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REGIONAL CENTRE FOR THE PROMOTION OF
ENVIRONMENTAL PLANNING AND APPLIED STUDIES (PEPAS)

REPORT

REGIONAL WORKSHOP ON OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS

Kuala Lumpur, Malaysia

6 - 10 May 1991

Kuala Lumpur, Malaysia

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REPORT
REGIONAL WORKSHOP ON OPERATION AND MAINTENANCE OF
WATER SUPPLY AND SANITATION SYSTEMS

Convened by the

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for the Promotion of Environmental Planning
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July 1991

NOTE

The views expressed in this report are those of the participants in the workshop and do not necessarily reflect the policies of the World Health Organization.

This report has been prepared by the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) for governments of Member States in the Region and for the participants in the Regional Workshop on Operation and Maintenance of Water Supply and Sanitation Systems held in Kuala Lumpur, Malaysia, from 6 to 10 May 1991.

CONTENTS

	<u>page</u>
SUMMARY.....	1
1. INTRODUCTION	3
1.1 Objectives.....	3
1.2 Organization	3
1.3 Opening ceremony.....	3
2. PROCEEDINGS	4
2.1 Summary of country reports.....	4
2.2 Summary of discussions/activities.....	4
3. CONCLUSIONS.....	10
<u>ANNEXES:</u>	
ANNEX 1 - LIST OF PARTICIPANTS, OBSERVERS AND SECRETARIAT	13
ANNEX 2 - WORKSHOP AGENDA	17
ANNEX 3 - LIST OF DOCUMENTS DISTRIBUTED DURING THE WORKSHOP.....	21
ANNEX 4 - INAUGURAL ADDRESS	23
ANNEX 5 - SUMMARIES OF THE COUNTRY REPORTS	25
ANNEX 6 - SUMMARY OF EVALUATIONS	39

Key words

Water supply / Sanitation / Operation / Maintenance

SUMMARY

Objectives of the workshop:

The objectives of the Regional Workshop on Operation and Maintenance of Water Supply and Sanitation Systems were:

- (1) to discuss operation and maintenance problems and develop strategies for more effective implementation of operation and maintenance programmes at both national and local levels;
- (2) to identify practical ways for external support agencies to support governments in their efforts to improve operation and maintenance services;
- (3) to discuss solutions to specific operation and maintenance problems, including unaccounted for water, leak detection methodologies, metering, mapping and preventive maintenance.

Summary of proceedings and conclusions:

The workshop was attended by 18 participants and four observers from the Western Pacific Region. The proceedings comprised presentations of country reports by participants, presentations of eleven technical papers and thirteen group and plenary discussions. A field trip to a handpump research project at the University of Malaya and a sewage treatment plant in Kuala Lumpur was undertaken on the third afternoon of the workshop. An evaluation by the participants showed that the above objectives had been successfully achieved.

Various conclusions were made as a result of the presentations and group discussions. Operation and maintenance was regarded as one of the greatest constraints for sector development and it should be given priority by both national governments and international organizations. Training activities, cost recovery systems and political encouragement were identified as aspects requiring most emphasis. Follow-up activities prepared by participants included workshops to provide additional depth of training in all aspects of operation and maintenance in their respective countries. Most participants considered that these workshops would require WHO/PEPAS support.

1. INTRODUCTION

1.1 Objectives

The objectives of the Regional Workshop on Operation and Maintenance of Water Supply and Sanitation Systems were:

- (1) to discuss operation and maintenance problems and develop strategies for more effective implementation of operation and maintenance programmes at both national and local levels;
- (2) to identify practical ways for external support agencies to support governments in their efforts to improve operation and maintenance services;
- (3) to discuss solutions to specific operation and maintenance problems, including unaccounted-for water, leak detection methodologies, metering, mapping and preventive maintenance.

1.2 Organization

The workshop was held at the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) on the campus of the University of Agriculture, Serdang, Malaysia from 6 to 10 May 1991.

The workshop was attended by 18 participants and four observers from 16 countries in the Western Pacific Region. A list of the participants, observers and secretariat members is presented in Annex 1. The programme comprised eleven technical papers, country reports, three group discussions, plenary discussions and a field trip. The consultant to the meeting, Mr A. Anderson, presented four papers; Mr J. Hueb, Sanitary Engineer, WHO Headquarters, contributed five papers; and Mr B. Fisher, Sanitary Engineer of PEPAS presented two papers. Mr Fisher chaired the meeting. Time was taken for discussion subsequent to each presentation.

The workshop agenda and list of documents distributed including working papers and country reports are given in Annexes 2 and 3 respectively.

1.3 Opening ceremony

Dr P. Guo, Director of PEPAS and Acting WHO Representative for Brunei Darussalam, Malaysia and Singapore made a few introductory remarks and delivered a message on behalf of Dr S.T. Han, Regional Director for the WHO Western Pacific Region. The message outlined some of the reasons for problems in the operation and maintenance of water supply and sanitation systems in the Region and expressed the hope that the workshop would lead to the establishment of improved policies and procedures in the Region. A copy of the address is given in Annex 4.

Professor Dr Syed Jalaludin Syed Salim, Vice-Chancellor of the University of Agriculture, Malaysia, then delivered a welcome address and wished all the participants a pleasant and worthwhile stay in Malaysia.

