

**WATER AND SANITATION
FOR HEALTH PROJECT**

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ASSESSMENT OF THE OPERATIONS AND MAINTENANCE COMPONENT OF WATER SUPPLY PROJECTS

WASH TECHNICAL REPORT NO. 35

JUNE 1986

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Prepared for the Office of Health, Bureau for Science and Technology
United States Agency for International Development
under WASH Activity No. 223

by

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ACRONYMS

CM	Corrective Maintenance
ESA	External Support Agency
LDC	Less Developed Country
NGO	Nongovernmental Organization
PM	Preventive Maintenance
PVO	Private Voluntary Organization
O&M	Operations and Maintenance
VL0M	Village-level Operations and Maintenance

PREFACE

One of the major challenges facing both external support agencies (ESAs) and the governments of less developed countries (LDCs) is to develop programs that ensure that new and existing water supply systems are adequately operated and maintained. Many of the water systems in LDCs have either failed to perform as designed or failed prematurely due to ineffective maintenance programs.

Effective operations and maintenance (O&M) of water systems requires systematic planning as the project is being designed. This planning, however, is frequently overlooked. Part of the reason for poor O&M is the lack of a planning tool that may be used by water system project designers to assess the likely effectiveness of the operations and maintenance component.

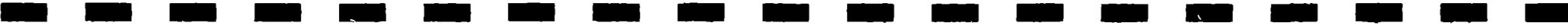
This guide, developed by James K. Jordan, with the assistance of Peter Buijs and Alan Wyatt, has been prepared to fill this need. It contains information concerning the operations and maintenance of water supply systems and four O&M assessment guides. The guides are organized in a question-and-answer format that addresses the critical elements involved in operating and maintaining a water system. These elements are as follows:

- Institutional capability
- System operations and maintenance
- Spare parts and supplies
- Logistics
- Finance
- Records
- Human resources and training.

The four operations and maintenance guides that have been developed represent the types of water supply systems generally found in LDCs. These systems are as follows:

1. Reticulated systems fed from either springs or streams
2. Water systems using handpumps
3. Water systems using electrically powered pumpsets drawing from groundwater sources
4. Water systems requiring treatment works.

The project planner will be able to identify potential problems with the operations and maintenance of the water system(s) that will be constructed (or rehabilitated) during the project by applying the appropriate assessment guide.





Chapter 1

INTRODUCTION

1.1 Purpose of this Report

Many water supply projects in developing countries fail to function as designed, because provision for effective operations and maintenance (O&M) of the system is not made during the planning stage. One of the primary reasons for giving inadequate consideration to the O&M component is the absence of a methodology for assessing operations and maintenance.

The purpose of this report is, therefore, to propose a technique for project planners to use in analyzing the O&M needs of a water project during the design phase and to offer recommendations for correcting deficiencies that are likely to affect the continuing success of the project. The report first discusses the concept of operations and maintenance, describes the central elements of O&M, and reviews the types of water supply projects that are most often constructed in less developed countries. It then recommends techniques for incorporating O&M assessment into project planning documents. Finally, O&M assessment guides for the four types of water systems typically constructed in developing countries are presented.

1.2 Description of Terms

Certain terms relating to operations and maintenance and project planning appear regularly in this workbook. Understanding their meaning as they are used in the assessment guides is important to using the guides properly. These terms are as follows:

External Support Agency- A bilateral or multilateral agency that provides funds in the form of either a loan or a grant to the government of an LDC to a PVO or NGO in order for a water supply project to be executed.

Implementing Agency - The agency with the responsibility for carrying out the objectives of the water supply project.

Project Documents - All binding and descriptive documents relating to the identification, design, financing, approval, implementation, and evaluation of the project.

Project Planning Team/Project Planner - The personnel who are responsible for designing the project and preparing the project documents.

Operations - A series of actions carried out by operators to make equipment and systems do the work it is intended to do.

Maintenance - A series of activities carried out to ensure that a piece of machinery or a system is able to do its intended work.

Breakdown Maintenance - Actions taken to either repair or restore equipment or systems to effective operating condition only after the equipment or system fails to operate. No preventive maintenance (PM) actions are performed on the equipment.

Corrective Maintenance - Actions taken to either repair or restore equipment or systems to effective operating condition. These actions may result from problems discovered during preventive maintenance or as a result of equipment or system failure during operation.

Preventive Maintenance - Actions performed on a regular and scheduled basis to keep equipment or systems operating effectively and to minimize unforeseen failures. These actions consist of inspections and or maintenance tasks.

Minor and Major Maintenance Tasks - For this workbook, minor maintenance tasks are those that are designated as the responsibility of the community. An example for handpump systems is the periodic lubrication of the above-ground parts of the handpump by the village caretaker. Major maintenance tasks are those that are the responsibility of regional maintenance crews.

1.3 Steps in Operating and Maintaining Water Supply Systems

In addition to lacking a methodology for assessing O&M, project planners may be inexperienced in developing an effective operations and maintenance program for water supply systems. This situation may lead to difficulty in promoting the need for local governments to support O&M programs. To assist the planner, the following four-step process has been identified that outlines the objectives of an effective O&M program:

1. The first step is to identify the operating standards of the system, that is, how the system is designed to operate. In many cases, the standards result from either a social or a political decision as well as from an engineering one.
2. The second step is to establish procedures that will enable those who have O&M responsibility to determine when maintenance work is needed. This step requires the development of a schedule for preventive maintenance (PM), and criteria for determining when corrective maintenance (CM) is needed, that is, to what extent can the operation of the system deviate from the operational standards before CM should be performed.
3. The third step is to provide the means to measure whether or not the system is functioning as designed.
4. The fourth step is to develop and implement a program that will enable the system to be restored to the standard in a timely manner and at an affordable cost.

To demonstrate how this process works, consider a community that is to be served by groundwater pumped from a well by a diesel-driven centrifugal pump

to a storage tank and then distributed by way of a piped network to either standpipes or in-house connections.

For the first step, the water authority decides that water will be provided to the community continuously. This step requires that the pump be operated for a certain number of hours per day, depending on the size of the pump and storage capacity. A second pump is furnished for standby service. An alternate approach could have been to provide water only at selected times during the day.

The second step requires the preparation of a preventive maintenance task schedule and the criteria for performing corrective maintenance. One feasible criterion for scheduling CM is if the pump output drops 10 percent from its original production. This situation would trigger an investigation to determine the cause for the reduced output. The basis for planning and scheduling PM and CM activities is generally field experience and manufacturers' recommendations.

The means to measure the actual output of the pump against the corrective maintenance criteria, step three, could be a flowmeter or a gauge to measure the depth of water in the tank. Note that criteria for other parameters, such as excessive temperature, also need to be established.

The requirements for the first three steps should be identified by the planner of the water system and incorporated into the system design specifications. The fourth step -- the development and implementation of a maintenance program -- is the most difficult to complete successfully and is the reason for the preparation of the O&M assessment guides. For example, if the waterpump is no longer operating within acceptable bounds, it may require the coordination of the finance, tendering, supply, and maintenance sections of the water authority to obtain and install the replacement parts that will restore the pump to the operating standard.

The role of the project planner in the fourth step is to investigate the O&M capabilities of the local government and community. The planner should determine whether a program of operations and maintenance is in place that will enable the water system to operate effectively throughout its expected life. If the program is not in place, the planner should identify the steps that are necessary to establish an effective O&M program.

The objective of the O&M assessment guides is to assist the planner in completing the requirements of the fourth step by providing a tool to systematically analyze the central elements of O&M before the project is implemented.

Chapter 2

KEY ELEMENTS OF OPERATION AND MAINTENANCE

Operating and maintaining a water supply system requires the effective interaction of a number of functions or departments within an organization as well as coordination between the agency responsible for water and the users. This situation is particularly true when the community is directly involved in the operations and maintenance of the water system.

The central elements that affect O&M are frequently the responsibility of several different entities. For example, the finance, tendering, supply, and operations sections of the government, as well as the community being served by the water system, may each provide support for O&M. Each must also be aware and carry out its required tasks regarding O&M.

An O&M program is composed of the key elements described below. Each element is addressed by the questions set forth in the assessment guides in sections five through eight.

1. Institutional Capability

Both the governmental agency responsible for water and the community (or communities) receiving water service need to be actively involved in the water project if it is to be successful. The questions pertaining to this element focus on determining the commitment of government and community to operations and maintenance of the systems.

2. System Operations and Maintenance

The key to ensuring effective equipment maintenance is to make certain that responsibilities are clearly defined and that maintenance personnel have the tools and skills to do their job correctly. It is also essential to schedule preventive maintenance (PM).

3. Spare Parts and Supplies

Many water systems have failed because spare parts were not readily available to service equipment. Even the simplest water supply system requires a reliable source of supply for spare parts and other material needed to keep equipment in reliable operating condition. Numerous donors and the many types of equipment have compounded the problem of spare parts and created the need for large and diverse spare parts inventories. Because some parts may need to be imported, the necessity for a reliable inventory is potentially even more urgent in developing countries.

4. Logistics

The questions concerning this element consider the need for vehicles and workshops dedicated to the maintenance function. It is not

unusual for the same group within a water authority to be responsible for both construction and O&M activities. In these cases, vehicles are not reserved solely for O&M and frequently are unavailable when needed. Such a situation may result in a poor response to equipment problems and lack of attention to preventive maintenance.

5. Finance

Before a water project is funded, the planner should address two issues relating to financing the recurring cost of the system as follows:

- How much will it cost to operate the system?
- Can the consumers and government afford this cost?

If the answer to the second question is negative, the project should be either redesigned (including the use of alternate financing) or abandoned. Project planners often assume that the host country is able to support O&M. If it is unable to do so, the result is a poorly maintained water system.

6. Records

Up-to-date and accurate records need to be maintained for all water supply (WS) systems. The type and number of records and reports needed is determined by the type of system. For piped systems with a large number of electrically powered units, an automated information system may be appropriate. For one involving either handpumps or protected springs with piped distribution, the requirements for records are quite different, yet equally necessary. Records and reports provide:

- System control enabling responsible officials to know the operational status of the system(s)
- O&M information for maintenance personnel
- Equipment operating history
- Information on parts and or supplies in inventory

7. Human resources and training

Training programs for equipment operations and maintenance are needed for all types of water systems. The technical content for training caretakers to maintain handpumps is, of course, less than for more sophisticated systems, but still must be planned. Training should be a continuing effort, particularly in LDCs where skilled technicians frequently learn a trade while employed by the water board and then seek higher paying work in the private sector. Ultimately, the success or failure of a water supply system will depend on the people who have the responsibility for operating and maintaining it.

These seven elements form the basis for a system of operations and maintenance. Each element must be investigated -- irrespective of the type of water system -- to ensure that O&M is adequately supported.

The following section describes the types of water supply systems found in developing countries.

Chapter 3

TYPES OF WATER SUPPLY SYSTEMS IN DEVELOPING COUNTRIES

Various types of improved water supply systems have been implemented in less developed countries, and each has different requirements for effective operations and maintenance. These range from hand-dug wells using a bucket and rope to piped systems with substantial water treatment. It is convenient, however, to narrow the list of water supply systems to those with significantly different O&M requirements by reviewing the components that are normally considered part of the delivery of water from the source to the consumer. These components are as follows:

1. Source
 - a. Rainwater
 - b. Groundwater
 - c. Spring
 - d. Surface water
2. Removal from Source
 - a. Bucket
 - b. Gravity
 - c. Handpump
 - d. Powered pump
3. Transmission from Source
 - a. Hand carry
 - b. Pipe
 - c. Open channels
4. Treatment
 - a. None
 - b. Disinfection
 - c. Flocculation and sedimentation
 - d. Filtration
 - e. Aeration
 - f. Desalination
5. Storage
 - a. Open impoundments (for example, reservoirs)
 - b. Closed tanks
 - c. Household containers
6. Distribution from Storage
 - a. Hand carry
 - b. Pipe
 - c. Vendors

7. Tap

- a. None
- b. Public standpipe
- c. Household standpipe
- d. House connection.

The foregoing components are combined in various ways to form community water supply schemes. From the standpoint of O&M requirements, however, all water supply systems may be represented by the following four types:

1. A village(s) obtaining water from standpipes that are fed by pipe from a protected spring. Village-based caretakers can perform all of the required maintenance.
2. A number of villages using handpumps to draw water from groundwater sources. Village-based caretakers can perform above-ground maintenance. Below-ground maintenance, however, requires regional maintenance crews -- either governmental or private contractors.
3. Communities served by electrically powered pumps drawing from groundwater sources and pumping to storage for distribution. Village-based mechanics perform some preventive maintenance. Other maintenance activities are the responsibility of regional water authorities.
4. Communities using surface water pumped to treatment works and then stored for distribution through a piped network. All maintenance is the responsibility of the water authority.

The author recognizes that other types of water supply systems (for example, rainwater catchment) may be found in LDCs. These system types may be analyzed by using the O&M assessment guide that most closely resembles the way the system is to be operated and maintained. For rainwater catchments, the village people are generally responsible for all maintenance, and the guide that would be used for case Number 1 above would also be appropriate for rainwater catchment systems.

The following sections of this report present operations and maintenance assessment guides for the four types of water supply systems listed above as well as recommendations concerning the use of the guides.

Chapter 4

PROJECT PLANNING FOR OPERATIONS AND MAINTENANCE

4.1 Assessing the O&M Component of Water Supply Projects

Consideration of the long-term operations and maintenance of a water supply project should be initiated when the feasibility of the project is first being studied. For an AID-funded project, this means that the O&M capability should first be investigated during preparation of the Project Identification Document (PID). One effective approach for analyzing O&M for the project is for one of the technical members of the PID team to use the O&M assessment guides (sections five through eight) to: (1) obtain a general idea of the ability of the communities and central government to provide effective O&M for water supply systems and (2) prepare a list of items relating to O&M that need to be investigated by the Project Paper (PP) team.

The primary O&M investigation should take place before and during the PP preparation. Because part of the work of the PID team is to enumerate the strategy and responsibilities for preparing the PP, the PID should establish who should perform the required O&M investigations during the PP phase and how they will be carried out.

If there are numerous aspects of O&M that require investigation, an engineer with experience in the operations and maintenance of water supply systems should be included in the PP team. If there are few problems identified, the scope of work of the PP technical member (typically a water supply engineer) should include the appropriate investigation into the O&M capability. Other external support agencies may use the guides by incorporating O&M assessment technique in their project development procedures.

A second alternative is to have an outside organization, such as the Water and Sanitation for Health (WASH) Project, review the PP after completion and before approval is sought. The purpose would be to document potential problems in the O&M area that may not be addressed in the PP. Such a review would be based on use of the O&M assessment guide, the reviewer's previous O&M experience in LDCs, and interviews with the PP team. Because this approach is not based on field observations, it will not be as effective as the other alternative. It would, however, be less expensive, and the results would still help to highlight potential O&M problems in the project and might suggest modifications to the design of the project.

Using one of these approaches, in addition to the recommendations associated with the assessment methodology, will help to improve the O&M component of the project by identifying:

- Assumptions about the project and O&M
- Potential problems
- Possible project milestones and evaluation criteria for inclusion in the project agreement.

4.2 Methodology for Assessing the O&M Component

The technique for analyzing the O&M component is an iterative one requiring answers to questions concerning the O&M capability. Its purpose is to help the project planning team pinpoint problem areas regarding O&M and to develop strategies for incorporating solutions to these problems into the project design. To facilitate the use of the technique, the factors that influence O&M, for example, long-term funding, spare parts, will be treated separately. Each step of the iteration will consist of the:

- Question
- Explanation of need for the question
- Response (check YES, NO, or UNSURE)
- Recommendation to satisfy needs identified by question if NO is the answer.

For example, question five in the Institutional Capability Section asks " Will a written agreement outlining the responsibilities of the village(s) in the project be made for each system among the government, the implementing agency, and the village(s)?"

The explanation step helps to clarify the intent of the question and its importance to successful O&M. For this question, the explanation is:

Explanation: While a written agreement detailing the responsibilities of the village is not essential to success, it is helpful because it:

- Provides a clear statement of responsibilities
- Increases the likelihood that assigned tasks will be carried out
- Fosters the concept of village ownership of the project.

The next step in the iteration is to respond to the question by checking YES, NO, or UNSURE. The format is as follows:

YES _____ NO _____ UNSURE _____

Finally, after determining whether questions which are initially checked "Unsure" should be answered as "Yes or "No", the guide user may use the recommendation given as a guide for resolving No answers or proceed to the next question if the answer is Yes. For the sample question, the recommendation is as follows:

Recommendation: Investigate the feasibility of including a requirement for such a written agreement in the contract between the government and the external support agency.

