4,650	280	115
100	18,500	7,350	185	75
200	- *	11,850	-	60
400	- *	18,750	-	50

* For these large sizes, elevated storage is uneconomic; a small elevated tank is used in conjunction with ground level storage and pumps.

One consequence of the much higher cost of elevated tanks is that, if the topography is suitable, it may be economical to site the storage on high ground some way from the village, and lay additional lengths of main to connect this ground level tank to the system. This possibility should always be examined, but elevated storage tanks are by far the most likely for small village systems. 2/

14. The following example considers four villages, each using the same average quantity of water per capita, and each requiring balancing storage equivalent to one quarter of one day's average demand, and illustrates the additional costs needed to provide one quarter day or one half day's emergency storage. It is assumed that elevated storage will be provided.

1/ Based on: CCIS Standard Unit Costs for Mexico, Zone III-B, 1974.

2/ Standpipes, rather than tanks on legs, are normally well suited to village conditions and may be cheaper to construct. They provide additional storage for water at lower pressures, which is an added advantage where greater reserve capacity is required. However, they are less suited for construction using local materials, because of the fairly high internal water pressure in the lower parts of the standpipe.

Village population	1,750	2,500	3,500	5,000
Average consumption, lcd	30	30	30	30
Average consumption, m^3/d	52.5	75	105	150
Case 1 - Balancing storage only				
Storage needed, m^3	13.1	18.8	26.3	37.5
Cost, $	6,250	7,750	9,250	10,800
Cost, $/capita	2.6	3.1	2.6	2.2
Case 2 - Balancing storage plus 1/4 day's emergency storage				
Storage needed, m^3	26.3	37.5	52.5	75
Cost, $	9,250	10,800	12,750	15,400
Cost, $/capita	5.9	4.3	3.6	3.1
Extra over Case 1, $	3,000	3,050	3,500	4,600
Extra over Case 1, $/capita	1.7	1.2	1.0	0.9
Case 3 - Balancing storage plus 1/2 day's emergency storage				
Storage needed, m^3	39.4	56.2	78.8	112.5
Cost, $	11,200	13,250	15,800	18,800
Cost, $/capita	6.4	5.3	4.5	3.8
Extra over Case 1, $	4,950	5,500	6,550	8,000
Extra over Case 1, $/capita	2.8	2.2	1.9	1.6
Extra over Case 2, $	1,950	2,450	3,050	3,400
Extra over Case 2, $/capita	1.1	1.0	0.9	0.7

15. These figures show that in this case the costs of providing the additional emergency storage are reasonably low, both in absolute and in per capita terms, when compared to the basic requirements for balancing storage. Even so, the extra costs will probably be excessive for large, low-budget programs, and will only be affordable in the larger villages or in ones with a high proportion of house connections, whose inhabitants are willing to pay more for a higher standard of reliability. Again, it must be emphasized that these figures are for illustration only, and should not be used for project estimation.

Security of Supply - Standby sourceworks

16. Provision of standby capacity at the source should always be considered, whatever the amount of system storage provided. If a village is dependent on a single pump, which breaks down, it will have no water until the pump is repaired, which may take weeks or months.

17. For basic systems with handpumps this standby usually exists in any case, since a number of pumps have to be provided and, if one fails, a higher load is placed on the remainder. For motorized systems standby

pumps and motors should normally be provided. For example, a large village (10,000 population) with a high proportion of house connections might require 1,000 m^3/day. This could be provided by one 30 cm well (cost about $5,500) but would be better provided by two 20 cm wells (costing $3,800 each, or a total of $7,600). If one fails, 50% supply is maintained; the extra cost of this safety measure is $0.21 per capita. For greater security, three 20 cm wells could be provided, so that 100% output would be supplied even with one out of service; on the same basis, this would cost $11,400, an extra $5,900 ($0.59 per capita) over the basic single 30 cm well.

18. For a smaller village the cost of duplicating wells will be more expensive. A 100 m^3/day supply may require one 15 cm well (costing about $2,800). Because of pump size limitations, 50% standby cannot be provided by replacing this single pump by two smaller (say 10 cm) pumps; a duplicate must be installed, providing 100% standby. If this village contains 1,000 people, the per capita cost of this standby is $2.80.