2. PROCEEDINGS

2.1 Summary of country reports

Each participant presented a report on operation and maintenance aspects of water supply and sanitation systems in his country. These reports showed a great diversity in the status of development of operation and maintenance activities in the Region. Nevertheless, the reports provided a useful source of working material for both the group and plenary discussions.

The presentation made by the Singapore participant showed that this country has a highly sophisticated operation and maintenance management system and can play an important role in the development and training of staff from elsewhere in the Region. Several of the participating countries reported serious problems particularly in management, funding and trained manpower aspects.

Most of the participants reported that unaccounted-for water in their water supply systems reached unacceptable levels of up to 50%.

Summaries of the individual country reports are given in Annex 5.

2.2 Summary of discussions/activities

2.2.1 Technical presentations

(1) Overview of operation and maintenance in community water supply and sanitation in the Western Pacific Region

Mr Fisher commenced the technical presentations by giving an overview of the status of operation and maintenance in the Region. Although specific data on various aspects of operation and maintenance are lacking in the Region, the rating of constraints by the countries themselves in the Decade sector digests shows that in 1988, inadequate cost recovery framework was rated the highest constraint and poor operation and maintenance rated a close second, together with shortage of manpower. Various reasons for poor operation and maintenance in countries of the Region were discussed under the headings of lack of funds, inadequate cost recovery, design deficiencies, lack of community involvement and lack of good management. Examples of each, as observed in the Region, were also described.

(2) Strategies for implementing operation and maintenance programmes

Mr Hueb's first presentation dealt with strategies for implementing operation and maintenance programmes. In his presentation, Mr Hueb emphasized the importance of operation and maintenance for sector development. The approach presented considers the development of operation and maintenance and the optimization of water supply and sanitation facilities as an important stage of an institutional development process.

It was demonstrated that the present situation of the water supply and sanitation sector is characterized by lack of adequate criteria for the application of suitable technology, institutional deficiencies, lack of trained personnel at both managerial and operative levels, and insufficient financial resources for both construction of new facilities and operation and maintenance. In urban areas where

coverage has experienced significant progress since the start of the Decade, the inhabitants of urban fringes still lack public facilities, and therefore are highly exposed to health risks. Unaccounted-for water, representing more than 50% of the produced water, have been reported in a number of large cities of developing countries. In rural areas of many developing countries, it is estimated that about 40-60% of the facilities are not operational or are not working properly.

The strategies proposed by Mr Hueb for the implementation of operation and maintenance programmes deal with the mobilization of resources at both the international and national levels, the development of training materials, and the formulation and implementation of national plans under the leadership of national agencies and with the support of international organizations.

(3) Management of operations and maintenance

Mr Anderson's paper covered general management principles giving a unified concept of managerial functions fitting together the generally accepted activities of management in a standardized mode. In allowing for the identification of activities such as management of change, problem analysis and management of differences, it brought together with sequential relationships and functions, the distinction between leadership, administration and strategic planning functions. The key aspects of operation and maintenance were further extended on a stratified basis encompassing senior, middle and operational management. Institutional variables, formulation of strategies, strategic programming, and strategic and operational budgets were put in place giving an overall coverage of operational and maintenance management, in the area of sewage and water supply operations.

(4) Priority projects directed towards the optimization of water supply and sanitation systems

In his second presentation, Mr Hueb introduced a paper on "Priority Projects Directed Towards the Optimization of Water Supply and Sanitation Systems". In this presentation, it was emphasized that the implementation of a process aimed at the optimization of water supply and sanitation systems implies the formulation and implementation of priority programmes and projects. Programmes and projects were described, which meet most of the requirements of water and sanitation agencies in developing countries. It was mentioned that the scope, objectives and content of each programme and project presented should be adjusted to the characteristics of the environment in which the institution operates and the types of service it delivers to the community. Consequently, those described are offered as typical examples, which must be adapted to the conditions of each institution.

(5) Sewerage operation, maintenance and control

Mr Anderson explored the operational and maintenance procedure of an urban wastewater treatment plant in lineal fashion, using each stage as a management base for operations and maintenance in an understanding of quality and chemical control, along with the functions of aerobic and anaerobic decompositions. Salvage operations of product material were examined, in the reuse of gases, grits, sludge and outflow effluent. A general discussion of the transmission and catchment systems was given, along with the management of nightsoil and septic tank sludge. Mr Anderson's paper was based on lower costs, increased service life, improved quality control and general operation and maintenance principles for the operational management of such plants. The session was complemented by a visit to an operational plant in Kuala Lumpur on the following day.

(6) Implementation of an operation and maintenance programme:
Case-study.

The fourth day's programme began with the presentation of Mr Hueb of a case-study on the implementation of an operation and maintenance programme in a large city of a developing country. In this presentation, it was demonstrated that great benefit to the institution and to the community of users can be derived from the implementation of programmes of this nature.

The first part of the presentation concentrated on major constraints at the beginning of the project. One of the major drawbacks was a high level of unaccounted-for water (37%) and the inability of the institution to extend coverage to fringe areas. Mr Hueb described the techniques employed to determine the components of the unaccounted-for water. The causes of these deficiencies were outlined.

In the second part of the presentation, the plan of action directed towards the optimization of the system, was discussed. This plan of action addressed managerial and organizational aspects as well as in-depth changes in operation, maintenance and commercial procedures.