Each of the four guides also contains an introduction that details the type of water supply system analyzed and lists assumptions that are made regarding the O&M component of the system.

4.3 Limitations of the O&M Assessment Guides

The Operations and Maintenance Assessment Guides are designed to assist project planners in pinpointing and resolving problems that are likely to limit the long-term success of a water supply system.

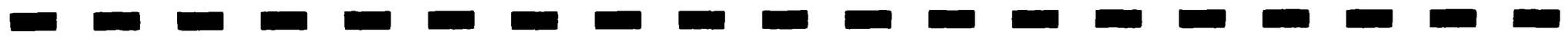
Successfully implementing a water supply project, however, requires that the project planner recognize that other components of the project that are not addressed in the guides also have an impact on effective operations and maintenance. Some of these components are as follows:

- Design of the water system
- Construction
- Water quality
- Health education
- Social factors.



REPLICATED SITE

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Chapter 5

O&M MAINTENANCE ASSESSMENT GUIDE FOR RETICULATED SYSTEMS FED FROM SPRINGS AND STREAMS

5.1 Introduction

This Operations and Maintenance Assessment Guide has been developed for use in planning water supply projects in which multiple systems are to be constructed, using spring and streams as water sources and gravity-fed pipeline systems and standpipes for water distribution. This guide may also be used in planning an O&M program for a single water supply system of this type.

The following assumptions apply regarding to system operations and maintenance:

- The water supply systems will be owned by the communities they serve.
- All operations and maintenance tasks are to be performed by one or more village caretakers.
- A village council or water committee is solely responsible for system O&M support activities (for example, financial management, logistics, and so forth).
- The quality of the sources to be used by the project is satisfactory, and no water treatment is necessary.

It is recommended that chapters one through four of the workbook be reviewed before one attempts to use this operations and maintenance assessment guide.

The remainder of this guide is organized as follows:

- 5.2 Institutional Capability
- 5.3 System Operations and Maintenance
- 5.4 Spare Parts and Supplies
- 5.5 Logistics
- 5.6 Finance
- 5.7 Records
- 5.8 Human Resources and Training.

5.2 Institutional Capability

Both the government and the communities receiving water service need to be actively involved in the water project if it is to be successful. The questions in this section focus on determining the commitment of the government and the community to the O&M component of the systems to be constructed by the project.

Village Level

1. **Has the willingness of the villages in the project area to accept responsibility for improving and maintaining their water supply systems been assessed?**

Explanation: It is important to be sure that the villages are strongly motivated to support the long-term O&M needs of their water supply systems. If the willingness is absent, the first O&M problem may result in the community either losing access to the improved supply of water or reverting to its previous water source(s).

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the willingness to assume responsibility will be assessed during the project design phase.

Recommendation: A baseline survey of village attitudes, including interviews with influential village people, will help to determine the level of support of the villagers in the project area for an improved water supply system and their understanding of the benefits of such a system. The survey will facilitate the planning of project extension and training activities relating to system construction, use, and O&M procedures and tasks.

2. **Is active village participation included in the project?**

Explanation: Previous experience with similar projects indicates that for O&M activities to be successful, participation by the villagers in all phases of the project is absolutely necessary in order to give them a sense of ownership and responsibility. This participation may involve system planning, money, labor, materials, or a combination of these.

YES _____ NO _____ UNSURE _____

If UNSURE, study the project documents to determine whether the planned degree of village participation is satisfactory.

Recommendation: Community participation is essential to long-term success. The project documents should, therefore, clearly define and spell out:

- The proposed methodology for involving the villages in planning, constructing, operating, and maintaining their water supply systems
- The expected village contributions during project implementation and its responsibility for system O&M.

3. **Will the project implementing agency(s) conduct village meetings prior to and after system construction?**

Explanation: To coordinate village participation in the project, the villagers and the project implementation agency should have a number of meetings to discuss and agree upon system design, construction, operations

and maintenance, selection and training of personnel, benefits of an improved water supply system, and each party's responsibilities for project activities.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such meetings have been planned.

Recommendation: The project planning team should plan a series of village meetings as a step in project implementation for every water supply system to be constructed under the project. These meetings should be conducted by qualified community development personnel, who should be part of the project implementation team.

This strategy will also allow the project to pay special attention to villages that do not have a history of successful community self-help projects.

4. **Do village groups exist that can assume responsibility for the operations and maintenance of a water supply system?**

Explanation: Operations and maintenance of a village water supply system is an organized, planned activity which requires certain management skills, such as supervision of caretakers, collection of funds, procurement and record-keeping. These activities will need to be performed by a group of respected individuals (for example, a water committee) from the village(s) served by the water supply system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such groups are available to assume this responsibility.

Recommendation: If such groups cannot be identified, the village councils should either be given the responsibility to form a water committee or they should be elected by the communities served by a system, depending on the prevailing sociopolitical situation. If more than one village is to be served by a water supply system, care should be taken to represent all villages on the water committee.

The tasks of these water committees should be clearly defined, and their establishment should be included by the project planning team in the project documents as an evaluation indicator.

5. **Will a written agreement outlining the responsibilities of the village(s) in the project be made for each system among the government, the implementing agency, and the village(s)?**

Explanation: The purpose of such agreements is to provide a clear statement of the responsibilities of all parties during and after project implementation, as agreed upon during meetings between the village(s) and the implementing agency. This approach will increase the likelihood that

assigned tasks will be completed and will foster the concept of village ownership of the water supply systems.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether written agreements are included.

Recommendation: The project planning team should include in the project documents the requirement for a written agreement to be made for each system among the government, the implementing agency, and the village(s). The team should prepare such an agreement in draft and ensure that the villages' responsibility for O&M is clearly stated.

Central/Regional Government Level

6. Does a (sub)regional governmental agency exist that could oversee the functioning of the village groups responsible for O&M upon completion of the project?

Explanation: While it is not always necessary that village water committees be supervised upon completion of a project, it is possible that management problems of a political or legal nature arise, thereby impeding the effective operation of a water supply system. Sometimes these problems can be resolved only through the intervention of a governmental agency.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such an agency exists.

Recommendation: The project planning team should determine which (sub)regional governmental agency would be best suited to help village water committees resolve problems that exceed its legal authority and or political influence. This agency should be identified in the project documents, and the project implementing agency should ensure that a relationship be established between the village water committee and the selected governmental agency.

7. Will the governmental water authority be involved in planning and implementing the project?

Assumption: The water authority is not the project implementing agency.

Explanation: Although the water authority is not expected to provide maintenance services upon system completion, its involvement in project planning, system design, and construction could be useful to the project planning team and implementing agency, especially regarding technical specifications, hardware selection, and sharing of O&M experience of existing systems.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the degree of water authority involvement.

Recommendation: The project planning team should preferably include a member from the water authority, who should at least have joint responsibility for system design, preparation of technical specifications, and O&M program planning.

Further, the implementing agency should make an effort to involve the water authority in quality control during system construction and O&M-related training.

5.3 System Operations and Maintenance

The key to ensuring effective system operations and maintenance is to ensure that responsibilities are clearly defined and that maintenance personnel have the tools and skills to perform their job correctly. It is also essential to schedule preventive maintenance.

1. Have system operation plans been developed that ensure equitable availability of water to all users?

Explanation: It is common that operating standards and system specifications for small gravity-fed water supply systems are based on per-capita water consumption estimates. It is difficult to forecast water consumption accurately, however, especially for villages that have not previously had running water. If taps are left open indiscriminately, water shortages may occur at some or all standpipes in the system, especially if spring flow is a limiting factor. Failure to address this problem may cause part of the community to forego its O&M contributions and return to its original water source.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such plans have been developed.

Recommendation: Operating standards should be defined for two scenarios, one for when supply exceeds demand and another for when demand exceeds supply. This approach requires defining two sets of system operation plans, criteria for changing system operation, and the means to measure system performance in each case.

2. Has a system maintenance plan been developed?

Explanation: The maintenance requirements for a gravity-fed piped water supply system using a spring catchment as the source are not great; yet, if scheduled preventive and corrective maintenance tasks are not performed as required, the system will malfunction quickly and may either be abandoned or pose health problems.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such a plan has been or will be developed.

Recommendation: A comprehensive maintenance plan needs to be developed and included in the project documents. Such a plan should not only be limited

to detailing specific caretaker tasks but also to defining responsibilities for O&M support activities, such as obtaining spare parts, record-keeping, and so forth.

3. Does the project include a provision to select villagers as system caretakers?

Explanation: The project has virtually no chance of long-term success if the villages themselves cannot provide persons to be employed as system caretakers.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such a provision will be included in the project documents.

Recommendation: For each system, one or more caretakers should be selected, in consultation with the community or its representatives, to perform system operation and maintenance tasks. Further, the caretaker(s) should:

- Participate in installing the system
- Be paid for the work by the community, unless an efficient, traditional system of voluntary service exists.

4. Will the village caretakers be provided with tools and supplies, as part of the project, to perform the required maintenance?

Explanation: The caretakers will need tools (for example, wrenches and hoes) and supplies (for example, threadseal) to perform maintenance tasks. Not all of these tools and supplies will be available in the villages.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether tools and supplies will be provided and by whom.

Recommendation: A comprehensive list of all tools and supplies needed for O&M activities should be prepared by the project planning team. It must be clearly stated in the project documents which of these tools and supplies will be provided by the donor agency, the government, or the villages.

5.4 Spare Parts and Supplies

Many water systems have failed because spare parts were not readily available to service equipment. Even the simplest water supply system requires a reliable source of spare parts and other supplies to keep the equipment in satisfactory operating condition. Numerous donors and the many types of equipment have compounded this problem, and because some parts may have to be imported, the need for a reliable inventory is even more urgent in developing countries.

1. Is the hardware selected for use in the water supply project compatible with spare parts and supplies currently available in the country?

Explanation: The availability of spare parts and supplies is often one of the most critical factors in any O&M program for village water supply systems, especially if they are managed at the village level. The introduction of imported, noncompatible hardware for system construction necessitates the creation of a new import and distribution network, which may prove more difficult and less effective than adjusting technical specifications during the project design phase to ensure hardware compatibility.

YES _____ NO _____ UNSURE _____

If UNSURE, determine compatibility.

Recommendation: The project planner should weigh carefully the impact on long-term project success of project hardware compatibility with locally available parts and supplies.

If the governmental water authority is not directly involved in project planning and implementation, it should be consulted regarding this matter.

If the project planning team elects to use noncompatible, imported hardware, the supplier contract should include a clause specifying the selection of an import agency, which is to guarantee spare part availability in the country for a specified amount of time (ideally, the life of the water supply systems).

2. Has an estimate been made of the quantities and types of spare parts and supplies needed for system O&M in an average year?

Explanation: Before addressing Question 3 of this section, or the Logistics and Finance sections, an estimate of the types and quantities of spare parts and supplies is needed. An accurate estimate can be made if O&M data of existing water supply systems of this type are available from local sources.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such an estimate has been or will be made.

Recommendation: The project planning team should prepare an estimate of the quantities and types of spare parts and supplies that would be needed for the O&M of a representative water supply system of this type in an average year. This information should be included in the project documents.

3. Will spare parts and supplies needed for system O&M be available in the project area?

Explanation: Though gravity-fed piped water supply systems require relatively few and simple replacement parts, they will fail if such parts

are unavailable at a reasonable cost in a (sub)regional center currently used by the villages for either trade or administrative matters.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the required spare parts and supplies are currently available in the project area, and if not, whether the project will establish a spare parts and supplies distribution system.

Recommendation: The project planning team should determine whether spare parts can best be supplied through governmental warehouses or private enterprises in the project area, taking into account such factors as each party's procurement process, distance, cost and the villagers' attitude toward the potential parts suppliers. The proposed distribution system should be described in the project documents, and, if no system exists as yet, its establishment should be included as an evaluation indicator.

If either the government or the private enterprises lack the financial resources to establish a sufficiently large stock of parts and supplies, the project planning team should consider credit arrangements or project financing for this purpose.

4. Will villages maintain a minimum stock of essential spare parts and materials at the village level?

Explanation: In many developing countries, manufactured goods are only available in (sub)regional commercial centers, and it is not unlikely that a trip to obtain spare parts for a village water supply system could take several days. Once a community is accustomed to an improved supply of water, a system breakdown lasting several days could cause significant problems. It is advisable, therefore, that the villages have a minimum supply of essential parts and materials in stock.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether each village will maintain such a stock.

Recommendation: The project should either provide or sell a minimum stock of the most essential spare parts and materials to each community, with the understanding that the community is to replenish the stock as items are being used. If written agreements are made among the villages, the government, and the implementing agency, such an arrangement should be clearly stated therein.

5.5 Logistics

The questions posed in this section consider the transportation, workshop, and storage requirements that need to be addressed to ensure the effective operations and maintenance of the water supply systems.

1. Is reliable transportation available for village caretakers to perform system O&M tasks?

Explanation: For small systems, a bicycle is usually adequate if passable roads lead to the source and most standpipes. For larger systems, sometimes a motorbike may be required. Tools and materials can be easily transported by these means. In mountainous areas where the only available means of transportation is on foot, more caretakers may be required to service each section of a water supply system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine need and availability.

Recommendation: The project planner should determine and include in the project documents:

- What means of transportation will be most appropriate for the caretaker(s).
- Who should provide it.
- Who will be responsible for its operations and maintenance component.

2. Is reliable transportation available for caretakers or village water committee members to procure spare parts and supplies?

Explanation: In remote areas, the distance to a regional center may be long, and transportation by public buses or private merchant vehicles infrequent.

YES _____ NO _____ UNSURE _____

If UNSURE, determine need and availability.

Recommendation: The project planning team should investigate the regional transport situation and:

- Estimate the frequency and duration of spare part procurement trips with the most reliable and economical means of transportation.
- Determine the required quantity of essential spare parts and supplies to be stocked at the village level consistent with the foregoing estimate.
- Include this information in the project documents.

3. Is suitable storage space available in the villages for spare parts, tools, and supplies?

Explanation: Although the quantity and size of spare parts, tools, and supplies for this type of water supply system is limited, a secure place for storage will, nevertheless, be needed.

YES _____ NO _____ UNSURE _____

If UNSURE, determine availability.

Recommendation: The project planning team should determine whether storage facilities are available in villages in the project area or whether need to be constructed as part of the project. If written agreements are made among the government, the implementing agency, and the villages, it should be specified where spare parts, tools, and supplies are to be stored and who is responsible for the construction or rental and maintenance of the storage facilities.

5.6 Finance

Before a water project is funded, the project planner should address the issues of recurrent costs, affordability to the users, and how funds for operations and maintenance are to be managed.

1. Has an estimate been made of the annual cost of operating and maintaining a representative water supply system of this type in the project area over the life of the system?

Explanation: Before addressing Question 2 of this section, an estimate of the recurrent system O&M costs needs to be made. This estimate should include not only parts, materials, and labor but also transport, storage, and, if applicable, banking charges, taxes, and replacement costs. If the maintenance program is planned (for example, preventive and corrective maintenance versus breakdown maintenance) a reliable estimate can be made.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the annual O&M costs have been or will be estimated during the project design phase.

Recommendation: The project planning team should prepare an estimate of the annual cost of operating and maintaining a representative water supply system in the project area. If, according to governmental water supply policy, the consumers are also responsible for covering system replacement costs, these should also be determined and included.

2. Has the ability and willingness of the consumers to pay all recurrent system costs been determined?

Explanation: The long-term success of a water project requires the active participation of the end users. Given that the O&M costs for gravity-fed piped water supply systems are relatively low, part of this involvement should include the complete financial responsibility for system O&M. Therefore, the ability and willingness of the communities to cover system O&M costs must be determined.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such a study has been or will be made during the project design phase.

Recommendation: The project planners need to conduct a study to assess the ability and willingness of the communities to cover the operations and maintenance costs of water supply systems. The results of the study may then be used to help determine selection criteria for communities to be included in the project.

The communities' responsibility for paying all O&M costs needs to be clearly stated in the written agreements among the implementing agency, the government, and the communities. In villages where there is no history of successful community self-help activities it may be useful to require the collection of an O&M fund (for example, for 12 months) prior to system construction.

Obviously, if the majority of the communities appear either unable or unwilling to support the O&M costs of these water supply systems, the project should be either redesigned (for example, modify system technology and or reconsider project objectives) or abandoned.

