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SOME TECHNICAL ASPECTS OF PLANNING WATER SUPPLY PROJECTS IN RURAL AREAS OF DEVELOPING COUNTRIES

John Briscoe

INTRODUCTION

Given the limited time available and the substantial amount of material to be covered, it has been decided to cover only the planning of a rural water supply program and not the sanitation program. It will be necessary to emphasize at the beginning the incorrectness of such a separation in a practical situation. I am prepared to furnish information on planning of sanitation programs along similar lines.

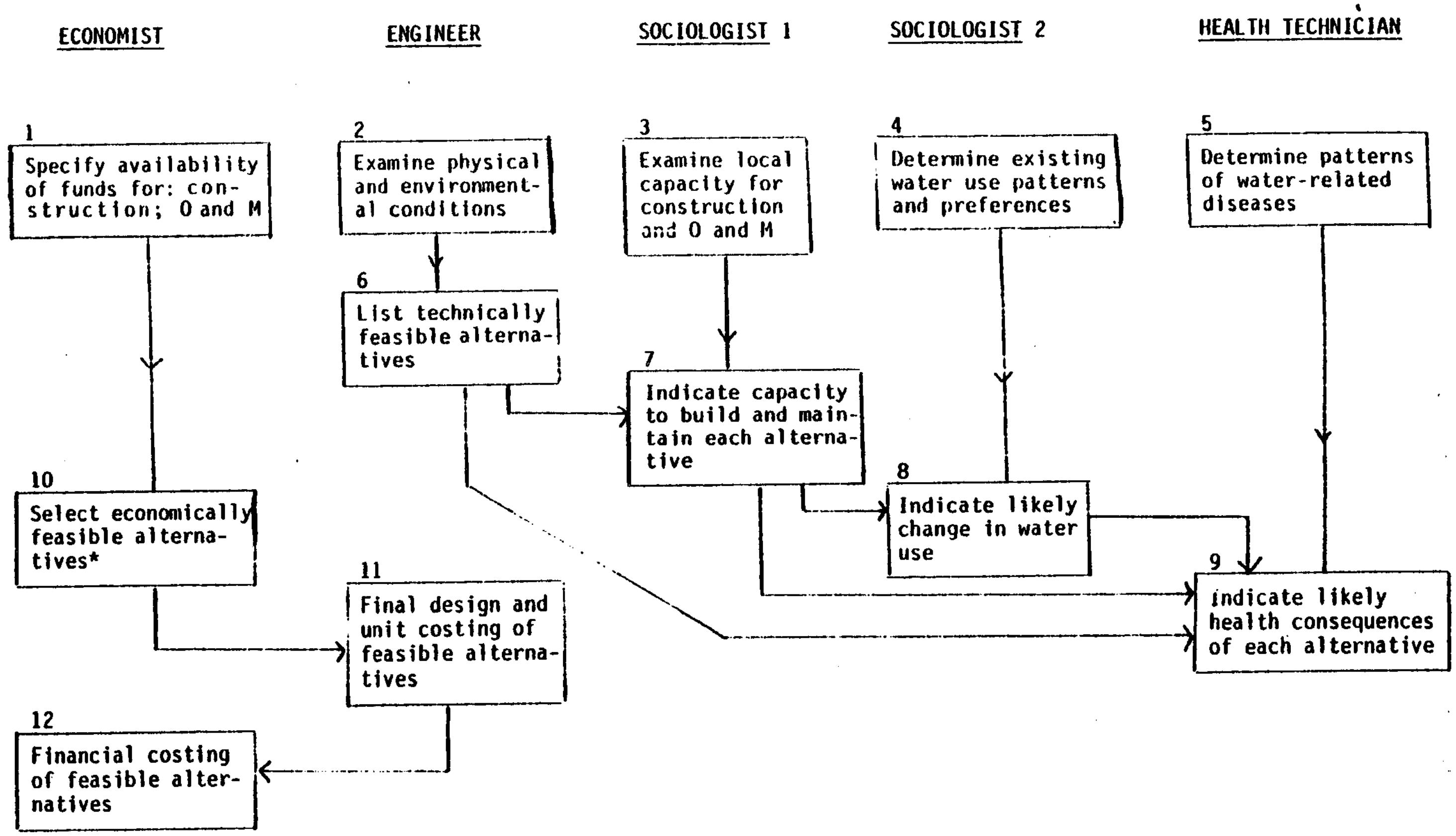
We will discuss the planning of a rural water supply program in a developing country on the basis of the following model (Figure 1). In the model the local community, ideally through its elected officials, is heavily involved in each of the exercises indicated by a box with double lines. Note that the classifications "economist," "sociologist," etc. are meant to indicate the type of individual and function rather than the specific discipline (see Figure 1). Throughout the presentation the general discussion will refer to the cases with which the author is most familiar.