Finally, in the third part of his presentation, Mr Hueb outlined the benefits and improvements achieved. From the beginning of the case-study programme's presentation in 1977 to the end of its first phase in 1982, the unaccounted-for water was reduced from 37% to 26%. The number of house connections increased from 1.023 million to 1.423 million. The water produced increased from 22.3 m³/sec in 1977 to 25.4 m³/sec in 1980 and was subsequently gradually reduced until it reached 25.1 m³/sec in 1982. Thus, with a relatively small increase in the production of water, it was possible to extend water coverage to an additional 2.0 million inhabitants living in fringe areas.

(7) Preventive maintenance water supply systems

This paper outlined, on a technical basis, the preventive maintenance of water supply systems, covering the following maintenance methodology: planning, designing, inspection/detection, monitoring and replacement/repair. Aspects of corrosion control were used as a base for the paper with an examination of the galvanic series listings. Physical characteristics of water in regard to flow velocity and temperature and their variable effects were introduced prior to examination of chemical characteristics. Biological characteristics of both aerobic and anaerobic bacteria in the formation of tubercle byproducts were discussed. Dissimilar materials along with anodic and cathodic aspects, in relation to chemical reaction variables, with inhibitive and supplemental controls, led to an examination of valve components and their maintenance. Problem solving techniques in preventive maintenance were outlined by Mr Anderson in the correlation of customer complaints, complaint maps, data monitoring, inspection/detection, system sampling, physical examinations and the implementation of control measures. Allied to this methodology was the routine maintenance of pumps and engines.

(8) Network Survey

In his third presentation, Mr Hueb covered "Network Survey". He emphasized the importance of network survey techniques to obtain, process, analyse and disseminate operational data concerning water flows, pressures and levels. By applying these techniques, it is possible to conduct diagnosis studies on the water production and distribution systems under real or simulated operating conditions of the systems. These studies lead to the identifying of constraints in the water supply

systems and to the definition of actions to overcome these constraints. The application of these techniques allows the undertaking of performance tasks in pumping stations, loss-of-head tests, hydrant tests, checking of accuracy of master meters and of macrometering equipment, studies on distribution networks, studies on transmission systems, sectorization, localization of buried pipes and special studies as required in emergency or programmed situations.

The techniques for conducting these tests were briefly presented with the support of slides showing the types of equipment used for this activity and their configuration in field application. Mr Hueb mentioned that a training package on network survey is under preparation in WHO Headquarters and that these materials will be available for use in developing countries by the end of 1991.

(9) Water leakage control

Mr Anderson's paper outlined in a technical manner the problems of reticulation survey, analysis and leakage control on the basis that conservation and reduced costs are complementary. The activities of flow testing in several aspects were discussed along with flow metering. Optimum survey to detect underground leakage by correlator, flow meters, and hydrophonic means was illustrated and discussed. An analysis of a water leak survey at city level (Waitakere City - New Zealand) was examined and the cost benefit analysis shown and discussed. The paper was enhanced by a video showing the work of leak detection teams and subsequent repairs done by the teams.

(10) Development of management information systems for operation and maintenance

In his fourth presentation, Mr Hueb covered "Development of Management Information Systems for Operation and Maintenance". He discussed the interrelationship between managerial activities (planning, organization, selection and development of staff, coordination, direction and control) and the functions of the organization (planning, operation, finance, administration, commercial) and the use of information in the decision process. Major principles, guiding the development of information systems were discussed and a list of managerial indicators was presented.

(11) Demand management

The last day of the workshop commenced with a short paper from Mr Fisher outlining various methods of demand management in water supply undertakings. Demand management was defined as control of accounted-for water or control of extravagant use of water that has been supplied to the consumers. Various methodologies were described including metering, in-house water saving devices, use control by-laws, system design, publicity, and education and promotion of in-house leak repairs.

2.2.2 Group discussions

(1) Approaches and concepts for developing countries

The group discussions recognized that the following factors contributed towards constraints in developing countries in regard to operation and maintenance. With the exception of Singapore, the constraints were seen as, funding limitations, inadequate cost recovery framework, logistic support and lack of operation and maintenance planning. The lines of action should cover plans and implementation of adequate funding for operation and maintenance, perhaps as a proportion of GNP, if applicable. Priorities must be set in recovery of unaccounted-for water, to

balance the cost recovery programme. Cost recovery should be approached by full metering of water and a corresponding load recovery by rating for wastewater. Flat tariff rates without metering were seen as a negative approach to the operation and maintenance programmes.

The implementation of strategic planning was seen as paramount in operation and maintenance programmes. Water supply planning should have water conservation, leakage control, reduction of unaccounted-for water, self-financing and efficient management as the main aims. Wastewater treatment should have system coverage, monitoring projects and operational control as its aims.

(2) Organization of operation and maintenance programmes

The group discussions on various aspects of operation and maintenance, which were directed towards the organization of operation maintenance programmes at the country level, were fully addressed in three separate sessions. The following strategies were generally agreed upon. Political decisions must be taken which enable and enforce the adoption of operation and maintenance policies at national level. A national agency needs to be defined as the focal point for activities concerning the promotion and coordination of operation and maintenance policies and programmes for water supply and wastewater treatment systems at that level. The motivation and willingness of managers to agree on the importance of operation and maintenance are considered essential, before the management groups are enhanced and supported in the areas of operational and strategic capabilities. The sector and institutional authorities should support these activities by arranging necessary priorities.