3. Will water charges be established for the use of water?

Explanation: One effective way to provide for O&M funds in this situation is for the village councils or water committees to collect water usage fees from each household served by the system. These funds may then be saved until needed for O&M expenditures. If funds are to be collected in this manner, the communities themselves must support the plan before system construction is undertaken.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how funds for system O&M are to be provided.

Recommendation: The project planning team must determine how O&M funds are to be obtained and be satisfied that the recurrent O&M costs will be covered. The project may fail if a satisfactory plan for the recovery of these funds is not made.

4. Has an acceptable means for banking or saving community O&M funds been identified?

Explanation: Much of the economy in rural areas is agriculturally based and, as a result, income is often seasonal. The collection of water charges may, therefore, also be a seasonal event. Fairly large sums of money will have to be maintained by village councils or water committees until they are needed, especially if the funds also include contributions for system replacement. It will be essential to long-term project success that these funds be saved in a secure place.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how O&M funds are to be managed upon collection.

Recommendation: The project planning team should investigate which banking or other legal, controllable savings facilities could be used by village councils or water committees for maintaining O&M funds. If no such

facilities exist in the project area, the team should assess the reliability of traditional savings arrangements.

The team should identify the most suitable savings arrangement for system O&M funds, and the establishment of O&M fund accounts should be included in the project documents as an evaluation indicator.

5.7 Records

Certain records need to be maintained for all water supply systems. The questions posed in this section will help determine which records are essential to operations and maintenance of this type of system, how they should be recorded, and by whom.

1. **Will the caretakers be required to maintain records of maintenance work completed and spare parts and supplies used?**

Explanation: Record-keeping sometimes facilitates the systematic execution of O&M tasks for village caretakers. It also facilitates caretaker supervision and other management tasks (for example, timely ordering of supplies and spare parts) performed by either village councils or water committees.

YES _____ NO _____ UNSURE _____

If UNSURE, determine record-keeping requirements and provisions for this in the project documents.

Recommendation: It is useful to include record-keeping requirements in system O&M plans. Appropriate written checklists and prepared (monthly) O&M forms should be provided to the caretakers for this purpose. In the case of illiterate caretakers, a literate member of the water committee can maintain these records.

2. **Will the village councils or water committees be required to maintain financial records for system O&M?**

Explanation: This essential requirement is essential. While water supply systems may continue to function if records are poorly maintained by a system caretaker, the probability of the misuse of O&M funds is significantly increased if no records are maintained of income and expenditures. This situation could easily lead to either the inability or unwillingness of a community to maintain its system.

The availability of financial records also facilitates assistance by other governmental agencies in the case of a dispute.

YES _____ NO _____ UNSURE _____

If UNSURE, determine provision for this in the project documents.

Recommendation: A simple accounting plan should be developed for use by village councils or water committees. Copies of the plan and forms should

be provided to the committees or councils. One effective way to increase the likelihood that adequate records are being maintained is to include a provision for them in the agreements among the villages, the government, and the implementing agency.

3. Will the village councils/water committees be required to send periodic (for example, annual) status reports to the governmental agency responsible for rural water supply?

Explanation: This requirement will probably not affect the successful O&M of individual water supply systems. It would provide the responsible governmental agency with useful macro-planning information, however, and allow it to take action if a particular O&M problem affected water supply systems in an entire region of the country.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the need for this requirement and the provision for this in the project documents.

Recommendation: If the governmental agency responsible for rural water supply maintains a databank for countrywide system monitoring, it should be requested to determine the reporting requirements for all systems to be constructed under this project and provide forms and instructions to the village councils or water committees.

5.8 Human Resources and Training

Ultimately, the success or failure of a water supply system will depend on the people who have the responsibility for operation and maintaining it. The questions set forth in this section help to identify the people at both the system and project level who may require training during the project.

Assumption: The cost of all project training activities will be included in the project budget, either as a donor or a governmental contribution.

1. Will management training be provided to village water committee members?

Explanation: As noted above in Institutional Support Question 4, the village councils or water committees are to assume the overall responsibility for the operations and maintenance of the water supply systems. The project planning team cannot assume, however, that the members of these councils or committees already have the skills needed to supervise system caretakers, collect and manage O&M funds, purchase and store spare parts and supplies, maintain records, and so forth.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such training will be provided during the project.

Recommendation: The project planning team should assess the training needs of village council or water committee members, and appropriate training

programs for water committee members during project implementation should be incorporated in the project design.

2. Does the project include training for village caretakers?

Explanation: Proper training is necessary if the water supply systems are to be operated and maintained correctly by the village caretakers. Training for O&M also places greater emphasis on its importance.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such training will be provided during the project.

Recommendation: Systematic hands-on training, during construction and during a refresher course (for example, six months later) should be planned and incorporated in the project design.

3. Have user education campaigns been planned before and during the initial months of system use?

Explanation: The mode of operation of a public standpipe is quite different from traditional village water supplies. A spring or a stream flows continuously, while a tap should only be opened when a person collects water. It cannot be assumed that all community members will understand and follow these operating principles, unless a user education campaign is launched. Failure to do so may lead to water wastage, higher costs, and disputes which may result in villages abandoning their system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such campaigns have been planned during the project.

Recommendation: The project planning team should include suitable user education activities in the project design. The team should identify who would conduct such a campaign at the village level (for example, community development workers or health workers, trained water committee members, and caretakers) and whether it could be combined with health and sanitation education activities.

4. Are training materials available that suit the level of the trainees?

Explanation: Appropriate training materials (for example, O&M manuals, accounting workbooks, and so forth) using either local language or visual techniques, will be necessary not only for training purposes but also for field use by village O&M personnel.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the availability of such materials.

Recommendation: The project planning team should review training materials available incountry for O&M procedures and support activities of water

supply systems and include a scope of work for the revision or development of these materials during project implementation in the project documents.

5. Have qualified trainers been identified?

Explanation: Not all agencies involved in rural water supply, whether private or governmental, have a training capability; yet, a successful O&M program depends considerably on training for caretakers and managers.

YES _____ NO _____ UNSURE _____

If UNSURE, determine who the trainers will be.

Recommendation: The project planning team should prepare a trainer needs assessment. If there are currently no qualified trainers within either the implementing agency or collaborating governmental agencies, a training-of-trainers' workshop should be included in the project. Ideally, these trainers should be employed by an agency that could also provide continued training for new O&M personnel.



HANDPUMPS

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Chapter 6

O&M ASSESSMENT GUIDE FOR SYSTEMS USING HANDPUMPS

6.1 Introduction

This Operations and Maintenance Assessment Guide has been developed for use in planning water supply projects in which a number of villages are to be provided with improved water systems by using handpumps to draw water from groundwater sources.

The following assumptions apply regarding system operations and maintenance:

- The water supply system will be owned by the communities it serves.
- All minor maintenance tasks are to be performed by one or more village caretakers.
- All major maintenance tasks (primarily those that require work on the part of the pump below ground) are to be performed by regional governmental maintenance crews.
- Treatment of the water from the source is not required.

The remainder of this guide is organized as follows:

- 6.2 Institutional Capability
- 6.3 System Operations and Maintenance
- 6.4 Spare Parts and Supplies
- 6.5 Logistics
- 6.6 Finance
- 6.7 Records
- 6.8 Human Resources and Training.

It is recommended that chapters one through four of this workbook be reviewed before one attempts to use the Operations and Maintenance Assessment Guide.

6.2 Institutional Capability

Both the community being served and the appropriate governmental agency need to assume part of the responsibility for operating and maintaining the water system in order for this type of water supply system to be successful.

Village Level

1. Is active village participation included in the project?

Explanation: Previous experience with similar projects points to the absolute necessity of participation by the villages to give them a sense of ownership. This participation may involve money, labor, materials, or a combination of these. The villages should also participate in planning the water schemes for their community. Such planning may include site selection and choice of technology.

YES _____ NO _____ UNSURE _____

If UNSURE, study project plan. Status must be determined.

Recommendation: Community participation is essential to long-term success. The responsibility of the village for O&M must be clearly defined in the project documents.

2. Has the village(s) participated in successful community self-help projects?

Explanation: Because village participation in the project is essential for long-term success, the project planner needs to ascertain the village history of self-help projects.

YES _____ NO _____ UNSURE _____

If UNSURE, determine village experience.

Recommendation: If the village either has no previous self-help experience or has been unsuccessful with a community project, the planner should consider two steps, as follows:

- Place particular emphasis (for example, by training) on the long-term role of the village.
- Require more frequent follow-up inspections and status reports of village efforts by appropriate organizations within the government.

The specific role of the village in system O&M should be described in detail and included in agreements involving the donor agency, the host government, and the village.

3. Will the project implementing agency(s) conduct village meetings prior to, and after system construction?

Explanation: To coordinate village participation in the project, the villagers and the project implementation agency should have a number of meetings to discuss and agree upon system design, construction, operations and maintenance, selection and training of personnel, benefits of an improved water supply system, and each party's responsibilities for project activities.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such meetings have been planned.

Recommendation: The project planning team should ensure that the implementing agency has planned a series of village meetings for every water supply system to be constructed under the project and that these meetings are to be conducted by qualified community development personnel.

4. Does a village group exist that can assume responsibility for maintenance?

Explanation: Maintenance is an organized, planned activity. The selection or appointment of a caretaker without follow-up by a village group to monitor work being done is insufficient in terms of ensuring adequate maintenance. This group may also reinforce to the caretaker the necessity and importance of his or her work.

YES _____ NO _____ UNSURE _____

IF UNSURE, determine whether such a group is available to assume this responsibility.

Recommendations: If such a group cannot be identified, the village council should be given the responsibility for forming the group. The specific tasks of this group also need to be clearly defined. The project planner should take the lead in ensuring that the formation of the maintenance group within the village is included in the project agreement.

5. **Has a determination been made of the villages' willingness to participate?**

Explanation: It is important to ensure that the village(s) are strongly motivated to support the long-term O&M needs of the WS system. If a willingness is absent, the first handpump failure may result in the village reverting to its previous water sources.

YES _____ NO _____ UNSURE _____

If UNSURE, follow up to determine whether YES or NO is true.

Recommendation: A baseline survey of village attitudes, including interviews with influential village people, will help to establish the level of support of the villagers. The survey, along with the requirement for village contributions, will enable the planner to better determine the willingness of the villagers to provide continuing support.

6. **Will a written agreement outlining the responsibility of the village in the project be made between the government and the village?**

Explanation: While a written agreement detailing the responsibilities of both the government and village is not essential to project success, it is helpful because it:

- Provides a clear statement of responsibilities
- Increases the likelihood that assigned tasks will be performed
- Fosters the concept of village ownership of the project.

YES _____ NO _____ UNSURE _____

IF UNSURE, determine whether agreement is included.

Recommendation: Investigate the feasibility of including a requirement for such a written agreement in the contract involving the ESA, the government, and the village.

Central/Regional Government Level

7. Does either the central or regional government have a history of effective response to O&M problems?

This question addresses the institutional capability of the government to handle O&M effectively. Its purpose is to assess the actual performance of the water authority in responding to O&M problems in the village.

YES _____ NO _____ UNSURE _____

IF UNSURE, investigate government's willingness and ability to address O&M problems.

Recommendations: The project team could make a survey of a small number of villages (five to ten) with handpumps to determine:

1. How quickly the governmental maintenance team responded to a problem
2. How effective their work was.

This investigation, combined with the answers to questions eight through ten, will help to assess the institutional capability and commitment of the government to providing adequate maintenance support.

8. Have steps been taken by the government to actively support O&M?

Explanation: "active support" is a subjective phrase, and that which constitutes support will vary depending on the level of government considered. Examples of support are as follows:

Central Government

- Ensure that O&M funds are available.
- Establish a water board.
- Have top governmental officials highlight O&M when making addresses on water supply policies or when commissioning new water schemes.
- Ensure that supplies and spare parts are available.

Regional Government

- Ensure that O&M and construction functions are separate.
- Establish a maintenance reporting system to track repairs to handpumps not carried out by the village.
- Make field trips to support the O&M.
- Encourage training exercises.

These are a few of the important ways in which O&M may be supported by government above the village level. The important point is that this support cannot be assumed, but must be included in the design of the project. It is desirable to establish some of these support activities, such as milestones used to evaluate the project.

YES _____ NO _____ UNSURE _____

If UNSURE, review project design and explanation above.

Recommendation: Have the project planning team prepare a list of appropriate O&M support activities for each level of government involved that can be used as performance indicators of O&M progress, and include all or part of list in final project design.

9. Does a distinct board or authority have responsibility for water supply projects?

Explanation: Responsibility for the water supply systems in an LDC frequently rests with a ministry that has numerous other duties. For example, the Ministry of Health is required to develop and implement programs in the health sector. If it is also responsible for water schemes, the WS system may take a secondary position and not be given the resources needed for effective O&M.

YES _____ NO _____ UNSURE _____

If UNSURE, determine responsible agency within government.

Recommendation: The agreement between the government and donor agency should include a provision for establishing a separate countrywide water board or authority with sufficient authority to establish water project standards and review project design.

10. Is there an O&M section or department within the water board?

Explanation: It is not unusual for the responsibilities for O&M and, for example, construction, to be in the same section. When this situation occurs, O&M generally does not receive its proper attention, because it does not have the same visibility as the construction of a new water system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether a separate O&M section exists.

Recommendation: Effective O&M requires the meshing of several components of an organization. Bringing these components together requires the concentrated effort of a group within the water authority. This is true whether the water scheme is a piped system with treatment or one using handpumps. It is recommended that the contract between the ESA and government address this need, with specific requirements for identifying the group or individual who will have O&M as its only responsibility. This requirement should be used as a milestone for monitoring the commitment of the government to the water supply program.

6.3 System Operations and Maintenance

This section focuses of the need to ensure that the responsibilities for O&M are clearly defined and that the community and regional maintenance crews have the tools to carry out their designated maintenance tasks.

1. Does the project include provisions for selecting villagers as pump caretakers?

Assumption: Villagers are available to be employed as handpump caretakers.

YES _____ NO _____ UNSURE _____

If UNSURE, determine community involvement and act accordingly.

Explanation: The project has virtually no chance of long-term success if the village itself is not responsible for periodic maintenance.

Recommendation: One or more caretakers should be selected to perform regular pump maintenance. Further, the pump caretaker(s) should:

- Participate in the installation of the well and handpump
- Be selected after consultation with the village council
- Be paid for the work.

The requirement that the caretaker be paid is probably unnecessary if the village has a practice of setting aside one day a week for the people to work on community projects. Maintaining the water system would be the caretaker's contribution to the community workday.

2. Will village caretaker be provided with tools and material as part of project to perform required maintenance?

YES _____ NO _____ UNSURE _____

If UNSURE, determine status.

Explanation: The caretaker will need tools (for example, wrenches) and material (for example, lubricant) to service the handpump properly. It must be clearly stated whether or not these will be part of the commodities supplied by the donor or whether a unit of the government has this responsibility.

Recommendation: Because certain handpump suppliers have designed special tools for use with their pumps, it is best if these are supplied as part of the project deliverables. It is also preferred if a quantity of material is provided. This approach will help to identify the proper materials such as lubricants that should be used with the handpump.

3. Has a preventive maintenance (PM) program been developed for the pump caretaker and regional maintenance team?

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether provision has been made for PM at community and regional level.

Explanation: The PM requirements for handpumps are not great; yet, if scheduled maintenance tasks are not performed as required, the pump will deteriorate quickly and fail to perform. The community may then return to its former water source.

Recommendation: Provision for preventive maintenance should be made in the project agreement. If, for example, a regional maintenance crew does not exist and is required to perform major maintenance tasks, the establishment of one could be one of the milestones used to release project funds to the government. This need cannot be left to chance.

4. Has the government made provisions for assigning responsibility for major maintenance to the pump?

YES _____ NO _____ UNSURE _____

If UNSURE, have the government detail plans for making major repairs and reconsider question.

Explanation: Handpumps occasionally require the replacement of below-ground parts, such as the leathers and foot valve, frequently requiring some type of lifting device.

The capabilities of the community, government, or private workshops to perform this work must be assessed.

Recommendation: The team planning the project must be certain that the capability exists to make below-ground pump repairs or parts replacement. The team should:

1. Determine from the government how this work is to be done.
2. Assess the feasibility of the plan. Field trips to assess the value of the plan should be made.
3. If the plan is determined to be inadequate, indicate how the maintenance capability is to be brought up to the required standard.
4. Use milestones in the project agreement to monitor the establishment of the maintenance capability.

5. Are the responsibilities for specific maintenance tasks between government agencies and villages clearly defined?

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether guidelines outlining these responsibilities exist.