Table 1: Basic Water Supply Systems for Rural Communities

Village population: 1,000 Per capita consumption: 20 lcd

Average daily total consumption: 20 m^3/day

1A. Groundwater supplies and hand pumps		No. of Units	Cost Per unit, $	Total Cost, $	Cost/ Capita, $
Driven well	(6 m depth) /1	3	175	525	0.50
Dug well	(15 m depth) /1	3	1,000	3,000	3.00
Tube well	(5 cm dia., 30 m depth) /2	6	400	2,400	2.40
Drilled well	(10 cm dia., 40 m depth) /3	2	1,500	3,000	3.00

1B. Groundwater supplies and motorized pumps, piped supply to hydrants /4		No. of Units	Cost Per unit, $	Source Cost, $	Storage and Distribution Cost, $	Total Cost, $	Cost/ Capita, $
Driven well	(6 m depth)	2	350	700	6,500	7,200	7.20
Dug well	(15 m depth)	1	1,400	1,400	6,500	7,900	7.90
Tube well	(5 cm dia., 30 m depth)	2	600	1,200	6,500	7,700	7.70
Drilled well	(10 cm dia., 40 m depth)	2	1,750	3,500	6,500	10,000	10.00

/1 Number of units based on 12 hours use per day, pumping 45 minutes per hour, 30 strokes/minute, with 5 cm pump cylinder and 20 cm stroke.

/2 Pump size as above, but number of units doubled because of slower pumping with increased lift of water.

/3 For high lift, rotary pump operated by two persons will be necessary to maintain reasonable output (up to 15 liters/minute) and avoid need for a larger number of costly units. However, 2 pumps/1,000 people is a low service level, and 3 would be preferable, increasing per capita cost to $4.50.

/4 Two units provided, to give 100% standby, except in dug well, where 100% standby on pump and motor provided. Eight hydrants/village, i.e., 125 persons/hydrant. Note that storage and distribution costs dominate in overall cost.

Notes: - Surface water supplies are not included for comparison with the above because their cost varies too widely depending on the distance to the source, the height of the village above the river, the type of intake and treatment facilities required. For a village on the banks of a river where an infiltration gallery can be constructed, per capita costs will be of the same order as for dug well systems -- $3 to $8 per capita depending on whether a distribution system is provided or not. Other systems will be more expensive.

- These costs are for illustration only, based on late 1974 prices, and should not be used for estimating.

Table 2: Capital Cost Implications of Service Levels and Treatment for Larger Systems

Village Population	Service Level/1	Assumed Per Capita Water Use, lcd	Daily Village Water Use, m^3/d	Water Source	Treatment	Typical costs, $/m^3 /2 Source Works	Treatment	Storage and Distribution	Total	Cost Per Capita
1,000	PH	40	40	Well	None	70	-	195	265	10
1,000	50% PH 50% HC	100	100	Well	None	28	-	176	204	20
1,000	PH	40	40	Clear Surface Water	Chlorination	10	10	195	215	9
1,000	50% PH 50% HC	100	100	Clear Surface Water	Chlorination	10	8	176	194	19
1,000	PH	40	40	Contaminated or Turbid Surface Water	Filtration and Chlorination	10	200	195	405	16
1,000	50% PH 50% HC	100	100	"	"	10	150	176	336	34
10,000	PH	40	400	"	"	5	40	158	203	8
10,000	50% PH 50% HC	100	1,000	"	"	4	18	108	130	13

/1 HC = House Connections;
PH = Public Hydrants provided at 1 for each 100 population.

/2 Costs are at 1973 levels and for illustration only.
They should not be used for estimating.

Excreta Disposal for Rural Communities

1. The excreta disposal facilities required for a village will be determined by village size, density of housing, soil and drainage conditions, cultural patterns and level of development. This annex describes some typical installations. For a full discussion of excreta disposal for rural areas, see WHO Monograph No. 39: "Excreta Disposal for Rural Areas and Small Communities," 1958, by E. G. Wagner & J. N. Lanoix.