Legislation for cost recovery for public utilities, along with enforceable penalties, should be put into place together with review procedures for tariff rates which would be monitored according to usage and ability to pay.

Spare parts availability was seen as a high priority in the organization of operation and maintenance, and consideration for commencing local manufacture of components is of paramount importance in lessening costs, and maintaining specification and standardization. The proper stocking and inventory control of spare parts are an integral part of the process which should be linked to forward planning and not management by exception.

Transport and communication were examined as a decentralized issue in most countries in setting up strategically located maintenance groups.

"Awareness" was a key word in community participation, along with the "open day" aspects of plant inspection, encompassing education programmes for adults and children that should be implemented for conservation. Systems within operation and maintenance should be comprehensive, in data storage and retrieval, as well as having an ability to allow strategic and operational decisions to be made. The formulation of training programmes, both formal and on-the-job training, was seen as a priority activity for all levels from senior management to operatives.

Without these activities, operation and maintenance organization would not be effective, at any level.

2.2.3 Round table on financial aspects of operation and maintenance

A round table discussion on financial aspects of operation and maintenance was organized on Thursday. It was chaired by Mr Fisher who made brief comments on key points. This was followed by questions launched at the participants on issues such as: metering vs non-metering, subsidized tariffs, financial autonomy of water

agencies, flat tariffs, cross-subsidy, etc. A very lively discussion took place when the participants reported their experience and difficulties in their countries. One of the major reasons noted was the lack of political support for the introduction and enforcement of regulations including restrictive measures concerning water conservation, metering, collection, etc.

2.2.4 Preparation of action plans

The final group discussions aimed at each group member producing an action plan for implementation on his return to his country. Groups initially discussed together possible actions needed to address various existing problems in countries of their groups. These actions included:

- tariff studies
- publicity/education measures
- legislation proposals
- training activities
- management structure reviews
- preparation of operation and maintenance programmes including estimation of costs
- leakage control programmes

The group rapporteurs then described in plenary session the various actions to be taken by members of their groups. Many participants considered the optimum first step to be a national workshop to create interest, provide training in various aspects and to formulate an operation and maintenance programme.

2.2.5 Field trips

Two field trips - a visit to a handpump research project, University of Malaya and to a sewage treatment plant in Kuala Lumpur - were included as part of the workshop and were held on Wednesday, 8 May 1991 afternoon. A presentation was given by Dr Goh Sing Yau, University of Malaya on handpumps and handpump research. This was followed by a practical demonstration of the Unimade handpump developed by the University. Afterwards a detailed inspection of the main Kuala Lumpur Sewage Plant was made where practical cases for operational management were discussed. This plant included grit removal, primary treatment tanks sludge digestors enhanced by oxidation providing systems with aeration and sludge drying beds.

2.2.6 Evaluation of the workshop

Evaluation questionnaires were completed by 17 of the workshop participants. Virtually all the participants considered the three workshop objectives had been met, with the exception of two participants who felt that practical ways for donor agencies to support their countries to improve operation and maintenance had not been identified. However, follow-up activities by external agencies were discussed at the meeting and several participants recommended that training and consultancy services be implemented in their countries by WHO. All the participants were satisfied with all the working papers and the discussions, and considered the papers suitable for wider distribution. The field trip was also unanimously considered to be

worthwhile. All the participants concluded that their attendance at the workshop had been worthwhile.

The duration and scheduling of the lectures and discussions were deemed satisfactory by all the participants. Five participants expressed the opinion that the workshop needed to be longer than one week to cover all the subjects adequately. This is a valid observation, but it is felt that more intensive training in operation and maintenance would be more effectively and efficiently carried out at the national level than by increasing the duration of a regional workshop. It was pleasing to note that eleven participants recommended WHO support follow-up national workshops or training activities in operation and maintenance in their countries.

The overall assessment of the workshop from the evaluation forms and comments made is that it was very successful and will lead to improved operation and maintenance procedures in the respective countries of the participants. A summary of evaluations indicating the responses of participants is attached in Annex 6.

3. CONCLUSIONS

The following conclusions were made as a result of the various presentations and group discussions:

- (1) The workshop fulfilled its primary objectives of developing strategies for implementation of effective operation and maintenance programmes, including solutions to specific problems and practical ways for external support agencies to participate.
- (2) Inadequate operation and maintenance represents one of the most important constraints for sector development in the participating countries. There was consensus about the need to develop activities addressing operation, maintenance and optimization of water supply and sanitation facilities, before a decision is taken for the construction of new facilities.
- (3) Operation and maintenance currently receives low priority in developing countries. International organizations, including funding institutions, should play a more active role in influencing governments to intensify efforts for the improvement of the efficiency and effectiveness of the water supply and sanitation sector.
- (4) Countries should be encouraged to reduce dependency from abroad with regard to funding for spare parts.
- (5) The implementation of activities directed towards sector improvement should not be envisaged without the perspective of an institutional development framework. The commencement of isolated activities without a long-term comprehensive perspective of development, may not lead to the sustainability of the improvements achieved.
- (6) Operation and maintenance planning should be implemented at the national level where possible. This strategy leads to a better use of the scarce resources allocated by governments and external support agencies to this type of programme.