Explanation: The need to define responsibilities for specific tasks is clear. The important point is that the planner cannot assume that this has been done, but must be certain that it is so.

Recommendations: One way to satisfy this requirement is to request that the responsible governmental agency prepare a plan giving its concept of how specific maintenance tasks are to be accomplished. This plan can then be measured against: (1) the understanding that the village has of its role in O&M and (2) the capability of the village to fulfill its role.

The plan should also define responsibilities for obtaining spare parts and for employing private workshops.

6.4 Spare Parts and Supplies

The questions set forth in this section pertain to the ability of the community and regional maintenance crews to obtain the spare parts and supplies needed to maintain and repair the handpumps. Investigations in this area are particularly important if the pumps are imported.

1. **Is the hardware selected for use in the water supply project compatible with spare parts and supplies currently available in the country?**

Explanation: The availability of spare parts and supplies is often one of the most critical factors in any O&M program for village water supply systems. The introduction of imported noncompatible hardware for the system necessitates the creation of a new import and distribution network, which may prove more difficult and less effective than adjusting technical specifications during the design phase to ensure hardware compatibility.

YES _____ NO _____ UNSURE _____

If UNSURE, determine compatibility.

Recommendation: The project planner should weigh carefully the impact on long-term project success of project hardware compatibility with locally available parts and supplies.

If the governmental water authority is not directly involved in project planning and implementation, it should be consulted regarding this matter.

If noncompatible hardware is to be used, the supplier contract should include a clause specifying the selection of an import agency which is to guarantee spare part availability in the country for a specified period of time (ideally the life of the water supply system).

2. **Has an estimate been made of the quantities and types of spare parts and supplies needed for system O&M in an average year?**

Explanation: Before addressing Question 3 of this section and the Logistics and Finance sections, an estimate of the types and quantities of spare parts is needed. A reliable estimate may be made if O&M data of existing water supply systems of this type are available from local

sources. Other reliable sources are the suppliers of major equipment to be used in the water supply system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether an estimate will be made.

Recommendation: The project planning team should prepare an estimate of the quantities and types of spare parts that would be needed to operate and maintain the water system in an average year.

3. Will supplies of the spare parts and material needed to service the pumps properly be available at the regional level?

Explanation: Though handpumps are relatively easy to maintain and require few replacement parts, they will fail if routine maintenance is not performed. This maintenance requires an inventory of spare parts.

YES _____ NO _____ UNSURE _____

If UNSURE, determine status.

Recommendation: The project planning team must investigate how spare parts are to be supplied. Supplies could be available from either private vendors or from regional governmental warehouses. Field investigations should be included in project preparation stage if public or private suppliers have been identified as sources of supplies. If the supply system is not yet established, it should be included as a milestone in the project agreement.

4. Does a system for control of inventory exist at the regional level?

Explanation: The need for a planned inventory control system may actually be greater in an LDC because spare parts frequently have to be imported. A manual card system that monitors the number of units of stocked items should be adequate.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how supplies are maintained in storage.

Recommendation: Unless local vendors are to stock all necessary spare parts, the responsible governmental unit should be required to develop an inventory system that feeds information into the tendering section for purchase. The likely effectiveness of the inventory plan should be assessed by the project team or by an independent consultant after the project has started.

5. Is the government's tendering process capable of obtaining spare parts and supplies in a timely manner?

Explanation: If the procurement process is unwieldy and slow moving, it is likely that necessary supplies will be unavailable when needed.

Reorganizing an ineffective tendering process is a major effort and, therefore, beyond the scope of most water supply projects.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how orders are placed.

Recommendation: The project preparation team should determine whether the tendering process can support the long-term needs of the project. If the team believes that the tendering process requires substantial improvement and if the project includes an institution-building component, the tendering process should be targeted for additional work during the project.

6. Will spare handpumps be provided by the project?

Explanation: The additional cost to the project of providing a number of spare pumps, for example, 5.0 percent of total installed, is not great and will probably permit faster replacement if a pump proves defective. (Note: If this provision is included in the agreement, the project preparation team should make certain that the pumps can be stored securely and be available when needed.)

YES _____ NO _____ UNSURE _____

If UNSURE, study terms of agreement.

Recommendation: Providing complete spare pumps needs to be carefully studied. The project team needs to consider whether the government will perform major service on handpumps, if pumps can be stored securely, and whether private vendors will stock complete pumps and other factors, before determining whether spare handpumps should be allowed for.

6.5 Logistics

Reliable transportation for pump caretakers, if they are responsible for more than one community and for regional maintenance crews, is an integral part of a successful maintenance program.

1. Is reliable transportation available for locally based caretakers and regional maintenance workers?

Explanation: For the caretaker, a bicycle or motorbike is usually satisfactory if the caretaker is responsible for a number of pumps in several villages. Tools and supplies can be easily transported by these means.

YES _____ NO _____ UNSURE _____

If UNSURE, determine status.

For regional maintenance, appropriate and sufficient vehicles must be dedicated to maintenance and not used for other duties, such as monitoring construction activities.

Recommendation: The project preparation team needs to take two steps regarding vehicles:

- a. Determine whether vehicles are available to be used for maintenance. If not,
 - b. Consider adding sufficient vehicles to support O&M to the commodities supplied as part of the project.
2. Are there practical plans for the village caretaker to notify the regional teams of the need for handpump maintenance?

Explanation: A method for the village to quickly and precisely notify the regional maintenance team of a pump problem should exist. The methods may vary from telephone to postcard to a visit by the caretaker to the regional maintenance office.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether a viable method is in place.

Recommendations: The project team should be satisfied that long delays on notification do not occur simply because the caretaker has not been given instructions regarding how the regional team is to be informed of problems.

3. Are adequate facilities available for the maintenance and repair of regional water authority vehicles?

Explanation: It is prudent to make sure not only that maintenance vehicles are available but also that the means for servicing them is in place. If the government is unable to maintain its vehicles, it is unlikely that it will be able to service the water schemes.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how vehicles are to be maintained and repaired.

Recommendation: If satisfactory arrangements for vehicle maintenance are nonexistent, it is useful for the project team to offer recommendations to improve this area. If a water supply system maintenance workshop is to be constructed, part of this facility should be dedicated to vehicle maintenance.

4. Will workshop facilities be available to repair handpumps?

Assumption: The handpump used for the project will require some servicing in a shop; that is, not all repairs can be made in the field.

Explanation: Some types of handpumps can be completely serviced in the field, while others require some shop work (for example, welding may be needed). Unless the regional maintenance crews are responsible for other types of WS systems, such as small piped ones, the maintenance workshop

can be a small structure used for supplies storage, vehicle, and handpump maintenance.

YES _____ NO _____ UNSURE _____

If UNSURE, determine need for workshops and take action as required.

Recommendation: The project planning team should determine whether a regional workshop is needed and, if so, if it is adequate in size and provisions to service handpumps properly. If the workshop is inadequate, provision should be made in the project agreement for the workshop to be upgraded, possibly with project funds.

5. Is the workshop outfitted with the tools and equipment needed to repair handpumps?

Explanation: It is not unusual to visit a workshop which is outfitted with virtually no tools or equipment to perform tests. With handpumps, the tool requirements are minimal; yet some must be provided if the maintenance team is to do its job.

YES _____ NO _____ UNSURE _____

If UNSURE, determine availability of tools and test equipment needed to repair handpumps.

Recommendations: A precedent exists for using project funds to provide maintenance hardware, for example, tools, to outfit maintenance facilities. The project team should investigate the feasibility of allocating a portion of project funds to support necessary maintenance hardware.

6.6 Finance

If properly maintained, the cost of servicing handpumps is not high. Some funds, however, will be needed to obtain replacement parts and supplies, to provide transport, and to pay salaries. The ability and willingness of the consumers and government to fund their part of the recurring cost of maintaining the water system must be determined before the project is approved.

1. Has an estimate been made of the annual cost of operating and maintaining the WS system over the life of the system?

Explanation: Before addressing Question 2 of this section, an estimate of the recurring costs of operating the system needs to be made. If the maintenance program is planned (for example, preventive maintenance rather than breakdown maintenance), an accurate estimate of maintenance costs can be made.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether recurring O&M costs have been, or will be, estimated.

Recommendation: The project preparation team needs to have the capability to estimate the annual cost of operating and maintaining the system. This estimate will require that the team include an engineer or financial analyst experienced in O&M.

2. Can the consumers and government afford to pay all recurrent costs relating to the operation and maintenance of the systems and facilities constructed under the contract?

Explanation: The long-term success of a water project involving the installation of handpumps requires the participation of the users. Part of this involvement should include partial or, preferably, total financial responsibility for the operations and maintenance of the water system. Any part of O&M related costs that could not be supported by the community would have to be borne by the government.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether a study is planned to gather this information.

Recommendation: The project planning team needs to conduct a study to assess the ability and willingness of the communities and government to cover the O&M costs of the water supply system.

If the assessment is positive, the results of the study may be used to help establish selection criteria for communities to be included in the project.

If the majority of communities and or the government appear unable or unwilling to support the O&M costs of these water systems, the project should be either redesigned (modify system technology or reconsider the project objectives) or abandoned.

3. Have the responsibilities for covering specific recurrent O&M costs between the government and the communities been well-defined?

Explanation: The need to define responsibilities for covering specific O&M costs is clear. The relative size of each party's share of these costs will depend on a number of factors, such as tax policy, the level of government involvement in the operations and maintenance of village infrastructure, the revenue base of the government and the communities, and so forth.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether these responsibilities are clearly defined.

Recommendation: The project planning team needs to ensure that both the responsibilities of the government and of the village for covering recurrent O&M costs are clearly defined in the project documents as well as in any written agreements between the government and the villages.

The villages should be required to collect funds for O&M for a period of time prior to the construction of their water system.

4. Will water charges be established for the use of water?

Explanation: One effective way to provide for O&M funds is for the village or community council to collect for water usage from each household. The funds may be banked, until needed, for labor or parts and to pay the wages of the caretakers.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how funds for O&M are to be provided.

If funds are to be collected in this manner, the community itself must support the plan before the handpump(s) is installed.

Recommendation: The project planning team must determine how the funds for O&M are to be obtained and be satisfied that the recurring costs of O&M will be covered. The project will most certainly fail if a satisfactory plan for the recovery of these funds is not made.

5. Has an acceptable means for banking or saving community O&M funds been identified?

Explanation: Much of the economy in rural areas is agriculturally based and as a result people's income is often seasonal. The collection of water charges may therefore also be a seasonal event. Fairly large sums of money will have to be maintained by village councils or water committees until they are needed, especially if the funds also include contributions for system replacement. It will be essential for long-term project success that these funds be saved in a secure place.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how O&M funds are to be managed upon collection.

Recommendation: The project planning team should investigate which banking or other legal, controllable savings facilities could be used by village councils or water committees for maintaining O&M funds. If no such facilities exist, the team should assess the reliability of traditional savings arrangements.

The team should identify the most suitable savings arrangement for system O&M funds, and the establishment of O&M fund accounts should be included in the project documents as an evaluation indicator.

6. Does the ministry responsible for regional maintenance have a separate O&M budget?

Assumption: The central government assumes the cost of major maintenance of handpumps or is responsible for this type of service and bills the community for the work.

Explanation: The success or failure of the project does not hinge on this item. If O&M is identified as a separate budget item, however, it helps to focus attention on the cost of O&M and the need for treating O&M as a distinct governmental function.

YES _____ NO _____ UNSURE _____

If UNSURE, determine method of budgeting by central government.

Recommendation: The project team should investigate the government's budget process to determine how the funds for regional maintenance are to be obtained. If funding for O&M appears haphazard, specific requirements for implementing O&M should be established and included in the donor-government agreement.

6.7 Records

Accurate records of O&M activities enable both the community and government to estimate the funds needed to support the water system in the future. Because an estimate of recurring costs should have been made as the project was being planned, the purpose of maintaining records will be to document the operations and maintenance history of the handpumps and to prepare annual operating budgets more accurately.

1. Will the caretaker be required to maintain records of PM done and materials used?

Explanation: The caretaker is more likely to provide proper maintenance if records are maintained on work completed and supplies and material used. If such records are maintained, the regional maintenance crew or village council must periodically inspect the records.

YES _____ NO _____ UNSURE _____

If UNSURE, determine status.

Recommendation: This requirement should be included in the maintenance plan for the handpumps. Appropriate written checklists and prepared O&M forms should be provided to the caretaker for this purpose. The most effective way to ensure that adequate records are maintained is to include a provision for them in the written agreement between the government and the village.

2. Will the village councils or water committees be trained in techniques for maintaining financial records for system O&M?

Explanation: This requirement is essential. While water supply systems may continue to function if records are poorly maintained by a system caretaker, the probability of the misuse of O&M funds is significantly increased if no records of income and expenditures are maintained. This

situation could easily lead to either the inability or unwillingness of a community to maintain its system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine provision for this in the project documents.

Recommendation: A simple accounting plan should be developed for use by village councils or water committees. Copies of the plan and forms should be provided to the committee. One effective way to increase the likelihood that adequate records are being maintained is to include a provision for them in the agreements among the villages, the government, and the implementing agency.

3. Will the regional maintenance group be required to maintain records on work that has been completed?

Explanation: This requirement is essential. While the project may be successful if records are poorly maintained by the caretaker, the probability of long-term success is significantly lessened if records of maintenance are not maintained by the regional maintenance work force.

YES _____ NO _____ UNSURE _____

If UNSURE, determine status.

Recommendation: A plan for maintaining records should be developed if one does not currently exist. The record should include a history of repairs (including their cost) that were made by the regional crew.

4. Will the regional work force prepare a regular report on repairs completed and submit it to the water board for review?

Explanation: A requirement for a regular (monthly is typical) report that is prepared by a regional office detailing monthly O&M activities is closely allied with questions seven through nine in the Institutional Support Section. Maintenance crews must be held accountable for their work and should be required to maintain a record of their activities. The central O&M group must, in turn, recognize and respond to the report of maintenance actions. It is counterproductive for field O&M personnel to submit reports that are ignored.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate reporting requirements.

Recommendation: Training of both central and regional personnel in effective record-keeping should be included in the project paper. The record-keeping system should be simple to understand and use.

6.8 Human Resources and Training

Village and governmental personnel are the most important part of a successful operations and maintenance program. It is, therefore, imperative that they be given proper training to enable them to maintain the handpumps correctly and at a reasonable cost to the users and to the government.

1. Has provision been made in the project for management training of village water committee members?

Explanation: As noted above in Question 4 under Institutional Capability, the participation of the village in the project is essential to its success. It is equally important that the village committee responsible for operating and maintaining the community water system be able to:

- Organize maintenance activities.
- Arrange for and manage the collection of funds.
- Purchase and store materials and supplies.
- Maintain records.
- Contract maintenance work to private enterprise, for example, village artisans.

This type of training is particularly important if the bulk of the maintenance work is performed by the village. As Village-Level Operation and Maintenance (VLOM) pumps are developed, the need for management training of village water committees will grow.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether training or extension work is planned for in the project.

Recommendation: One effective way to train the water committee is through community development or extension workers (CDW). The CDWs may be trained to impart the necessary skills to the village committees. The training of the committee should be completed before the water system is constructed. The use of project funds to train the CDWs is desirable, because this helps to emphasize the need for such training.

2. Does project include training for handpump maintenance for both caretakers and regional maintenance crews?

Explanation: Proper training is essential if the handpumps are to be maintained properly. Training for O&M also places greater emphasis on its importance.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether training is scheduled.

Recommendation: Hands-on training must be incorporated into the project design.

3. Will training materials be developed to suit the level of trainees?

Explanation: This point should be self-evident. The point is that documents such as O&M manuals must be translated and illustrated if they are to be useful for maintaining equipment.

YES _____ NO _____ UNSURE _____

If UNSURE, determine, if possible, who trainer will be.

Recommendation: The scope of work for the training component of the project should include review and revision of maintenance manuals, as needed. (Note: The use of visual techniques to illustrate maintenance techniques can be valuable training tools.)

4. Has the responsible ministry within the government made provision for continued training of maintenance workers?

Explanation: Because of the simplicity of the handpump, continued training of maintenance workers is not as important as it would be for higher technology systems. A plan for providing at least on-the-job training of new personnel by experienced mechanics should, however, be developed.

YES _____ NO _____ UNSURE _____

If UNSURE, determine governmental position on training.

Recommendation: The project planning team should determine how new employees of a regional maintenance crew are to be trained and make recommendations to the water board on techniques to improve the training method, if needed.