2. Vault and borehole latrines are the least cost solution to disposal of body waste in uncongested areas. When properly located, constructed and maintained, latrines meet all public health requirements. Costs may range from $10 per unit where labor and the shelter are provided by the household, to around $200 if vault, slab and a reasonably good structure are supplied. Provided that the slab and vault are properly constructed, the shelter structure is of little importance from the public health standpoint. Depending on size of vault and the care given, frequency of cleaning may vary from one to ten years.

3. Householders in smaller villages who wish to install water-flushed toilets will usually need individual sewage disposal facilities. In areas with sand and gravel soils, and with no water wells in the vicinity, simple leaching pits curbed with rock, brick, or concrete blocks can be constructed at costs ranging from a few dollars up to $200, depending on labor and materials used. Where soils are less pervious, or where larger volumes of sewage must be disposed of, septic tanks are employed, discharging either to leaching pits or to tile fields (a network of buried drainpipes, allowing the effluent to soak away). Costs range from $100 to $1,000 depending on the tank size and material and on the type of soil absorption system required. The higher figures apply where a tile field of substantial length is required and where no labor or materials are contributed. Disposal of septic tank effluents to road ditches, while a common practice, is not satisfactory because of the public health and environmental problems it causes. It is sometimes possible to discharge into systems serving some other purpose, such as storm drains. This is not generally recommended, but it may be used for a limited number of houses as a temporary measure until there are enough to warrant construction of a sewer system.

4. For large villages where density of housing is high, where the space surrounding houses is insufficient to permit construction of latrines, or where soils are impervious, a community sewer system should be considered. Such systems are expensive and will function only if a sufficient number of houses have water-flushed toilets so as to ensure a flow in the sewers adequate to scour the piping and prevent clogging. Considerable problems can arise if materials such as coconut husks or corn cobs are used for personal cleansing. Because only a few houses usually have water-flushed toilets, and these will frequently be widely dispersed, few villages will find it technically feasible to construct sewer systems.

5. Where a sewer system is provided, the means of effluent disposal has to be considered. In some communities adjacent watercourses provide sufficient dilution to allow direct discharge, but in many countries with a monsoon-type climate, stream beds are empty during the dry season and some form of treatment is desirable. In most developing countries waste stabilization ponds will be found to be the simplest, cheapest and most reliable treatment process. Details of their design and construction are given in WHO Monograph No. 60: "Waste Stabilization Ponds," 1971, by E. F. Gioyna.

6. Because of their high cost and problems with operation and maintenance, sewer systems should not be used in villages except in the rare cases when no cheaper alternative can be found.

7. Community toilets, while not uncommon, are not a suitable facility for village use except to serve market areas and places of assembly. Often they are not maintained in a hygienic condition, and because of this and their distance from individual households they may not be used by many of the people they are designed to serve.

Inter-American Development Bank Rural Water Projects

1. From 1961 to February 1973, IDB made fifteen loans for rural water supply and five other loans which had rural water components. These loans were made to national water supply agencies and ministries of health in eleven countries. The total amount of loans for rural water supply in these projects was US$69.9 million for a total project cost of US$130 million. As a result of experience obtained from these projects, general criteria and policies were developed.

2. The individual country definition for rural communities was accepted. The size of the community generally ranged from 300 to 2,000 inhabitants. The rural water supply projects included the design, construction, and placing into operation within a stated period of time, water systems to serve a large number of rural communities. These systems could serve individual communities, or under favorable circumstances, several villages. The projects also included the investigation and development of water sources, engineering, community development, and technical assistance for institution building, training and planning.

Design Criteria and Level of Service

3. Each country has developed criteria which include the type of materials to be used, the per capita consumption by house connections and public standpipes, service pressure, service storage requirements, design period, and estimates of future growth. The trend from the early loans has been to move from systems having a predominance of hydrants to systems with numerous house connections. This trend in policy has occurred because of the demands of the communities and the difficulties of charging for the water and the wastage where only public hydrants are installed. The systems are now generally designed and built with at least 50% of the houses provided with house connections and financing covers up to as much as 70% of the total project cost including house connections. In some countries a few water meters have been installed for the larger consumers with flow-control devices for the others. All rural water projects have been concentrated on communities rather than the dispersed populations.