Before discussing more narrow technical aspects involved in rural water supply planning, we feel it important to note that the problems involved in such planning are not predominantly technical, as they are in large cities. Rather, they are predominantly organizational, political, and managerial.

ASSESSING EXISTING LOCAL CONDITIONS

Funds for Construction, Operation, and Maintenance

Unlike cities, rural communities reluctantly accept the principle of paying for water. In financing an urban scheme, all of the required funds usually come from the community itself in the form of water rates. In rural communities, typically about 80 percent of construction costs come from outside of the community, with the remaining 20 percent coming from direct participation.



*Representatives of the various ministries and local communities involved choose the alternative to be implemented. A plan is drawn up and commitments made by each party to their fulfillment of their part of the plan.

Figure 1: A MODEL FOR PLANNING RURAL WATER SUPPLY PROGRAMS IN DEVELOPING COUNTRIES

Development finance from donors for construction is generally relatively easy to obtain, while recurrent funds for operation and maintenance must usually be taken from the government's own, often limited, sources of revenue. This is an important factor in the disequilibrium between the construction of water supply systems and maintaining them. Voluntary agencies can make an important contribution by focusing on operation and maintenance.

Physical and Environmental Conditions

This includes an examination of:

- climate, topography, geology, hydrology
- population distribution
- state of existing water supply system.

Local Capacity for Construction, Operation and Maintenance

- historical background of local institutions
- existing regional structures for supporting local government
- community organization including local cooperatives, village betterment committees, and political parties
- statutory powers of local institutions
- availability of skilled and semi-skilled manpower for construction, and operation and maintenance.

Existing Water Use Patterns and Preferences

- the effect of different factors (such as distance, type of source, perceived quality and ownership) on use of water for drinking, cooking, washing, bathing, and cattle watering.
- the time spent in collecting water

- the reliability of the existing water supplies in different seasons

- the bacteriological quality of the existing water sources.

The Pattern of Water-Related Diseases

Relying on health records, discussions with epidemiologists, local health practitioners, and the population, determine the relative importance of:

- water-borne, such as cholera

- water-washed, such as scabies and shigellosis

- water-based, such as schistosomiasis

- water-related, such as malaria.

IDENTIFYING FEASIBLE ALTERNATIVES AND THEIR LIKELY CONSEQUENCES

List Technically Feasible Alternatives

Particular attention should be given to groundwater sources, for these are often more easily developed by stages, closer to the served areas, less turbid, and of better bacteriological quality. Groundwater sources require less treatment and are more reliable throughout the year.

The following algorithm (see Figure 2) may be used to compile a list of alternative water sources and to arrive at rational conclusions for the selection of a certain technology.

Examination should be made of availability and reliability of materials and equipment for construction, as well as the equipment, chemicals, fuel, and other supplies and parts necessary for the operation of the system.