POWER-DRIVEN PUMPS

11



Chapter 7

O&M ASSESSMENT GUIDE FOR WATER SUPPLY SYSTEMS USING DIESEL OR ELECTRICALLY DRIVEN PUMPSETS

7.1 Introduction

This Operations & Maintenance Assessment Guide has been developed for use in planning water supply projects in which multiple systems are to be constructed, using diesel or electrically driven pumpsets drawing from groundwater sources. The complexity of the systems may vary from a pair of small 12 VDC pumps powered by a photovoltaic array, supplying water to a small village, to a number of diesel-driven pumpsets supplying water to a small town by way of a reticulated system and household connections.

These systems may be owned either by the communities they serve or by a regional or national water authority. In preparing this guide, it has been assumed that the systems are community-owned and that a high degree of community participation in planning, constructing, operating, and managing the water supply systems is both feasible and desirable.

If the systems to be constructed under the project are to be owned and managed by a regional or national water authority, the project planner should use the assessment guide in Chapter 8 (except for any questions regarding water treatment), which assumes complete water authority responsibility for system O&M.

The following assumptions apply concerning operations and maintenance of the water supply systems to be constructed under the project:

- The systems will be operated by village craftsmen, who also perform maintenance on the water storage and distribution system and some preventive maintenance work on the pump unit.
- All other maintenance will be performed by employees of a regional (or national) water authority; the associated costs are either assumed by the government or billed to the community.
- Village councils or water committees are responsible for administrative and financial management of their own water supply system.
- The quality of the groundwater to be used by the project is satisfactory, and no water treatment is necessary.
- The technical design of the water supply systems and the selected equipment, including standby equipment, will allow the systems to function according to the defined operating standards.

The remainder of this guide is organized as follows:

- 7.2 Institutional Capability
- 7.3 System Operations and Maintenance
- 7.4 Spare Parts and Supplies
- 7.5 Logistics
- 7.6 Finance
- 7.7 Records
- 7.8 Human Resources and Training.

It is recommended that Chapters one through four of the workbook be reviewed before one attempts to use this Operations and Maintenance Assessment Guide.

7.2 Institutional Capability

Both the government and the communities receiving water service need to be actively involved in the water project if it is to be successful. The questions presented in this section focus on determining the commitment of the government and the community to the operations and maintenance of the systems to be constructed by the project.

Village Level

1. **Has the willingness of the villages in the project area to accept responsibility for improving and maintaining their water supply systems been determined?**

Explanation: It is important to be sure that the villages are strongly motivated to support the long-term O&M needs of their water supply system. If the willingness is absent, the first O&M problem may result in the community losing access to the improved supply of water and or reverting to its previous water source(s).

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the willingness to assume responsibility will be assessed during the project design phase.

Recommendation: A baseline survey of village attitudes, including interviews with influential village people, will help to determine the level of support of the villagers in the project area for an improved water supply system and their understanding of the benefits of such a system. The survey will also facilitate the planning of project extension and training activities relating to system construction, use, and O&M procedures and tasks.

2. **Is active village participation included in the project?**

Explanation: Previous experience with similar projects indicates that for O&M activities to be successful, participation by the villagers in all phases of the project is absolutely necessary in order to give them a

sense of ownership and responsibility. This participation may involve system planning, money, labor, materials, or a combination of these.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the planned degree of village participation is satisfactory.

Recommendation: Community participation is essential to long-term success. The project documents should, therefore, clearly define:

- The proposed methodology for involving the villages in planning, constructing, operating, and maintaining their water supply systems
- The expected village contributions during project implementation and its responsibility for system O&M.

3. Will the project implementing agency(s) conduct village meetings prior to and after system construction?

Explanation: To coordinate village participation in the project, the villagers and the project implementation agency should have a number of meetings to discuss and agree upon system design, construction, operations and maintenance, selection and training of personnel, benefits of an improved water supply system, and each party's responsibilities for project activities.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such meetings have been planned.

Recommendation: The project planning team should plan a series of village meetings, as a step in project implementation, for every water supply system to be constructed under the project. These meetings should be conducted by qualified community development personnel, who should be part of the project implementation team.

This strategy will also allow the project to pay special attention to villages that do not have a history of successful community self-help projects.

4. Do village groups exist that can assume responsibility for managing a water supply system?

Explanation: Operations and maintenance of a village water supply system is an organized, planned activity which requires certain management skills, such as supervision of caretakers, collection of funds, procurement of goods and services, and record-keeping. These activities will need to be performed by a group of respected individuals (for example, a water committee) from the village(s) served by a water supply system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such groups are currently available to assume this responsibility.

Recommendation: If such a group cannot be identified, either the village councils should be given the responsibility for forming water committees, or they should be elected by the communities served by a system, depending on the prevailing sociopolitical situation. If more than one village is to be served by a water supply system, care should be taken to represent all villages on the water committee.

The tasks of these water committees should be clearly defined, and their establishment should be included by the project planning team in the project documents as an evaluation indicator.

5. Will written agreements outlining the responsibilities of the village(s) in the project be made for each system among the government, the water authority, the implementing agency, and the village(s)?

Explanation: The purpose of such agreements is to provide a clear statement of responsibilities of all parties during and after project implementation, as agreed upon in meetings between the village(s) and the implementing agency. This procedure will increase the likelihood that assigned tasks will be completed and will foster the concept of village ownership of the water supply systems.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether written agreements are included.

Recommendation: The project planning team should include in the project documents the requirement for a written agreement to be made for each system among the government, the water authority, the implementing agency, and the village(s). The team should prepare such an agreement in draft and ensure that the responsibilities for O&M tasks and support activities are clearly stated for both the village(s) and the water authority.

Central/Regional Government Level

6. Does the central/regional government have a history of effective response to O&M problems?

Explanation: It cannot be assumed that the government has the institutional capability and the willingness to effectively support O&M programs for new water supply systems. It is useful, therefore, to analyze the effectiveness of government O&M policies and programs in the past and present, to facilitate realistic project planning and to determine any institutional development needs that should be addressed by the project.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate the effectiveness of governmental agencies involved.

Recommendation: To highlight institutional capability problems relating to O&M, the project planning team should analyze official governmental O&M policy and survey a small number of existing village water supply systems of the type to be constructed by the project and determine:

- Who is responsible for system O&M
- How quickly the agency responsible for O&M responds to problems
- How effective its work is.

Preferably, such a survey would include both government- and village-owned or operated water supply systems. The results of the O&M policy analysis and the survey combined with the answers to questions 7 and 8 will help to determine whether any institutional development components need to be included in the project design.

7. Does a distinct board or authority have responsibility for water supply projects?

Explanation: Responsibility for water supply systems in an LDC frequently rests with a ministry that has numerous other duties. For example, the Ministry of Health may have the responsibility for water supply in addition to providing health services in the country. Unless the water supply department within the ministry has sufficient authority and a proper budget, adequate resources may be unavailable for effective O&M activities.

YES _____ NO _____ UNSURE _____

If UNSURE, determine responsible agency within the government.

Recommendation: The agreement between the government and the donor agency should include a provision for establishing a separate countrywide water authority with sufficient authority to establish water supply standards, O&M policy, and programs and review new project proposals.

8. Is there an O&M section or department within the water authority?

Explanation: Effective O&M requires the meshing of several components of an organization. Bringing these components together requires the concentrated effort of a group within the water authority. This is true whether the water scheme is using handpumps, electrically powered pumps, treatment plants, and or a pipeline distribution system.

It is not unusual for water authority personnel or units to have both construction and O&M responsibilities. When this occurs, O&M generally does not receive proper attention, because it does not have the same visibility as the construction of new water supply systems.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how the authority handles O&M.

Recommendation: The project planning team should include a specific requirement in the project documents for the water authority to either

identify or establish groups or individuals both at the central and the regional level who will have O&M as their only responsibility.

9. Will the water authority be involved in planning and implementing the project?

Assumption: The water authority is not the project implementing agency.

Explanation: Given that the water authority is expected to provide maintenance services upon system completion, its involvement in project planning, system design, and construction will not only be useful to the project planning team and implementing agency but also will increase the sense of responsibility for continued system operations and maintenance on the part of water authority personnel.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the degree of water authority involvement is satisfactory.

Recommendation: The project planning team should preferably include one or more members from the water authority, who should at least have joint responsibility for system design, preparation of technical specifications, and O&M program planning.

Further, the implementing agency should make an effort to involve the water authority in quality control during system construction and O&M-related training and ensure that a close relationship be established between the water committees and the regional office or workshop of the water authority responsible for system maintenance.

7.3 System Operations and Maintenance

The key to ensuring effective system operations and maintenance is to make certain that responsibilities are clearly defined and that maintenance personnel have the tools and skills to do their job correctly. It is also essential to schedule preventive maintenance.

1. Have system operation plans been developed?

Explanation: The operation of a water supply system is an organized, planned activity and a function of system specifications, operating standards, and the actual water consumption. Haphazard system operation by either the system operator or the users may lead to unnecessary water shortages in all or part of the system, especially during peak hours. Failure to address this problem may cause part of the community to forego its O&M contributions and return to the original water source.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such plans have been developed.

Recommendation: The water authority should prepare system operation plans for each system to be constructed under the project. If either the well yield and or the power supply are potentially limiting factors, alternative system operation plans should also be developed for instances when water demand exceeds supply.

2. Has the reliability of the electricity supply to be used for system operation been determined?

Explanation: It is obvious that a water supply system based on electrically powered pumps will inevitably fail without a reliable supply of electricity, whether it is a national grid, a renewable energy-powered system (solar, hydro, wind, and so forth), or a stand alone fossil fuel powered generator.

YES _____ NO _____ UNSURE _____

If UNSURE, determine reliability.

Recommendation: The project planning team needs to determine the reliability of the electricity supply to be used for water pumping. The methodology for this assessment will depend on whether the project intends to use power from an existing grid in the project area or if the project itself will provide the necessary power supply equipment for individual water supply systems.

In case power is to be supplied from an existing national or regional grid, the project planning team should conduct a survey in a small number of villages where electrically powered pumps are to be installed and determine:

- The hours of service provided each day
- The frequency and duration of breakdowns affecting the entire village
- The effectiveness of the electricity company in responding to O&M problems experienced by individual service connections.

The results of the survey may be used by the project planning team to determine whether the project will need to provide a standby generator to ensure system reliability consistent with the established water supply operating standards.

If the project is to provide the power supply equipment for individual systems, the O&M of this equipment should, of course, be guaranteed as part of these water supply systems.

3. Have system maintenance plans been developed?

Explanation: The continuous operation of this type of water supply system not only depends on the availability of a reliable supply of electricity but also on the timely execution of preventive and corrective maintenance tasks. A comprehensive maintenance plan, including criteria for when to perform corrective maintenance for all system components, is of primary importance for local and regional O&M personnel. If such a plan is

unavailable and O&M tasks are not completed as required, the pump and other system components may deteriorate quickly and fail to perform.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such plans have been developed.

Recommendation: Comprehensive system maintenance plans should be developed by the water authority, if necessary with assistance from the project planning team. Field trips must be made to confirm the feasibility of the plan. The plan should not only be limited to detailing specific PM and CM tasks but also to defining O&M support activities such as the procurement of parts and supplies, record-keeping, and so forth.

4. Are the responsibilities for specific O&M tasks and support activities between the water authority and the village well-defined?

Explanation: The need to define responsibilities for specific tasks is clear. Normally, this task would be accomplished while preparing the system O&M plans mentioned under questions 1 and 3. It cannot be assumed, however, that this aspect has been thoroughly and realistically planned or because the division of such responsibilities has an administrative/political dimension as well.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the division of responsibilities is clearly defined in the project documents.

Recommendation: The project planning team needs to ensure that both the villages' and the water authority's responsibilities for system O&M are clearly defined and included in the project documents as well as the written agreements among the villages, the water authority, and the implementing agency. Further, job descriptions should be developed for everyone having any O&M responsibility, whether or not they are involved at the village level or employed by the water authority.

5. Does the project include a provision for selecting village craftsmen as system caretakers?

Assumption: Village craftsmen with sufficient qualifications are available to be (trained and) employed as system caretakers.

Explanation: The project has virtually no chance of long-term success if the communities themselves cannot provide persons to be employed as system caretakers. The level of skills and experience necessary to operate the water supply system and perform certain maintenance tasks depends in part, on the type of power supply used to operate the pump, given that electrical handpumps themselves have low preventive maintenance requirements.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether provision is included.

Recommendation: One or more caretakers should be selected for each system in consultation with either the community or its representatives to perform operations and maintenance tasks. Depending on the type of power supply, this may be either a part-time or full-time job. The caretakers should:

- Participate in the installation of the system
- Be paid for the work by the community, unless only part-time work is required and an efficient traditional system of voluntary service exists
- Receive training, as required.

6. Will the system caretakers be provided with tools and supplies as part of the project to perform the required maintenance?

Explanation: The caretakers will need tools (for example, wrenches) and supplies (for example, threadseal) to perform maintenance tasks. Not all of these tools and supplies will be available in the village.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether these will be provided and by whom.

Recommendation: A comprehensive list of all tools and supplies needed for O&M activities should be prepared by the project planning team. If the supplier(s) of the pumps and or power supply systems have designed special tools for use with their equipment, it is best if these are supplied as part of the project deliverables. It must be clearly stated in the project documents which of these tools and supplies will be provided by the donor agency, by the government, or by the village.

7. Has the water authority made provisions to handle major system maintenance?

Explanation: It is deemed that the maintenance requirements of electrically powered pumps generally exceed the technical know-how of village craftsmen in LDCs. Further, depending on the depth of the well and the type of pump used by the project, below-ground pumps or parts will occasionally need to be raised for either servicing or replacement. Usually, this procedure will require some type of lifting device. If a water supply system requires its own power supply system (or a standby unit), this may involve technically complex maintenance work as well.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether provision has been made.

Recommendation: The project planning team must be certain that the water authority has the capability to provide major maintenance services to all systems in the project area, as needed. Therefore, the team should:

- Determine how the water authority proposes to implement its share of the O&M plans defined in questions 1 and 3 (for example, through mobile maintenance teams).
- Assess the feasibility of the proposal.
- If the proposal is determined to be inadequate, indicate how this maintenance capability is to be brought up to standard.
- Include evaluation indicators in the project documents to monitor the establishment of the maintenance capability.

7.4 Spare Parts and Supplies

Many water systems have failed because spare part were not readily available to service equipment. Even the simplest water supply system requires a reliable source of spare parts and other supplies to keep the equipment in satisfactory operating condition. Numerous donors and the many types of equipment have compounded this problem, and, because some parts may have to be imported, the need for a reliable inventory is even more urgent in developing countries.

1. **Is the hardware selected for use in the water supply project compatible with spare parts and supplies currently available in country?**

Explanation: The availability of spare parts and supplies is often one of the most critical factors in any O&M program for village water supply systems. The introduction of noncompatible imported hardware for system construction necessitates the creation of a new import and distribution network, which may prove more difficult and less effective than adjusting technical specifications during the project design phase to ensure hardware compatibility.

YES _____ NO _____ UNSURE _____

If UNSURE, determine compatibility.

Recommendation: The project planners should weigh carefully the impact on long-term project success of project hardware compatibility with locally available parts and supplies.

If the project planning team elects to use noncompatible imported hardware, the supplier contract should include a clause specifying the selection of an import agency, which is to guarantee spare part availability in the country for a specified amount of time (ideally, the life of the water supply systems).

2. **Has an estimate been made of the quantities and types of spare parts and supplies needed for system O&M in an average year?**

Explanation: Before addressing Question 3 of this section or the Logistics and Finance sections, an estimate of the types and quantities of spare parts and supplies is needed. A reliable estimate can be made if O&M data

of existing water supply systems of this type are available from the government or other agencies involved in this work. Further, the suppliers of major equipment to be used in the water supply systems (for example, pump and power supply) should be able to provide information regarding annual spare parts needs for their equipment.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such an estimate has been or will be made.

Recommendation: The project planning team should prepare an estimate of the quantities and types of spare parts and supplies that would be needed for the O&M of a representative water supply system of this type in an average year. This information should be included in the project documents.

3. Will spare parts and supplies needed for system O&M be available at the regional level?

Explanation: Any water supply system will fail if damaged parts are not replaced, moving parts not oiled as needed, and so forth. If a fossil fuel-powered (standby) generator is required for system operation, fuel supplies will be needed on a regular basis. Given the long distances, poor roads in the rural areas of LDCs, and infrequent transportation to and from the capital, stocks of spare parts and supplies should be available for system O&M at the regional level.