Water Quality

4. Preference is given to gravity supplies from safe sources that require no treatment such as springs and infiltration galleries and then deep wells with pumps. Sources that require filtration or special treatment are used as a last resort. Disinfection by chlorination is practiced where there is technical support from a regional or district office and chemicals are not difficult to obtain.

5. The physical and chemical standards employed are those in the country and are similar to those of the WHO International Standards. In some areas where it is difficult to obtain water, such as parts of Argentina,

higher concentrations of chemicals are allowed. Bacteriological standards such as those of WHO are used as a basis for the initial selection of the sources but are seldom monitored once the systems are built.

Criteria for Selection of Communities

6. In the initial loans the basic country criteria for selecting the communities were accepted but some refinements have been added over a period of years. The essential factor is that community desire and participation be demonstrated before undertaking the water system.

7. Recently, attempts have been made to develop a priority rating system for the villages. Many factors such as accessibility of water, density of population, accessibility of village, cost of the system, nearness to other villages, health conditions and population growth of the village are given relative weights, and a rating for each village is obtained. From these ratings a list is worked out.

Community Participation

8. Community participation includes the decision to have a system, the formation of a group to operate the system, the contribution to construction, and the payment for receiving service from the system.

9. The contribution to the construction of the system has been found to be the equivalent of 3% to 20%. Generally 10% is now accepted as the average amount of community contribution. The contribution has been in the form of services such as storage areas, transportation of materials (such as sand, gravel, rock, bricks and lumber), labor, and cash.

Range of Conditions for Rates and Charges

10. For each project a system of rates and charges is established that takes into account the socio-economic level of the villagers and usually does not exceed 3% to 5% of the head of the family's income and usually produces a revenue sufficient to pay at least operation and maintenance costs.

11. The 5% can be expected to produce revenues sufficient to cover the cost of operation, maintenance and depreciation for average cost systems.

12. Experience has shown that in very few cases have the communities been able to pay rates exceeding the 5% level.

Costs

13. Per capita costs on IDB projects show a wide range reflecting differences in water sources, varying levels of technical assistance, and organizational efforts required to prepare communities. On 20 projects the per capita cost range has been from about $30 to $50 with an average of about $40. These systems have generally been designed to serve about 50% of the houses with connections, meaning either water to a tap in the house or to a point on the property, usually not further than 3 m from the main.

Guidelines for Bank Group-Financed Village Water Supply Programs

1. Government support for the program must be clearly indicated, including not only an undertaking to provide construction funds and possibly operating subsidies, but also the resolve to give the organization responsible for the program sufficient authority, personnel and equipment to perform its tasks on a continuing basis.

2. Countries should prepare sound and balanced sector development programs. In many cases sector studies will be required to provide basic data. The sector programs should have a proper balance between urban and village systems, and should be consistent with national rural development goals. The programs must not place an undue burden on national resources.

3. Programs should be planned on the basis of technical and socio-economic studies, adequate for establishing pricing policies and criteria for project selection and for choosing the level of service. In order to avoid delay and to reduce cost, these studies should be based on a representative sample of the villages which might be supplied with water. The studies should always include an assessment of groundwater availability, since this is in most cases the preferred source of water. Programs should include provision for encouraging village involvement and obtaining a clear expression of interest by the village, and for agreement with the village on the service to be provided, in the light of the financial policies proposed.

4. Competent institutions are the key to success in village water programs. The Bank Group should agree to finance programs only when effective administrative arrangements, including staffing, exist or where careful plans have been prepared for establishing them. The project organization should not only be capable of preparing and executing the project but also of operation and maintenance. The degree of village involvement in operation and maintenance and in collection of charges should be defined, and appropriate arrangements made. A substantial training component should be included in the project. In the initial stages of a national program model installations may prove useful for in-service training; some additional facilities might be provided for group instruction, demonstration and practice.