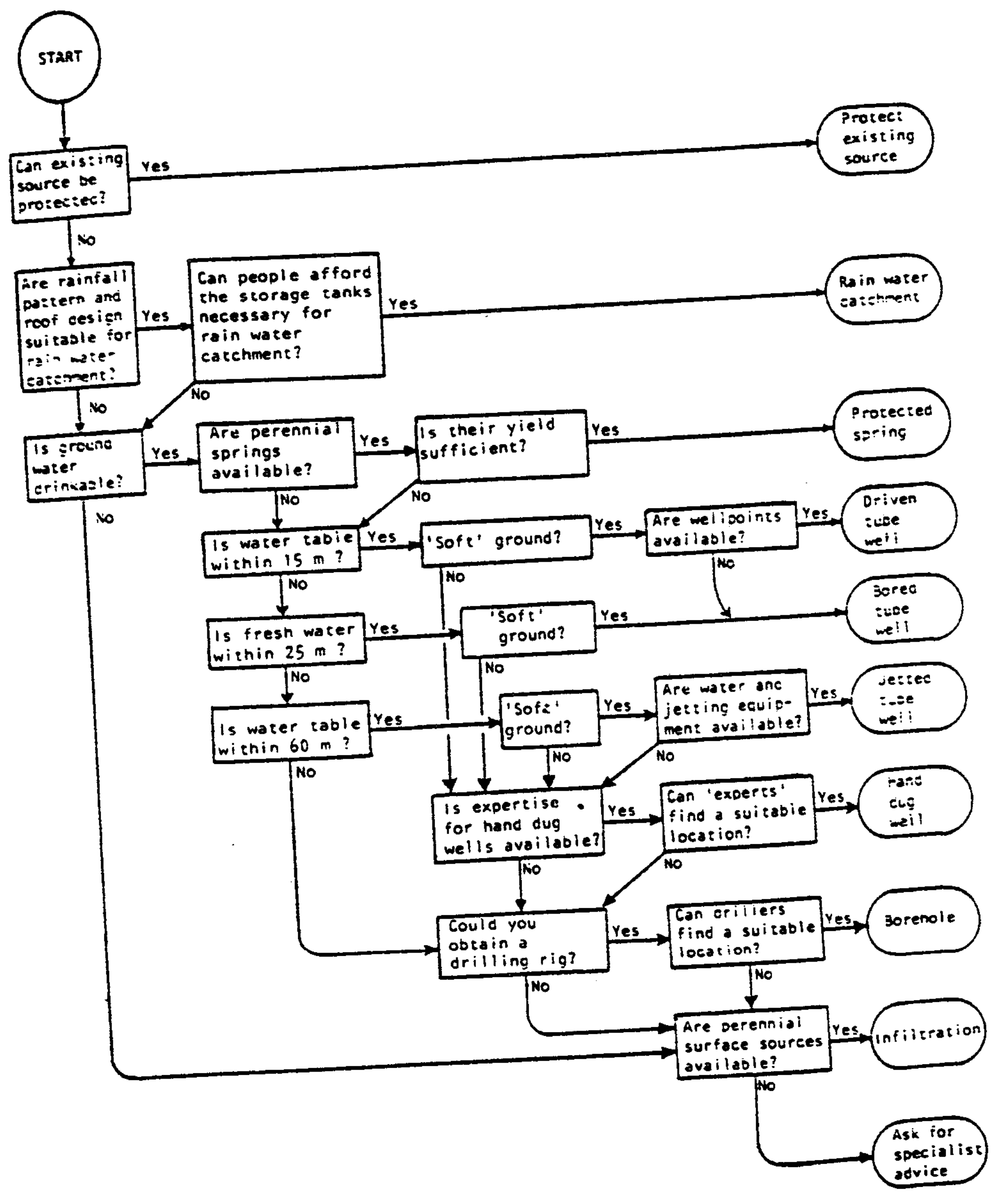


Figure 2. Choosing a source of water. Follow the arrow corresponding to your answer to the question in each box.