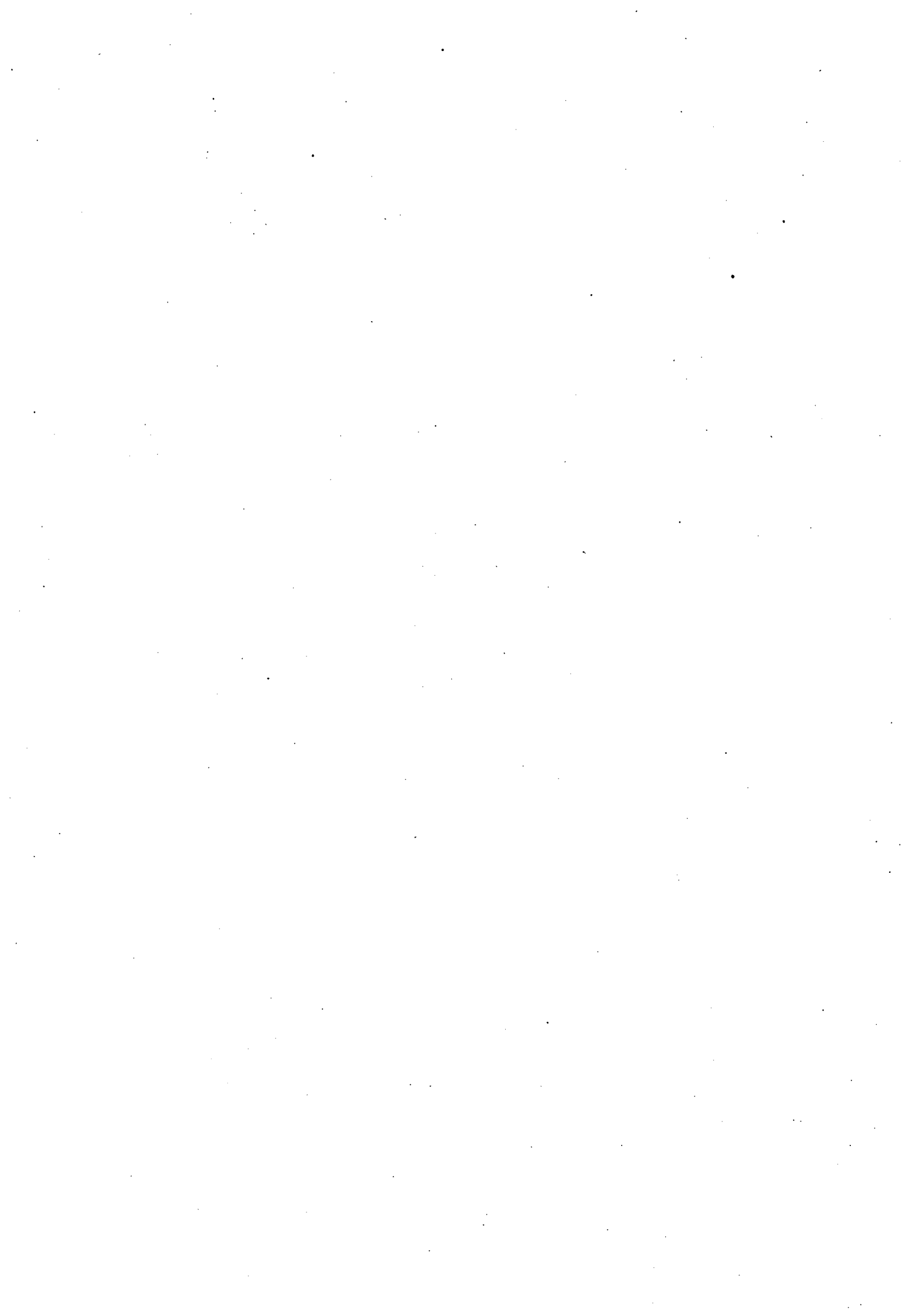
(7) The water supply and sanitation sector lacks sound training material packages which could be used by trainers in support of the implementation of operation and maintenance programmes. Training materials should be prepared in a flexible manner for wide dissemination so that they can be assembled by users in accordance with the requirements of specific target populations.

(8) One of the major constraints for the proper undertaking of operation and maintenance tasks is lack of financial resources. The cost-recovery policies in many of the participating countries are not effective, and are leading to situations in which funding is not available for operation and maintenance. Sound cost recovery policies should be adopted to ensure the conveying of financial resources and the self-sufficiency of the water supply and sanitation institutions.

(9) A high level political decision launching the development of operation and maintenance programmes is required to facilitate the mobilization of local and international resources for this endeavour. The implementation of this type of programme requires huge changes in behaviour, organization, and technologies and therefore it is not likely to be successful unless high level support is made available.

(10) The participants considered that follow-up activities should include the holding of national workshops to provide additional depth of training in all aspects of operation and maintenance that apply to their respective countries. Most participants felt that WHO support in holding national workshops would be necessary.

(11) Implementation of action plans prepared by the participants is a necessary follow-up activity to the workshop. PEPAS technical support to the action plans will be required in several parts of the plans.