YES _____ NO _____ UNSURE _____

If UNSURE, determine current availability and, if negative, whether the project intends to establish a spare parts distribution system.

Recommendation: The project planning team should conduct field studies in the project area and determine which spare parts and supplies can best be supplied through the regional office of the water authority and which ones through private enterprises, taking into account such factors as distance, cost, and the effectiveness of each party's procurement process. The proposed distribution system should be described in the project documents and, if no system exists as yet, its establishment should be included as an evaluation indicator.

If either the water authority or private enterprises lacks the financial resources to establish a sufficiently large stock of parts and supplies in the project area, the project planning team should consider credit arrangements or project financing for this purpose.

4. Does an inventory control system exist at the regional level?

Explanation: The need for a planned inventory control system may actually be greater in an LDC because spare parts frequently have to be imported. A manual card system that monitors the number of units of stocked items should be adequate.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such a system exists or will be established during the project.

Recommendation: The water authority should be required to develop an inventory system that feeds information into the authority's procurement process for purchase. The effectiveness of the plan should be evaluated by the project planning team and during the first project evaluation, at which times recommendations for system improvement may be made, if required.

5. Is the water authority's procurement process capable of obtaining spare parts and supplies in a timely manner?

Explanation: If the procurement process is unwieldy and slow moving, it is unlikely that spare parts and supplies will be available when needed, not only for water supply systems to be serviced but also for the water authority's own physical infrastructure. Reorganizing an ineffective procurement process is a major effort and beyond the scope of many water supply projects.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the water authority's procurement capability.

Recommendation: The project planning team should determine whether the water authority's procurement process can support the long-term needs of the project. If the team concludes that substantial improvements are needed and the possibility exists to include an institution-building component in the project, the procurement process should be targeted for additional work during the project.

An alternative would be to increase the initial stock of spare parts and supplies to be provided by the project, to create a larger buffer supply at the water authority's regional office or warehouse.

6. Will spare pumps (and if applicable, other major pieces of equipment, such as spare power supply systems) be provided by the project?

Explanation: The additional cost to the project of providing a number of spare pumps, for example, 5 percent of the total installed, is not great, and it will probably permit faster replacement if a pump proves defective. Further, if pumps are to be overhauled occasionally at a regional workshop, replacement pumps would be available for temporary installation in the village.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such a provision is included.

Recommendation: The project planning team should study whether spare pumps (and other major pieces of equipment) are available from either private enterprises or the water authority or if the project needs to supply these items.

7.5 Logistics

The questions in this section consider the transportation, workshop, and storage requirements that need to be addressed to ensure the effective operations and maintenance of the water supply systems.

1. Will suitable shelter be provided to serve as an O&M work area and for storing tools, supplies, and equipment?

Explanation: To perform simple O&M tasks and to store tools, supplies, and equipment a simple, but secure, building will be required for each individual water supply system.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether provision is included.

Recommendation: The project planning team should consider and determine the space requirements for performing O&M activities by the system caretakers and regional water authority personnel and the storage of tools, supplies, and equipment. Space may be provided for these purposes in an extended pumphouse.

2. Is reliable transportation available for system caretakers and regional water authority personnel to perform O&M duties?

Explanation: For system caretakers, a bicycle or a small motorbike is usually adequate, even if the caretaker is responsible for system O&M in several villages. Tools and supplies (except fuel) can be easily transported by these means.

For regional water authority personnel, appropriate and sufficient vehicles must be dedicated to O&M activities and not used for other duties, such as monitoring construction activities.

YES _____ NO _____ UNSURE _____

If UNSURE, determine availability.

Recommendation: The project planning team should determine and include in the project documents:

- Whether sufficient vehicles are currently available both for the system caretakers and for regional O&M personnel
- If not, who is to provide these vehicles
- Who will be responsible for covering the recurrent and depreciation costs of these vehicles.

3. Are there practical plans for the system caretakers or the water committees to notify the regional water authority office of the need for pump maintenance?

Explanation: A method for the villages to quickly and precisely notify the regional water authorities of a pump (or other equipment) problem should it exist. These methods may vary from a letter sent with a reliable person or a telecommunications message, to a visit by the caretaker or a water committee member to the regional office of the water authority.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the viability of the present or proposed system.

Recommendation: The project planning team should be satisfied that appropriate notification procedures are institutionalized early in the project through training and extension efforts. The effectiveness of these procedures should be evaluated during project evaluations.

4. Are adequate facilities available for the maintenance and repair of regional water authority vehicles?

Explanation: It is not only necessary to make sure that the regional water authority has vehicles available specifically for O&M but also that the means for servicing them is in place. If the authority cannot service its vehicles, whether in a garage of its own or at a government or private service station in the area, it is unlikely that it will be able to service all of the water supply systems in the project area.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how vehicles are to be maintained.

Recommendation: If a satisfactory arrangement for vehicle maintenance does not exist at present, the project planning team should investigate how this situation can be improved. If a water supply maintenance workshop is to be constructed, it should be considered to dedicate and equip part of this facility for vehicle maintenance.

5. Will adequately equipped workshop and storage facilities be available for major pump and equipment repairs and storage of tools, equipment, spare parts, and supplies?

Explanation: While many types of pump repairs can be handled in the field, major jobs, such as welding a pumpbody or rewiring a pumpmotor, are best performed in a well-equipped workshop. The same is true for the repair of other equipment, for example, generators. Further, substantial space will be required to securely store O&M equipment, an inventory of spare parts for the entire region, supplies and spare pumps, and so forth. Office space may also be required.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the suitability of the currently available facilities.

Recommendation: The project planning team should assess the space and equipment requirements for a regional workshop or storage facility and

determine whether an existing workshop could be upgraded or if a new regional water authority workshop or storage facility should be constructed and equipped as part of the project.

The project documents should clearly define who will be responsible for covering the investment as well as recurrent and depreciation costs of such a facility.

6. If fuel is required for the operation of any of the water supply systems, is fuel delivery to the communities in question assured?

Explanation: If a community depends on a fuel-powered generator to operate its water supply system, a reliable supply of fuel will be crucial to project success. Without it, the system would inevitably fail.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the reliability of fuel supply.

Recommendation: Because there is usually no fuel delivery service in rural areas of LDCs, a fuel transportation contract would be required between the community and a local trader who supplies consumer goods to the area by truck from a regional commercial center.

If fuel delivery cannot be assured, the project planning team should consider either alternative power sources for these water supply systems or a different water supply technology altogether.

7.6 Finance

Before a water project is funded, the project planner should address the issues of recurrent cost, affordability to the users and the government, and how funds for operations and maintenance are to be managed.

1. Has an estimate been made of the annual cost of operating and maintaining this type of water supply system in the project area over the life of the system (or alternatively, the cost per m³)?

Explanation: Before addressing Question 2 of this section, an estimate of the recurrent system O&M costs needs to be made. This estimation should include not only parts, supplies, and labor but also transport, storage, water authority overhead costs and, if applicable, banking charges, taxes, and replacement costs. If the maintenance program is planned (for example, preventive and corrective maintenance versus breakdown maintenance) a reliable estimate may be made.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether the annual O&M costs have been, or will be, estimated during the project design phase.

Recommendation: The project planning team should prepare an estimate of the annual cost of operating and maintaining a representative water supply

system in the project area. If according to governmental water supply policy the consumers are also responsible for covering system replacement costs; these should also be determined and included.

2. Can the consumers and the government afford to pay all recurrent costs relating to the operations and maintenance of the systems and facilities to be constructed under the project?

Explanation: The long-term success of a water project requires the active participation of the end users. Part of this involvement should include the partial or, preferably, the complete financial responsibility for covering all recurrent costs. Any part of recurrent costs that could not be supported by the beneficiary communities would have to be born by the government.

Therefore, the ability and willingness of the communities and the government to cover recurrent costs of the water supply systems and facilities must be determined.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such a study has been or will be made during the project design phase.

Recommendation: The project planning team needs to conduct a study to assess the ability and willingness of the communities and the government to cover the recurrent costs of water supply systems and the facilities to be constructed under the project.

If the assessment is positive, the results of the study may be used to help determine selection criteria for communities to be included in the project.

If the majority of communities and or the government appear unable or unwilling to support the O&M costs of these water supply systems, the project should either be redesigned (for example, modify system technology and or reconsider the project objectives) or abandoned.

3. Have the responsibilities for covering specific recurrent O&M costs between the government and the communities been well-defined?

Explanation: The need to define responsibilities for covering specific O&M costs is clear. The relative size of each party's share of O&M costs will depend on a number of factors, such as tax policy, the level of governmental involvement in O&M of village infrastructure, the revenue base of the government and the communities, and so forth.

YES _____ NO _____ UNSURE _____

If UNSURE, determine each party's responsibility.

Recommendation: The project planning team needs to ensure that both the responsibilities of the village and the government for covering recurrent O&M costs are clearly defined in the project documents as well as the

written agreements among the implementing agency, the water authority, and the communities.

In villages where there is no history of successful community self-help activities, the villages should be required to collect funds for O&M (for example, for 12 months) prior to system construction.

The project planning team should also determine how the regional water authority will receive funds from the government for the O&M of water supply systems and water authority facilities in the area.

4. Will water charges be established for the use of water?

Explanation: Two important issues that should be addressed here are as follows:

- First of all, it should be known whether the consumers will pay charges based on the volume of water they use or if they will pay a flat monthly or quarterly rate (for example, per household or per head).

While metered water requires a more complex organization, such a system would be well worth it if the electricity for system operation is supplied from a grid or a stand-alone, fuel-powered generator, because in these cases O&M costs are virtually directly proportional to water consumption.

- Second, how water charges are to be collected should be determined. One effective way is for the village councils or water committees to collect the water usage fees from the consumers and save the funds until needed for O&M expenditures.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how funds for O&M are to be provided.

Recommendation: The project planning team must determine how O&M funds are to be obtained and be satisfied that the recurrent costs will be covered. The desirability of basin water charges on actual consumption (metered water) should be investigated, in which case a provision should be made to supply water meters as part of the project deliverables.

In whatever way funds are to be collected, the communities themselves must support the financial management plan before system construction is undertaken.

5. Has an acceptable means for banking or saving the community's O&M fund been identified?

Explanation: Much of the economy in rural areas is agriculturally based, and, as a result, income is often seasonal. In some instances, the collection of water charges may, therefore, be seasonal as well. Fairly large sums of money will have to be maintained by the village councils or water committees until they are needed, especially if these also include

contributions for system depreciation. It will be essential to long-term project success that these funds be saved in a secure place.

YES _____ NO _____ UNSURE _____

If UNSURE, determine how O&M funds are to be managed upon collection.

Recommendation: The project planning team should investigate which banking or other legal, controllable savings facilities could be used by village councils or water committees for maintaining system O&M funds. If no such facilities exist in the project area, the team should determine the reliability of traditional communal savings arrangements.

The team should identify the most suitable savings arrangement for system O&M funds, and the establishment of O&M fund accounts should be included in the project documents as an evaluation indicator.

6. Does the regional water authority have a separate O&M budget?

Explanation: The success or failure of the project does not always depend on this item. If O&M is identified as a separate budget item, however, it will facilitate financial management of O&M activities in the region (that is, determining charges to be paid by the communities for parts, supplies, labor and overhead, the use of governmental subsidies for O&M activities or facilities, and so forth.)

YES _____ NO _____ UNSURE _____

If UNSURE, determine method of budgeting by water authority.

Recommendation: The project planning team should investigate the water authority's budget and account process to determine how funds for O&M activities will be obtained and managed. If these financial management procedures appear inadequate, specific requirements for handling O&M funds should be established and included in the project documents.

7.7 Records

Certain records need to be maintained for all water supply systems. Questions in this section will help determine which records are essential to operations and maintenance of this type of system, how they should be recorded, and by whom. Record-keeping requirements for spare parts inventory control and financial management have already been addressed in Question 4 of the Spare Parts and Supplies Section and Question 6 of the Finance Section, respectively.

1. Will the system caretakers be required to maintain records of operations and maintenance work performed and supplies used?

Explanation: Record-keeping will facilitate the systematic execution of O&M tasks for system caretakers. It also facilitates caretaker supervision and other management tasks (for example, the timely ordering of supplies, monitoring electricity or fuel use, notifying the regional office of the

need for CM, and so forth), performed by village councils or water committees. The records may also prove useful to regional O&M personnel in analyzing past system performance when carrying out corrective maintenance.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether this requirement has been included.

Recommendation: It is useful to include record-keeping requirements in the system O&M plan. Appropriately written checklists and printed (monthly) O&M forms should be provided to all caretakers for this purpose.

2. Will the village council or water committee be required to maintain financial records for system O&M?

Explanation: This requirement is essential. While water supply systems may continue to function if records are poorly maintained by the system caretaker, the probability of the misuse of O&M funds is significantly increased if no records of income and expenditures are maintained. This situation could easily lead to either the inability or unwillingness of the community to maintain the system.

The availability of financial records also facilitates assistance by governmental agencies in case of a dispute.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether this requirement has been included.

Recommendation: A simple accounting plan should be developed for use by village councils or water committees, if one does not yet exist. Copies of the plan and forms should be provided to either the committees or councils. One effective way to increase the likelihood that adequate records are being maintained is to include a provision for them in the agreement among the village, the government, and the implementing agency.

3. Will regional water authority personnel be required to maintain records of maintenance work performed?

Explanation: This requirement is essential, because the day-to-day operation and the administrative and financial management of the regional office of the water authority depends on it.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether this requirement has been included.

Recommendation: The water authority should be required to develop a record-keeping plan for use by regional maintenance personnel if one does not currently exist. Under the plan, each water supply system should have its own separate file with design and construction information and a history of CM completed and repairs made by regional water authority personnel.

4. Will the regional water authority office submit a regular report on the operating status of all systems in the region, CM performed and repairs completed to the central water authority office?

Explanation: The requirement for regular (for example, monthly) reports to be prepared by the regional office detailing monthly O&M activities and the operating status of water supply systems in the region is closely allied with questions 6 to 8 in the Institutional Capability Section. Maintenance personnel must be held accountable for their work, and should be required to report their activities. The O&M department in the central office must, in turn, recognize and respond to reports of O&M activities. It is counterproductive for any field personnel to submit reports that are ignored.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such reports are to be submitted.

Recommendation: The project implementing agency and the water authority should be required to develop a simple and easy-to-understand format for reporting and responding to O&M activities. Training for both central and regional office staff in effective reporting and record-keeping should be included in the project documents.

7.8 Human Resources and Training

Ultimately, the success or failure of a water supply system will depend on the people who have the responsibility for operating and maintaining it. The questions presented in this section help to identify the people at the system and at the project level who may require training during the project. It has been assumed that the cost of all training activities during the project will be included in the project budget, either as a donor or as a governmental contribution.

1. Will management training be provided to village water committee members?

Explanation: As noted in Question 4 in the Institutional Capability Section, the village councils or water committees are to assume responsibility for managing the water supply systems. The project planning team cannot assume, however, that the members of these councils or committees already have the skills needed to supervise system caretakers, to collect and manage an O&M fund, to purchase and store supplies, to maintain records, and so forth.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such training will be scheduled.

Recommendation: The project planning team should assess the training needs of village council or water committee members and incorporate appropriate training programs in the project design.

2. Does the project include training for system caretakers?

Explanation: Proper training is necessary if operations and maintenance tasks are to be carried out correctly by the system caretakers. Training for O&M also places greater emphasis on its importance.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether appropriate training will be provided.

Recommendation: Systematic, hands-on training during construction and during a refresher course (for example, six months later) should be planned and incorporated in the project design.

3. Have user education campaigns been planned before and during the initial months of system use?

Explanation: The mode of operation of a public standpipe is quite different from traditional village water supplies. Given that considerable effort is required to manually remove water from a well, water waste is automatically kept to a minimum. And while it is easy to open a tap, forgetting to close it costs money and or reduces available supplies. It cannot be assumed that all community members will understand and follow these operating principles unless a user education campaign is launched. Failure to do so may lead to water wastage, higher costs, and disputes and possibly to villages abandoning their systems.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such campaigns have been planned.

Recommendation: The project planning team should analyze the difference in operation of the present village water supplies in the project area and the new systems and include appropriate user education activities in the project design. The team should identify who will conduct the campaign at the village level (for example, water committee members, caretakers, and health workers) and whether it can be combined with health and sanitation education activities.

4. Has the water authority made provision for continued training for regional maintenance personnel?

Explanation: It is important to recognize two types of training needs here. First of all, as time passes and new equipment is introduced, existing water authority staff will need to familiarize themselves with that equipment. Second, it is important that new water authority employees are properly prepared to handle O&M responsibilities.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such provisions have been or will be made.