Indicate Capacity to Build and Maintain Each Alternative System

As outlined above, the engineer has done an analysis of the availability and reliability of the equipment and materials necessary for construction, operation and maintenance. The sociologist examines the capacity of the local and regional governments to undertake the construction, operation, and maintenance of each alternative in view of the assessment of local conditions. The sociologist specifies the material, such as vehicles and tools, as well as human and institutional resources necessary for each alternative.

Indicate Likely Changes in Water Use

In light of the information gathered in looking at water use patterns and subsequent investigations in the community, the sociologist indicates how these patterns are likely to change. Is the population likely to use the water from the new source? Will they continue to use their old sources for some purposes? How much time will be saved, and how much more or less reliable will the system be in light of assessed capacity to build and maintain alternative systems?

Indicate Likely Health Consequences of Each Alternative

The health technician can assess the likely health consequences of the water supply project once the following are known: the changes in the quantity and quality of water used for domestic purposes, the exposure to water, the changes in habitats of the transmitters of water-based diseases (e.g. snails) and for the vectors of diseases such as malaria.

SELECTING A PROGRAM

Appraising Economically Feasible Alternatives

On the basis of the availability of funds for development and recurrent expenses, the costs of each technically feasible alternative are determined. These costs are estimated for a range of service levels and for a variety of assumptions about the staging of construction. In the table below (Table 1) we present some typical costs for rural water supply schemes.

Village population	Service level[a]	Assumed daily per capita water use (liters)	Daily village water use (cubic meters)	Water source	Treatment	Typical costs (U.S. dollars per cubic meter)[b] Source works	Treatment	Storage and distribution	Total	Cost per capita
1,000	PH	40	40	Well	None	70	—	195	265	10
1,000	PH, HC[c]	100	100	Well	None	28	—	176	204	20
1,000	PH	40	40	Clear surface water	Chlorination	10	10	195	215	9
1,000	PH, HC[c]	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	PH, HC[c]	100	100	As above	As above	10	150	176	336	34
10,000	PH	40	400	As above	As above	5	40	158	203	8
10,000	PH, HC[c]	100	1,000	As above	As above	4	18	108	130	13

a. HC = House connections; PH = Public hydrants provided at one for each 100 population.
b. Costs are at 1973 levels and for illustration only.
c. Each 50 percent of total.

Table 1. Hypothetical Capital Cost Implications of Service Levels and Treatment

From this table we note the substantial increases in per capita cost associated with house connections rather than public standposts, treatment of the water, and smaller systems (i.e. economies of scale).

Final Design and Unit Costing of Feasible Alternatives

Rural water programs have a strikingly high number of repetitive units such as water tanks, standposts, pump houses, etc. There are substantial economies in using standardized designs. Where standardized national designs exist, these should be used. Where they do not exist, they should be developed, at least for the project. Every attempt should be made to ensure that equipment, drilling rigs, vehicles, pumps, faucet, etc., used in the project have been chosen nationally as the standard and that there will be a reliable supply of spare parts. The capacity to undertake repairs should be considered.

Costing of Feasible Alternatives

This strictly technical task involves costing in terms of local and foreign components.

Choice of a Program

On the basis of the above steps, a list like the following is drawn up.

	Level of service	Reliability of supply	Construction requirements Govt.	Construction requirements Comm.	O and M requirements Govt.	O and M requirements Comm.	Health Consequences
Alternative 1							
Alternative 2							

This information is then presented to representatives of the various ministries and other agencies, such as relevant foreign voluntary agencies and representatives of the local communities.

The most desirable alternative is chosen and commitments are made to a concrete plan. A further decision is made to choose which alternative, if any, is to be implemented. Targets are set for construction, for operation and maintenance, for the organization of the necessary institutions, and for the training of the required personnel.

Each of the institutions participating then makes a commitment in writing to fulfill its part of the overall plan by the specified dates.