5. The Bank Group should recognize that village water programs will not be able to achieve the same standard of financial performance as urban projects. The pricing policies of the program should be designed to ensure that all consumers who are able to pay the full cost of service do so, and that those who are not able to pay the full cost should pay as large a contribution as their means allow. The village should normally agree to pay at least all operation and maintenance costs and to make a contribution

(either in cash or in kind) to construction costs. The operation and maintenance costs may either be determined village by village or averaged over all villages in a region. Local conditions and customs will determine which is more acceptable. The basic facilities to be provided in a village would be wells or public hydrants reasonably accessible to all inhabitants; house connections should be encouraged, but provided only where the villages are prepared to meet a substantial proportion of the extra costs. Subsidies may be necessary to assure the financial viability of the organization responsible for the program, or may be included in the pricing structure as part of national social policy; the Bank should be prepared to accept such subsidies provided that they do not adversely affect the distribution of income within the country. Programs financed by the Bank Group should have a clear financing plan which recognizes the financial implications of strengthening an existing organization or creating a new one and also the probable necessity of meeting debt service. If the plan includes government contribution, firm understandings should be obtained on their timely availability.

6. Demonstration projects should be encouraged, for developing or improving various approaches; improving the basis for cost estimates; developing larger projects; and training. They should be used to test the suitability of standard designs, and for assessing the ways in which self-help components of projects can be increased or made more effective. Even though financial requirements may be relatively small, the Bank Group should be prepared to make loans for project preparation and for initial demonstration projects in cases where the country itself is unable to do so and where provision of funds by other agencies 1/ is not possible or would cause undesirable delay. Subsequently, demonstration projects would be included in "piggy-back" type of operations, in which the Bank Group would fund a package of preparation work, demonstration projects, and project execution.

7. The Bank should encourage the development of local capability in the manufacture of components, groundwater exploration and exploitation, and construction, by assistance either to the local sector institutions or to the private industry. The proposed methods may be tested during demonstration projects. Procurement procedures may require some adjustment to help new local companies. Bank Group projects could include funding for applied research, where frequently only a few thousand dollars are needed to assist local workers in adapting established approaches to local conditions.

8. Except in cases where village water programs are undertaken as components of larger projects (such as integrated rural development) Bank assistance should be on a "sector loan" basis, financing a package of village systems which either form a "time slice" of the program or are concentrated in a particular region. Since so many existing systems are inoperative for various reasons, the first Bank loan to any country might well be for system rehabilitation and institution building. The method of selecting villages

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1/ e.g., UNDP, UNICEF, CIDA or SIDA, all of which have been active in rural projects.

and the general principles of the designs to be used would be agreed upon during loan negotiations, with final decisions being taken during project execution. Detail design of the systems will therefore not normally be undertaken before the loan is made. 1/ Cost estimates will therefore be based on standard designs and preliminary visits to villages. A substantial contingency item (25% to 35%) should be included. The number of villages to be served should be adjusted in the light of actual costs.

9. The foreign currency component of village water projects will usually be low. 2/ Local currency financing should therefore be considered.

10. All projects, particularly those in the first Bank Group loan to any country, require careful monitoring, initially to check the appropriateness of the assumptions, design criteria and method of approach, and subsequently to determine their impact and to identify problems in operation and maintenance.

11. Basic public health education should usually be associated with any village water supply program, both during its preparation, to stimulate village interest, and during implementation, to ensure full benefits are derived from the new systems.

12. Any village in which the water supply system is being improved should also be provided with other sanitary facilities, in particular latrines, which will usually be constructed largely on a self-help basis. (Village sewerage systems are not likely to be feasible or justified in the great majority of cases, and should only be installed if villages show a real willingness to pay for them, and if a sufficient number of houses have water-flushed toilets to ensure proper operation.) Whether public laundry and bathing facilities should be provided depends upon the cultural patterns of the area and the desires of the villagers. They should be encouraged whenever they are likely to be appreciated and used. The cost of these facilities should be included with the costs of the water system. While the cost of materials for latrines to be constructed on private property should be borne by the householders, the construction costs of central latrine facilities may be considered as part of the overall project cost.

1/ The final approach to the village to determine the system it wants should not be made until shortly before commencement of construction. The design will therefore be made final only at that time.

2/ 15% to 50%, averaging 35%, according to the WHO survey, but this may refer only to the percentage of materials costs. The percentage of total costs would then be much lower.