Recommendation: The project planning team should evaluate present water authority human resource development efforts and make recommendations regarding:

- The establishment of a continuing training program for present and new regional maintenance personnel within the larger framework of the water authority's HRD program
- The design and implementation of pilot training courses of this type during the project.

5. Are training materials available that suit the level of the trainees?

Explanation: Appropriate training materials (for example, O&M manuals, accounting workbooks, and so forth) using either local language or visual techniques, will be necessary not only for training purposes but also for field use by system caretakers and water authority O&M personnel.

YES _____ NO _____ UNSURE _____

If UNSURE, determine whether such materials are currently available or will be developed.

Recommendation: The project planning team should review training materials available in country for O&M procedures and support activities of water supply systems and prepare a scope of work for the revision or development of training materials during project implementation.

6. Will qualified trainers be available to conduct training sessions during the project?

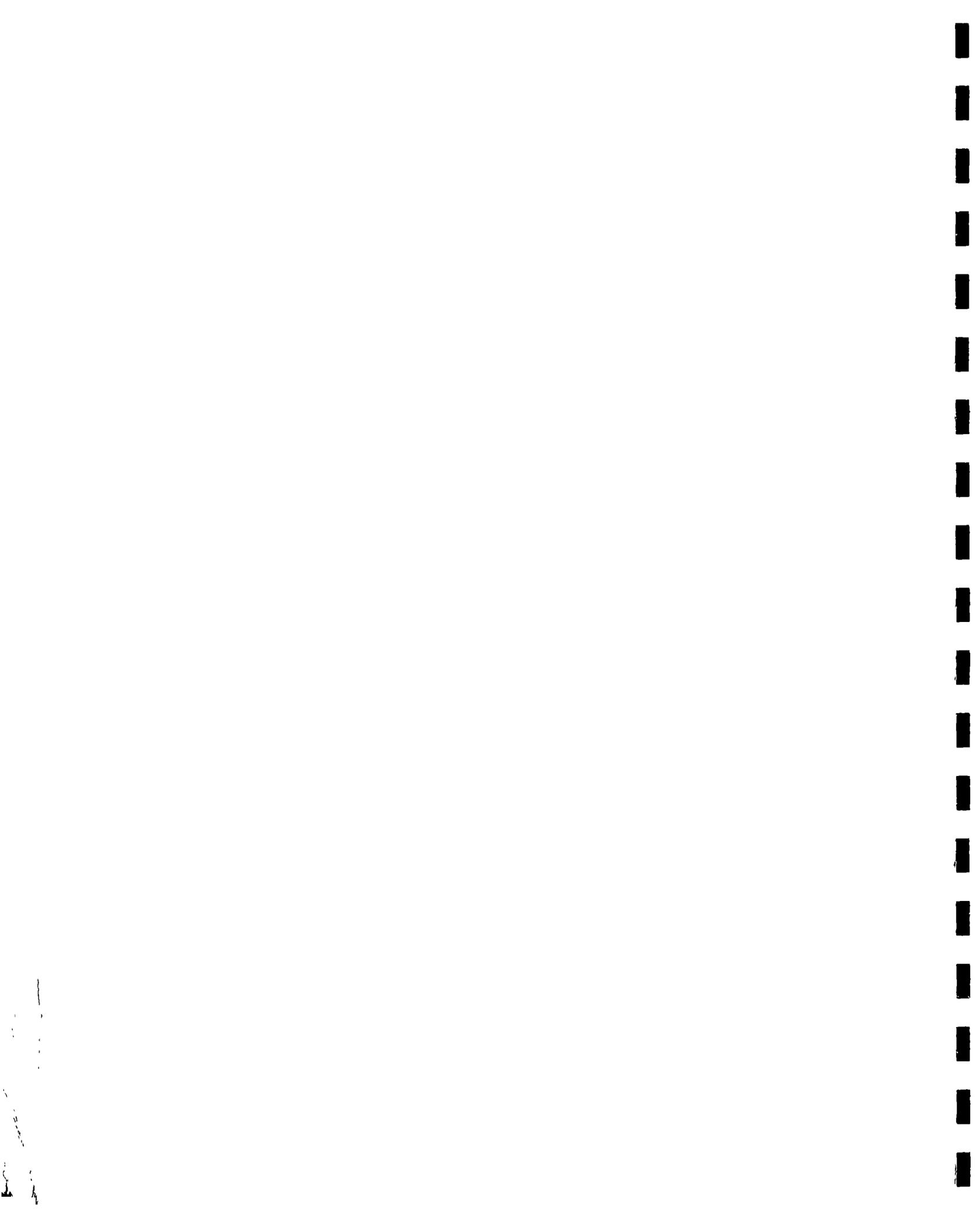
Explanation: Not all of the agencies involved in rural water supply, whether private or governmental, have a training capability; yet, a successful O&M program depends significantly on training for O&M technicians and managers in the communities as well as the agency responsible for water supply.

YES _____ NO _____ UNSURE _____

If UNSURE, determine who trainers will be and what their qualifications are.

Recommendation: The project planning team should prepare a trainer needs assessment. If there are currently no qualified trainers within the water authority, a training of trainers workshop should be included in the project. The newly trained trainers should be permanent water authority employees so that the water authority will be able to provide training not only during the project but also thereafter.





Chapter 8

O&M ASSESSMENT GUIDE FOR SYSTEMS REQUIRING TREATMENT WORKS

8.1 Introduction

This Operations and Maintenance Assessment Guide has been developed for use in planning water supply projects in which multiple systems are to be constructed involving surface water resources with pumping and treatment works. It is assumed that water is pumped from surface resources to treatment works, and then pumped to storage for distribution to users by way of a piping network. Obviously, the guidelines may also be used in planning O&M for a single system of this type.

It is assumed that the system(s) are owned by a water authority, be it a national, regional, or municipal organization. All operations and maintenance activities are the responsibility of this water authority. Thus, the population of the village, town, or city has a limited role.

The water authority may be organized in a number of ways. Several different scenarios can be envisioned. At one extreme, there is the case of an autonomous local water authority which controls its own finances, procures its own parts and supplies, and operates the system independently. On the other extreme, is the case of a system which is operated and maintained by a small local office of a national water authority, which provides services, such as billing, parts procurement or stock, and technical support for major repairs, either directly or by way of a regional support structure. This first setup is common in larger urban areas, and the second in smaller towns. This guide will primarily address the later case, because the fragmented institutional setting will often require more effective management to be successful. If the case at hand is a single autonomous agency, many of the same issues must be addressed but within a simplified institutional context.

Pumping and treatment works imply a greater degree of technical complexity. Thus "operations" will have a greater emphasis here, as compared with the systems covered in previous chapters. In addition, the increased complexity will mean a greater emphasis on preventive maintenance and proper maintenance organization. In addition, the use of surface water and treatment will require careful water quality monitoring to ensure the availability of safe water.

It is assumed that, prior to using this guide, the project planning team will have completed the following tasks:

- Definition of project objectives
- Definition of water quality and quantity standards
- Preliminary water system design and development of equipment technical specifications
- Definition of preventive maintenance schedules and criteria to determine when corrective maintenance is required

- Identification of methods for monitoring system performance.

Systems involving surface resources and treatment are often used for larger water demands in either big communities or towns. Cities often have this type of system. Thus, it may occur that some subprojects will involve upgrading and or expanding an existing water system. In these cases, the project planners will have to familiarize themselves with relevant past experiences as well as O&M practices already in use. It is assumed that the team has made such a review before using this guide.

The remainder of this guide is organized as follows:

- 8.2 Institutional Capability
- 8.3 System Operations and Maintenance
- 8.4 Spare Parts and Supplies
- 8.5 Logistics
- 8.6 Finance
- 8.7 Records
- 8.8 Human Resources and Training.

It is recommended that chapters 1 through 4 of this workbook be reviewed before one attempts to use this O&M assessment guide.

8.2 Institutional Capability

While the water authority has full O&M responsibility, the support of the local population is important. This relationship must be based on a clear understanding of services and responsibilities. Perhaps more crucial, in this case, is that the various local, regional, and national departments of the water authority will carry out their respective O&M responsibilities.

Local Population

1. Is the local population involved, in any way, in planning, construction, or O&M of the proposed water project?

Explanation: Popular involvement ensures that the project is addressing an important need, promotes and encourages public support for system operation, and facilitates maintenance. In an instance where the water authority has full O&M responsibility, public involvement is not as critical. Full public support, however, makes the authority's job easier.

YES _____ NO _____ UNSURE _____

If UNSURE, determine degree of involvement and consider recommendation.

Recommendation: The project design team may wish to propose hearings or meetings to obtain local input and engender local support.

2. Does the local population understand the level of service to be provided and the water rates to be charged?

Explanation: It is important for long-term customer satisfaction, and long-term rate compliance, that potential ratepayers understand the services to be provided and what they will have to pay for them.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: The project design team may wish to propose hearings or meetings to explain the plans, handle citizen expectations, and engender local support. Surveys of potential consumer attitudes may be advisable. A public relations strategy, involving information, nonformal education, and promotion may be warranted.

3. Will the population have any responsibility for notifying the water authority in case of problems, pipe breaks, and so forth?

Explanation: Local people are not expected to play a significant role in system O&M, except in notifying either the water authority or the local police, if they observe cases of leakage, wastage, or clandestine hook-ups.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: The project design team should consider planning public awareness campaigns to make it clear that water losses hurt the water authority and ultimately the local people. Moreover, the cooperation of the local police must be assured.

Central/Regional Water Authority

4. Is the same institution (water authority) involved in water system planning, construction, local O&M, and regional/central O&M support?

Explanation: Often, these different functions are split among different institutions. Lack of full communication and coordination may lead to major problems.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate institutional roles.

Recommendation: A full review of the roles of all institutions involved is important. Ensure that each institution understands its role. Ensure that adequate means exist for communication and coordination.

It is not uncommon for one institution to have overall national O&M responsibility, with local/regional and central functions. This situation will facilitate O&M greatly. If local O&M is separated from higher-level support, poor maintenance may be the result. In addition, if the same institution that is planning and building the systems is operating and

maintaining them, then proper consideration of O&M may be achieved from the early stages of system development.

5. Does the central/regional water authority have a history of effective response to local O&M problems?

Explanation: The water authority may not have the institutional capability to extend itself to new systems. It is useful, therefore, to review past and present effectiveness of O&M programs, especially support to similar type water systems. Weak points may be addressed and better programs implemented.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate effectiveness of existing O&M.

Recommendation: If the water authority is weak in this area, the problems must be identified. A survey of a small number of existing water supply systems will highlight the concern for O&M and gather valuable project planning input. Points of interest include:

- Roles of local, regional, and central O&M staff
- Degree of reliability of water service
- Effectiveness of maintenance and repair services.

6. Does the water authority have full control over the billing and collection operation?

Explanation: This function is probably the most important to clarify. Often a government will collect water rates and then divert revenues to other functions, thereby crippling the water O&M department.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate and consider recommendation.

Recommendation: It is essential that the water authority have control over its revenues, so that they can be used for system support. If the authority does not control water receipts, efforts should be made to earmark funds for O&M through legislation or enforceable regulation.

8.3 System Operations and Maintenance

The key to proper operations is ensuring that an effective method exists for determining that the machinery or system(s) is conforming to established operational standards. All tasks must be well-defined and well-understood by the operators, who must be sufficiently trained and have all of the resources to carry out their work efficiently. The key to effective equipment maintenance is proper organization, a clear definition of all maintenance tasks (their nature and timing), and access to all the necessary resources.

Operations

1. Have complete operational plans for the system(s) been developed?

Explanation: Operation of water systems, especially those involving treatment must be based on a clear operational plan. Without it, operations will be haphazard, and service will be poor.

YES _____ NO _____ UNSURE _____

If UNSURE, review any existing plans and consider recommendation.

Recommendation: If not already completed, the water authority should prepare detailed operational plans for the system(s), perhaps during early stages of the project. A complete plan should consider:

- Operating standards for water quality and quantity
- Operating standards for pumping and treatment equipment
- Monitoring of water service and equipment performance
- System for ordering maintenance work (repairs) when system or machines fail to meet standards.

The exact tasks of operators should be well-defined in the form of job descriptions and with the help of operator manuals.

2. Will there be a regular program to monitor water quality and quantity?

Explanation: A regular program of monitoring water quality and quantity at a variety of points throughout the system is essential for systems where treatment is needed.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that appropriate data will be collected, analyzed, and compiled. Monthly operational status reports showing water quality and delivery versus standards are recommended. Trend analysis over the long-term will also be useful for planning purposes.

3. Is there reliable electric power for pumping and treatment equipment?

Explanation: Pumps and treatment equipment will need constant electric power. If the local town power is unreliable, major operational problems will result.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate and consider recommendation.

Recommendations: If available power cannot be relied upon, recommend back-up power systems with their own dedicated fuel supply and dedicated parts and supplies.

4. Are back-up systems for pumping and treatment equipment planned in the design?

Explanation: Pumping and treatment plants are best designed with a certain amount of redundancy, that is, not just one pump at a crucial location but two, side by side. This approach means not only less wear and tear on each but also a longer total life. Further, if one pump breaks down the whole system does not have to be shut down until a repair is made. On the whole, operation is greatly improved by some redundancy, despite a higher initial cost.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that the system engineering includes some redundancy, and, if not, make provisions for it.

Maintenance Practice

5. Is the current program of repairs effective?

Explanation: A review of current practice will help in the planning process. Existing maintenance departments often do repairs only, sometimes effectively, and sometimes with long delays.

YES _____ NO _____ UNSURE _____

If UNSURE, examine repair programs, and consider recommendation.

Recommendation: If staff are able to manage only critical repairs with long delays, the problem areas need to be identified and corrected. An evaluation of current performance on corrective maintenance is a logical starting point. Review repair records, if any, and locate weak points. Down time is the key indicator. Examine potential problem areas such as tools, parts, supplies, logistics, staff skill level, notification system, and so forth.

6. Has a comprehensive preventive maintenance (PM) plan been developed?

Explanation: Many utilities in developing countries are unable to carry out preventive maintenance; yet, in the long run it can save money. Some PM programs are simply inadequate.

YES _____ NO _____ UNSURE _____

If UNSURE, examine any existing PM plans and consider recommendation.

Recommendation: Plan PM program. The steps involved include:

- Identifying tasks for each piece of equipment
- Describing each task (manuals, checklists, and so forth)
- Identifying resources needed for each task (finance, manpower, tools, supplies, and transport)

- Developing a detailed schedule for the program
- Conducting regular inspections of all system components.

Maintenance Organization

7. Are the maintenance tasks for the local and regional/central O&M staff appropriately and clearly defined?

Explanation: Maintenance plans should define the roles of the various crews and staff involved, but sometimes responsibilities are unclear. Further, it should be ensured that personnel are performing tasks appropriate to their level.

YES _____ NO _____ UNSURE _____

If UNSURE, examine situation and consider recommendation.

Recommendation: Review the current organizational structure, reviewing each type of staff member, and redefine their roles and responsibilities. Then ensure that their tasks are appropriate to their level. For example, local people should be performing regular maintenance and should probably leave complicated, less frequent repairs to mobile regional maintenance personnel.

8. Is the maintenance program organized along functional lines of maintenance workers and maintenance control personnel?

Explanation: A key principle of industrial maintenance management, which probably applies well here, states that maintenance work must be divided between people performing actual maintenance work and people planning, organizing, and controlling it.

YES _____ NO _____ UNSURE _____

If UNSURE, examine situation and consider recommendation.

Recommendation: Two types of maintenance staff should be available. First, there should be maintenance workers, probably organized in crews with supervisors, probably both at the local and central/regional level. These people should do the work carefully and effectively and fill out brief reporting cards at the end of a job. Second, there should be a planning or control group office, probably at the central and or regional level, guiding the crews, especially regional crews, to make most effective use of their time. They should ensure that the crews are doing the work properly and have the necessary resources. A control office should:

- Inspect equipment and help determine needed maintenance.
- Assign priority, plan and schedule preventive and corrective maintenance.
- Write maintenance work orders for supervisors.
- Handle major logistical support for the crews.
- Analyze work performance.

Try to establish this type of organization. Ensure that the paperwork, such as work orders, schedule, and maintenance work reports, will be completed in an efficient manner.

8.4 Spare Parts and Supplies

Operations and maintenance staff need quick access to the appropriate tools, replacement parts, and consumable supplies (that is, chemicals, lubricants, and so forth) to complete their work efficiently.