LIST OF PARTICIPANTS, OBSERVERS AND SECRETARIAT

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WORKSHOP AGENDA

Monday, 6 May 1991

- 0900 - 0930 Introductory remarks
 Dr P. Guo, Director, PEPAS
- Opening speech
 Dr P. Guo, Acting WHO Representative
 for Brunei Darussalam, Malaysia and
 Singapore on behalf of the Regional Director
- Welcome address
 Professor Dr Syed Jalaludin Syed Salim,
 Deputy Vice-Chancellor, University of
 Agriculture, Malaysia
- 0930 - 1015 Group photograph and coffee/tea break
- 1015 - 1030 Administrative briefing
 L.Y. Chan, Administrative Officer, PEPAS
- 1030 - 1100 Introduction of consultant and participants
 B. Fisher, Sanitary Engineer, PEPAS
- 1100 - 1140 Overview of operation and maintenance in community
 water supply and sanitation in the Western Pacific
 Region
 B. Fisher
- 1140 - 1200 Country report - China
- 1200 - 1330 Lunch
- 1330 - 1500 Country reports - Fiji
 Kiribati
 Lao People's Democratic Republic
 Malaysia
- 1500 - 1520 Coffee/tea break
- 1520 - 1700 Country reports - Marshall Islands
 Federated States of Micronesia
 Papua New Guinea
 Philippines
 Republic of Korea

Tuesday, 7 May 1991

- 0900 - 1040 Country reports - Western Samoa
 Singapore
 Solomon Islands
 Tonga
 Vanuatu
- 1040 - 1100 Coffee/tea break

1100 - 1120	Country report - Viet Nam
1120 - 1200	Strategies for implementing operation and maintenance programmes J. Hueb, Sanitary Engineer, WHO/HQ
1200 - 1330	Lunch
1330 - 1420	Operation and maintenance management A. Anderson, WHO Consultant
1420 - 1500	Priority projects directed towards the optimization of water supply and sanitation systems J. Hueb
1500 - 1520	Coffee/tea break
1520 - 1600	Priority projects directed towards the optimization of water supply and sanitation systems (Cont'd)
1600 - 1700	Sewerage operation and maintenance control programme A. Anderson

Wednesday, 8 May 1991

0900 - 0930	Planning for maintenance - slide show
0930 - 1030	Group sessions: Approaches and concepts for developing countries (a) Analysis of constraints (b) Lines of action to be adopted at the country level for the promotion and implementation of operation and maintenance programmes (c) Selection of priority projects/activities
1030 - 1100	Coffee/tea break
1100 - 1200	Group presentations
1200 - 1330	Lunch
1330 - 1700	Field trip (Handpump research, University of Malaya; City Waterworks Maintenance, Kuala Lumpur) Presentation on Handpumps by Dr Goh Sing Yau, University of Malaya Visit to Sewerage Plant, Kuala Lumpur

Thursday, 9 May 1991

0900 - 0950	A case-study on the implementation of an operation and maintenance programme J. Hueb
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0950 - 1030	Technical presentations: Preventive maintenance A. Anderson
1030 - 1050	Coffee/tea break
1050 - 1120	Technical presentations: Network survey J. Hueb
1120 - 1200	Technical presentations: Leakage control A. Anderson
1200 - 1330	Lunch
1330 - 1415	Development of management information systems for operation and maintenance J. Hueb
1415 - 1500	Round table on financial aspects of operation and maintenance Moderator: B. Fisher
1500 - 1520	Coffee/tea break
1520 - 1700	Group discussions on various aspects of operation and maintenance directed towards the organization of operation and maintenance programmes at the country level. Aspects to be considered: (a) Organization of operation and maintenance programmes at the national level and at the level of the water agencies (b) Tariff and cost recovery (c) Spare parts availability (d) Transport and communication (e) Information systems (f) Training

Friday, 10 May 1991

0900 - 0930	Demand management B. Fisher
0930 - 1030	Group presentations
1030 - 1100	Coffee/tea break
1100 - 1200	Preparation of action plans
1200 - 1330	Lunch
1330 - 1500	Presentation and discussions on action plans
1500 - 1530	Coffee/tea break
1530 - 1600	Workshop summary/evaluation
1600 - 1620	Concluding remarks Dr P. Guo

LIST OF DOCUMENTS DISTRIBUTED DURING THE WORKSHOP

Working papers

WPR/RUD/PEPAS(2)91.2	Overview of operation and maintenance in community water supply and sanitation in the Western Pacific Region. By Mr B. Fisher
WPR/RUD/PEPAS(2)91.3	Strategies for implementing operation and maintenance programmes. By Mr J. Hueb
WPR/RUD/PEPAS(2)91.4	Management of operation and maintenance. By Mr A. Anderson
WPR/RUD/PEPAS(2)91.5	Priority projects directed towards the optimization of water supply and sanitation systems. By Mr J. Hueb
WPR/RUD/PEPAS(2)91.6	Sewerage operation and maintenance control. By Mr A. Anderson
WPR/RUD/PEPAS(2)91.7	Preventive maintenance. By Mr A. Anderson
WPR/RUD/PEPAS(2)91.8	Water leakage control. By A. Anderson
WPR/RUD/PEPAS(2)91.9	Development of management information information systems for operation and maintenance. By Mr J. Hueb
WPR/RUD/PEPAS(2)91.10	Demand management. By Mr B. Fisher