1. **Is the technology selected for use in the system(s) compatible with local suppliers of parts and supplies?**

Explanation: The availability of spare parts and supplies is crucial to any O&M program, especially those involving treatment. Without the proper chemicals, water quality cannot be assured.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that the parts and supplies can be made available, either from domestic production or importation. All issues relating to taxes, import duties, and hard currency issues, over the long-term must be addressed, or the system will encounter major problems.

2. **Has an estimate been made of the type and volume of parts and supplies needed for the system(s)?**

Explanation: Precise lists of the specifications and quantities of the tools, parts, and supplies needed for the system(s) must be developed.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that detailed requirements regarding tools, parts, and supplies are defined. Such a determination may be made more precisely once the project begins and the equipment is delivered. In addition, experience with the machines may modify the commodity requirements.

3. **Will a stock of appropriate parts and supplies be maintained on local/regional/ central levels?**

Explanation: Supplies, especially chemicals and fuel, must be maintained on a local level. Frequently, used parts need to be maintained on a local level, while less commonly used ones are maintained on a regional or higher level.

YES _____ NO _____ UNSURE _____

If UNSURE, determine availability.

Recommendation: This is an important function to plan. Project designers must evaluate which parts and supplies must be stocked where, and in what volumes, to ensure that ready access to these items is possible. Avoid costly overstocking.

4. Does the existing stock, inventory, or ordering system work well?

Explanation: The water authority probably has a storeroom and some sort of inventory, control, and procurement procedures. A common system uses stock cards, which trigger ordering, once stock reaches a minimum inventory level. The effectiveness of the current arrangements must be determined.

YES _____ NO _____ UNSURE _____

If UNSURE, evaluate the service and consider recommendation.

Recommendation: Evaluate the service, as much as practical. Examine inventory levels and the flow of parts in and out. Flow of parts and supplies should be smooth. Another indicator may be the residence time of parts and supplies in the storeroom. If the time is short, the item is probably not being ordered in sufficient quantities or frequently enough. If it is long the stock may be excessive. A complete reformulation of the procedures may be needed.

5. Is the water authority's procurement process capable of providing parts and supplies in a timely manner?

Explanation: In some instances, procurement must be carried out by another group on a central level, or through another agency. Even small orders may be subject to a burdensome approval or procurement process.

Procurement is somewhat an institutional issue and somewhat a parts and supplies issue. It has been included here because the institutional setting will be different in every country, but procurement is always crucial to the availability of parts, supplies, and so forth.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Recommend that procedures be streamlined and, preferably handled directly, by the water authority itself, on a local level. Decentralization of purchasing will mean smaller orders and perhaps slightly higher prices, but will often mean faster procurement and less incidence of theft.

6. Are local spare parts of sufficient technical quality?

Explanation: Locally available parts will be preferable as long as quality is good.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Plan to evaluate local spare parts during the project. Ensure that the experience of operators or maintenance personnel is taken into account in selecting locally available parts. If local parts are poor, import reliable parts, or investigate ways to improve quality.

7. Has an effort been made to standardize the equipment used to simplify tool, parts, and supplies requirements?

Explanation: In many countries, given the variety of donors involved, there tends to be a variety of imported treatment equipment, pumps, and so forth, each with its own requirements for tools, parts, and supplies. Having a broad range of equipment also greatly complicates the operations and maintenance task as well as the training needs.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Efforts toward standardization will benefit both the project and the country as a whole. Ensure that proposed equipment is, at a minimum, compatible with existing machines. Efforts toward complete standardization are worthwhile, but must be made carefully and over a period of time, to ensure that the best selections have been made. Ideally, a standard of locally produced equipment will be best, but good quality must be assured.

8.5 Logistics

Reliable communications and transport for O&M workers, on all levels, must be assured as well as the necessary workshops and facilities.

1. Is there sufficient reliable transport for local O&M staff?

Explanation: Maintenance crews and system or equipment inspectors will require sufficient numbers of reliable vehicles.

YES _____ NO _____ UNSURE _____

If UNSURE, review transport plans and consider recommendation.

Recommendation: Ensure that sufficient vehicles for the O&M functions are available, or will be purchased in the project. A motor pool or vehicle use control system will be needed in larger systems. Ensure that sufficient fuel is allocated to this function and that it is readily available.

2. Is there sufficient reliable transport for regional O&M support staff?

Explanation: In many cases, there will be regional or national maintenance crews, which perform special O&M tasks in support of local, on-site personnel. These workers must have the transport to the different locations they serve.

YES _____ NO _____ UNSURE _____

If UNSURE, review transport plans and consider recommendation.

Recommendation: Ensure that sufficient vehicles for the regional personnel are available, or will be purchased in the project. A motor pool or vehicle use control system is essential. Ensure that sufficient fuel is allocated to this sector.

3. Is there a suitable workshop for repairs of valves, pumps, meters, and so forth?

Explanation: O&M personnel will need a workshop to repair either small equipment or components of larger equipment. A facility for meter calibration will be important, if meters are to be used. Such a workshop may be on a city, regional, or national level, depending on the size of the system(s) involved. Probably large or special equipment will be sent out to specialty shops for maintenance.

YES _____ NO _____ UNSURE _____

If UNSURE, consider review workshop facilities.

Recommendation: Ensure that workshop facilities exist or will be built and that they can handle the workload. Also ensure that the workshop(s) have the necessary equipment, tools and supplies, and sufficient trained personnel.

4. Is there a capability for vehicle maintenance and repair?

Explanation: Vehicles used on either a local or regional level will require maintenance and repairs. Depending on the scale and number of systems, a vehicle workshop may exist only on a regional level. Thus, repair of local vehicles may become a problem. In addition, such a workshop may not have the parts, supplies, or personnel to keep vehicles in proper running order.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate vehicle O&M plans.

Recommendation: Ensure that local and regional vehicles will receive the attention they need. If local vehicles cannot be easily serviced in a regional water authority workshop, then arrangements with local private repair facilities should be made. Ensure that a regional workshop has the tools, parts, supplies, and personnel to make the repairs efficiently.

5. Are there practical plans for notifying O&M personnel, at all levels, in the event of a problem?

Explanation: Sometimes communication is poor, for example, in such instances when even local O&M personnel do not hear of a distant pipe break or the like until well after it occurs. Similarly, it can take a long time before a message reaches a regional O&M crew in the event of a

more major problem. These communication problems can cause long repair delays and poor water service.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Evaluate the notification or communication systems. Mail may be unreliable and telephones nonexistent in rural areas. Radio links may be more effective.

8.6 Finance

O&M is often poorly done as a result of an overtaxed staff and insufficient tools, supplies, parts, transport, and so forth. Operation becomes a patchwork procedure and maintenance a question of crisis management. The problem is often that people know how things could be done correctly, but they do not have the financial resources for training sufficient numbers of staff or for assuring the availability of other material resources. Proper financial management and planning can go a long way to make these resources available, and is perhaps the single most critical issue.

A financial plan addressing a full cost-recovery system is essential. To achieve this, costs must be estimated and rates established to ensure sufficient revenue. Following this, finances must be managed effectively to ensure sustained operation.

Expenditures

1. Have detailed estimates of all O&M costs been prepared for the system(s)?

Explanation: Detailed cost estimates are essential to proper financial planning.

YES _____ NO _____ UNSURE _____

If UNSURE, carefully review cost estimates, considering the recommendations set forth below.

Recommendation: Prepare detailed cost estimates. Start with any existing cost records. Compile any current cost information for similar systems and compute unit cost figures (\$/m³ and \$/connection or \$/capita). If possible, tabulate over a number of years, correct for inflation, and look for trends.

After reviewing any useful cost records, new cost estimates must be prepared, including:

- Salaries and wages
- Utilities (power, water, and telephone)
- Tools, supplies, and parts for O&M
- Vehicles, fuel, repairs, and insurance
- Training

- Rent and or building maintenance
- Office expenses (paper)
- Replacement of (minor) equipment
- Contract services.

account for growth in demand, inflation, and commodity price increases.

2. Has an expenditure summary for all costs been prepared?

Explanation: Estimates of total expenditures are needed to complete the financial picture.

YES _____ NO _____ UNSURE _____

If UNSURE, carefully review cost estimates, considering recommendations below.

Recommendation: Compile complete expenditure estimates, including:

- O&M costs (above)
- Debt service
- Replacement or contingency fund
- Service expansion fund.

Revenues

3. Have detailed estimates of revenue been prepared for the system(s)?

Explanation: Detailed revenue estimates are essential for proper financial planning.

YES _____ NO _____ UNSURE _____

If UNSURE, carefully review estimates, considering the recommendations set forth below.

Recommendation: Prepare revenue projections. A good place to start is any current revenue information. Compile data and compute unit figures (\$/m³ and \$/connection or \$/capita). Look at collection efficiency (amount collected/amount billed), as well as billing efficiency (amount billed/amount for total water production). Tabulate over a number of years, correct for inflation, and look for trends. Next, prepare new estimates of revenue for the system(s). Obviously, water tariff revenue will be a major item and will be based on the number of users and the planned rate structure. Ensure that such estimates are realistic. Tabulate any other sources of revenue.

4. Will water revenue cover the estimated costs?

Explanation: This issue is perhaps the most important one in this document. Water revenue must cover all O&M costs, or else well-defined subsidies will be needed.

YES _____ NO _____ UNSURE _____

If UNSURE, carefully review estimates, considering recommendations below.

Recommendation: Carefully compare water sale revenue with O&M costs. As an example, in the USA, public water utilities' O&M costs have been close to 55 percent to 65 percent of water sale revenue, from 1945 to 1970. The balance of revenue has been used for debt service, expansion, and so forth. If the case at hand is far different, some financial restructuring may be needed.

If water revenue does not cover O&M costs, then a subsidy will have to fill the balance. Compute net subsidy, if any. Choices will have to be made depending on national policy. At a minimum, revenues, based on either existing or revised rates, must cover a major portion of O&M, when the government or another agency is willing to underwrite the balance. This approach may be necessary where local family income is low or city or national government policy fixes water rates at a low level. In this instance, appropriate subsidies must be guaranteed. A more conservative policy would indicate that revenues must cover all O&M, but not debt service, expansion, and so forth. A financially healthy utility will cover some or all of its debt service, replacement fund, and so forth, in addition to O&M.

5. Are the existing or any new water rates affordable to the local population?

Explanation: Users must be able to afford the rates and be willing to pay.

YES _____ NO _____ UNSURE _____

If UNSURE, carefully review situation, following the recommendations set forth below.

Recommendation: The project design team should compare either existing or proposed water rates to local income and to rates or prices of other utilities, such as cooking fuel or electricity. Local surveys may be needed to obtain an accurate picture. It is generally the case that the poorest residents cannot afford to pay. Some form of cross subsidy can be put in the rates, whereby lower income users would pay lower unit costs and higher income users pay more. This arrangement may be difficult to implement based solely on income; therefore, consumption may be used. Perhaps users who consume less than a certain minimum amount will have to pay only a certain flat, low fee.

6. Have any arrangements been made whereby local neighborhood organizations can collect water fees from either unmetered users or public standposts?

Explanation: Some low-income or urban fringe areas may have only standpipe connections or unmetered water users. If possible, these people should pay something, even if just a token amount, to increase revenue and discourage waste.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: The project design team should recommend that the water authority investigate and implement such programs with local neighborhood organizations.

Financial Management

7. Will there be regular (quarterly) budget reviews covering incurred expenses and revenue?

Explanation: Regular budget reviews are essential to good financial management. Comparisons of actual and budgeted expenses and revenue can be made. Depending on the size and number of systems involved, this budgeting may be on a local or regional level (using aggregate figures).

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that project management plans regular budget reviews. Be certain that they can interpret the results and implement proper corrective action, if necessary, such as cutting costs or increasing preventive maintenance inspections. These financial reviews will become an essential budgeting and planning tool.

8. Are there any financial incentives in place for effective O&M and financial management?

Explanation: Financial incentives may help encourage effective operations and maintenance.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Consider incentives as a boost to O&M. Many possibilities exist here, such as additional financial compensation to operators who keep their equipment above target operative criteria, to service expansion loans available to system(s) or regions where financial performance is good.

8.7 Records

Detailed data on all aspects of system status and operation, as well as on maintenance activity, must be collected, analyzed, and summarized in reports to ensure proper O&M and effective future planning.

1. Will data be collected on a local level on system operations and maintenance on a regular basis?

Explanation: Records are essential to proper operation and effective maintenance.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that data will be collected and records maintained on:

- Water quality at various points in the system
- Water quantity delivered at various points in the system
- Water meter readings
- Water fees collected
- Pump or treatment machinery performance
- O&M work performed (local and regional crews)
 - inspections
 - preventive maintenance
 - repairs
 - time, personnel, supplies, and tools used for each task
- Stock of parts and supplies

2. Will brief summary reports be prepared on a monthly or quarterly basis?

Explanation: Reports allow data summaries to be shared at all institutional levels, and among different departments, thereby allowing efficient and effective management and planning.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: A variety of reports should be prepared on a local or mostly regional level. Ensure that reports will be prepared on a regular basis, on:

- Operational performance
- Machinery performance
- Preventive maintenance performed
- Corrective maintenance (repair status)
- Tools, parts, and supplies consumed
- Payment compliance (delinquent hook-ups)
- Revenue/expense balance sheet.

3. Will equipment history logs be maintained continuously?

Explanation: For proper O&M, records of equipment operational history and maintenance history are useful.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that a card-based equipment history log will be developed for major machinery. A file for each piece will include manuals, performance reports, maintenance logs, and preventive maintenance requirements. Local and regional crews will need access.

4. Will system layout diagrams be revised continuously as changes are made?

Explanation: Modifications to pipe networks or other system components must be recorded so that O&M will have an accurate knowledge base.

YES _____ NO _____ UNSURE _____

If UNSURE, consider recommendation.

Recommendation: Ensure that operations staff will maintain such diagrams. This procedure is especially important if the construction agency and the O&M agency are not one and the same. Local and regional crews will need access.

8.8 Human Resources and Training

The water authority must have sufficiently trained staff for the O&M tasks at hand and should conduct a variety of continuing training programs.

1. Under the project, will a staffing and training plan be developed, including job descriptions, number of staff needed, and overall training needs?

Explanation: Sufficient, appropriately trained staff must be available to operate and maintain the system(s). A full staffing or training plan, if followed, will help ensure this.

YES _____ NO _____ UNSURE _____

Recommendation: A staff or training plan should be developed in the early project stages and be reviewed during the later stages of the project. In carrying out the plan, job tasks must be defined (job descriptions), job qualifications outlined, numbers of necessary staff calculated, and necessary training programs described. Ensure that regular, continuing training programs, if not already under way, will be established for:

- Maintenance crews (local and regional)
- Equipment operators
- O&M control
- O&M management.

In addition, ensure that there is frequent contact between the O&M personnel and trainers so that training is responsive to the staff needs.

2. Are qualified trainers available in country?

Explanation: The water authority may or may not have the appropriate training capability, especially if new technologies are used. A local technical school or college might have the expertise needed. The training capability must be available.

YES _____ NO _____ UNSURE _____

If UNSURE, investigate local training resources.

Recommendation: The project team should assess the training skills needed and determine whether these are available locally, either within the water authority, or at some other training institution. If not locally available, arrangements for bringing in skilled personnel to train trainers, or sending personnel elsewhere for training, must be planned for. If the water authority does not, or will not, have its own training department, a long-term relationship with another institution must be established for continued training.

3. Will training materials and manuals be prepared in the local language to suit the level of the O&M staff?

Explanation: Training materials often are unsuited to the existing O&M staff and new trainees and thus are of little use. Manuals often come with imported equipment, but once the foreign experts leave and the equipment requires either adjustments or repairs, no one is able either to read or to understand the manuals.

YES _____ NO _____ UNSURE _____

If UNSURE, determine the nature of any manuals.

Recommendation: Ensure that the project includes a component to write suitable training materials and in the local language, with numerous illustrations. The use of such comprehensive manuals may be linked to specialized project training courses.

4. If new technologies or procedures are to be introduced, will specialized training programs be established?

Explanation: New, especially imported, equipment may necessitate specialized training short courses for operators or maintenance personnel, even if they have years of experience with other systems. New monitoring or quality-control procedures will also call for focused training sessions.

YES _____ NO _____ UNSURE _____

If UNSURE, determine what training is planned.

Recommendation: Ensure that such courses will be offered. One practical approach will be include O&M staff in the final construction stages, so that all component details are clear. This inclusion is especially important when the constructing agency and the O&M agency are not the same.

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