Country reports

WPR/RUD/PEPAS(2)/INF./1 (Rev.1)	China By Drs J.S. Huang and S.T. Li
WPR/RUD/PEPAS(2)/INF./2	Fiji By Mr A. Khan
WPR/RUD/PEPAS(2)/INF./3	Kiribati By Mr N. Tiacke
WPR/RUD/PEPAS(2)/INF./4	Lao People's Democratic Republic By Mr V. Soulinphoumy
WPR/RUD/PEPAS(2)/INF./5 (Rev.1)	Malaysia By Messrs S.C. Tay and Hamidon Othman

WPR/RUD/PEPAS(2)/INF./6	Marshall Islands By Mr B. Jacob
WPR/RUD/PEPAS(2)/INF./7	Micronesia, Federated States By Mr L. Fred
WPR/RUD/PEPAS(2)/INF./8	Papua New Guinea By Mr D. Collins
WPR/RUD/PEPAS(2)/INF./9	Philippines By Mr M. Agdeppa
WPR/RUD/PEPAS(2)/INF./10	Republic of Korea By Mr B.C. Choi
WPR/RUD/PEPAS(2)/INF./11	Samoa, Western By Mr S. Mariner
WPR/RUD/PEPAS(2)/INF./12	Singapore By Mr R. Singh
WPR/RUD/PEPAS(2)/INF./13	Solomon Islands By Mr R. Fugui
WPR/RUD/PEPAS(2)/INF./14	Tonga By Mr L. Tu'itua'ou
WPR/RUD/PEPAS(2)/INF./15	Vanuatu By Mr T. Ata
WPR/RUD/PEPAS(2)/INF./16	Viet Nam, Socialist Republic of Dr P.T. Giang

Publications/hand-outs

1. Proceedings of the meeting of the operation and maintenance working group, Geneva, 19-22 June 1990, Volumes 1 and 2.
2. Sustainable operations and maintenance of rural water supplies in the Sudan.
3. Preventive maintenance of rural water supplies.
4. Handbook of financial principles and methods.
5. Human resources development case study No. 1 - 8.
6. Systems approach.
7. Importance of O&M, Asia Regional Consultation, Manila, 21-25 October 1985.
8. Draft proceedings of the advisory committee meeting of operation and maintenance working group.

INAUGURAL ADDRESS

Opening speech by Dr S.T. Han, Regional Director,
WHO Western Pacific Region, delivered on his behalf
by Dr Paul Guo, Director, PEPAS and Acting WHO Representative
for Brunei Darussalam, Malaysia and Singapore

On behalf of Dr S.T. Han, WHO Regional Director for the Western Pacific, I have pleasure in welcoming you to this five-day Regional Workshop on Operation and Maintenance of Water Supply and Sanitation Systems. Dr Han regrets he is unable to attend this opening today and he sends his best wishes to you all.

It is evident in many countries of the Region that the operation and maintenance of water supply and sanitation systems have been so badly neglected that these systems no longer provide the intended level of service. This neglect has in part been caused by the emphasis placed by many countries on providing expanded service by constructing new facilities without making parallel efforts to ensure the sustainability of completed schemes. Operation and maintenance have a relatively low profile in comparison with the construction and extension of new facilities. A second cause of this neglect has been the tradition in many countries of seeing water supplies including their operation and maintenance as the government's responsibility. This is particularly true in rural areas, where the population is often reluctant to help maintain systems provided by the government. It is interesting to note that in a recent survey carried out in this Region, countries rated the lack of an adequate cost recovery framework as the highest constraint in the water supply and sanitation sector. Poor operation and maintenance was rated a close second, together with insufficient trained personnel. Although the lack of adequate operation and maintenance has long been recognized as one of the major constraints to sector development, the past ten years have not witnessed any substantial progress in this field. In rural areas where water is provided from wells equipped with handpumps, a high percentage of such facilities has been reported to be not functioning, in some cases more than 50%. In urban areas of developing countries in this Region, loss of water through leakage and unauthorized use is sometimes more than half of the total distributed. Typically, there are high wastage rates and low tariffs inside the cities, while inhabitants on the urban fringes remain unserved or forced to use alternative water sources of doubtful quality.

The key factors contributing to poor operation and maintenance of water supplies have been identified as: absence of data on operation and maintenance, inefficient use of funds, poor management of water supply facilities, inappropriate systems design, low profits from operation and maintenance, inadequate policies and legal frameworks, overlapping responsibilities and political interference.

Standards of service must be set at levels the community is willing and able to operate, maintain and finance using good business practice. However, the level of service must also meet the minimum requirements, to ensure the health and well-being of the community, so in some circumstances, subsidies to the water agencies will need to be given. New programmes should fully take into account at the outset the requirements of all operation and maintenance concerns in the system designs. WHO will be pleased to collaborate with countries in their endeavours to implement these policies.

I hope the deliberations will enable participants to review their own national sector policies and practices on operation and maintenance and lead to the establishment of improved policies and legal and institutional frameworks which ensure that operation and maintenance concerns receive adequate consideration in all stages of project implementation.

I urge you all to participate actively in the workshop and wish you a fruitful week of discussions as well as a pleasant stay in Malaysia.

Thank you.

SUMMARIES OF THE COUNTRY REPORTS

People's Republic of China

The total population of the People's Republic of China is 1 036 million of which 868 million are living in rural areas. With the development of public health and sanitary conditions in China, waterborne infections have decreased dramatically. The annual incidence of bacillary dysentery is 500 per 100 000 whilst the incidence of typhoid/paratyphoid is 10-15 per 100 000.

In rural areas, the total population attended with water supply facilities is 624 million (71.8% of the rural population), divided into the following types of facilities: treatment plants and water distribution systems: 26.7%; handpumps: 21.3%; shallow well and rainwater cellar: 23.8%. The main international, multilateral and bilateral agencies which are contributing to the development of the sector are the World Bank, UNDP, GTZ, EEC, WHO and WFP.

About 45% of the cost of construction of water works are covered by the peasants, in accordance with the following principle: "to contribute labour instead of money; and acceptance of money or material as funds". The peasants have an active role in the construction, management, operation and maintenance of facilities. The peasant committee is responsible for the selection of staff for posts dealing with operation and maintenance of water supply and sanitation systems.

There is no overall rules for cost recovery in the country. Present measures are: water charges are collected monthly according to the metered volume of water, if metering is available; or a flat amount, proportional to the water consumption per capita, if metering is not available. The water costs/tariffs are calculated from costs of energy, chemicals, maintenance, equipment depreciation and personnel wages. In general, the water charges range from 0.2 - 0.4 yuan¹ per cu.m for individual users, to 0.4 - 0.5 yuan per cu.m for enterprises.

Great importance is being given to training in China. A national rural water supply training centre has been established in Beijing for training of people dealing with operation, maintenance and management. Approximately one-third of the total rural operation and maintenance personnel have attended training courses and have now several years of experience in this type of activity.

One of the major constraints for sector development in China is lack of suitable managerial practices. Although the National Patriotic Health Campaign Committee has made great progress on aspects including overall leadership, coordination amongst different departments and mobilization of communities for rural water system management, much more has to be done to achieve sound rural water supply and sanitation management.

¹US\$1 = 5.210 yuan

Fiji

Fiji is an archipelago of some 332 islands of which 100 are permanently inhabited. The main islands are Viti Levu and Vanua Levu which together comprise an area of 15 927 sq.km. or 88% of the total area. The largest urban centre is Suva with a population of over 70 000. The total population in 1989 was about 720 000.

Waterborne diseases are not considered an important cause of morbidity and mortality, as compared with other diseases prevalent in the country.

Urban and minor public supplies account for 46% and 2% respectively of the total population. The remaining balance of 52% represents about 350 000 people living in small communities and individual homesteads, often remote and difficult to access, where metered water supply operated by the Ministry of Public Utilities is impracticable and is unlikely to be installed.

The responsibility for water supply in urban and rural areas remains with the Central Government, through the Ministry of Infrastructure and Public Utilities. This Ministry maintains and operates metered water supplies at 12 major urban centres and is also responsible for operation and maintenance of water supply facilities in small communities.

Generally, the major cities, towns and the peri-urban areas are provided with sewerage systems. In the absence of these systems, the premises have their own septic tanks. The rural settlement and villages have generally pit latrines and these are gradually being improved into water-sealed latrines. It is considered that about 40% of the total population lack proper sanitation facilities.

The main constraints affecting operation and maintenance in the country are as follows:

- Funding is the major constraint and is directly associated with failure of projects due to lack of maintenance.
- The communities are not fully involved in the initial surveys, design and construction of the water supply and sanitation projects.
- Lack of training.
- Cost recovery is considered a critical issue. The users are not able to contribute regularly as required for adequate funding of operation and maintenance. As a consequence of non-availability of funds for maintenance, the systems frequently cease to work and are abandoned.
- The external assistance (Government, water authority, etc.) for operation and maintenance is very limited. At times, grants may be available towards the improvement or extension of the systems.

Kiribati

The total population in Kiribati is about 67 000 of which 23 000 are living in urban areas. Approximately 96% of the urban population and 47% of the rural population count on safe water supply. Only 50% of the urban population count on sanitation facilities.

After completion, the water supply projects are fully maintained by communities under the supervision of a local person who has the knowledge and skills needed for activities regarding the maintenance of the systems. For urban facilities, projects are planned by top government officials through advisory committees, such as the Water and Sanitation Committee, with little consultation of communities. Implementation is generally undertaken by the concerned department for example, the Public Utilities Board, the Public Works Department and the Housing Corporation.

It has been experienced that communities sometimes fail to accomplish their tasks with regard to operation and maintenance for various reasons. Limited funding, inability to recover costs and inadequate supervision and shortage of required materials are some of the reasons expressed. Despite these difficulties, there is a continuous programme for training of personnel on several aspects of operation and maintenance through workshops, field demonstration or on-the-job training.

Local institutions or bodies comprising representatives covering sectors of the community have been formed for the local management of the systems. In urban areas, the water and sanitation coordinating committee is a vital instrument in coordinating activities on construction, management, operation and maintenance. To manage the systems in the periphery, the village welfare groups provide a managerial role in coordinating efforts related to operation and maintenance.

Water is generally metered and water rates are high (US\$1.00/cu.m.). The high cost is due to the expensive process of producing water of reasonable quality from shallow gallery wells.

Collection of water charges is not regular. The total costs concerning operation, maintenance and administration of water supply and sanitation systems are supplemented by the government which contributes 45% of the total cost. Training has been made a vital part of manpower development. Job descriptions for the various posts within departments responsible for operation and maintenance have been clearly defined.

Skilled manpower is available locally in the form of qualified plumbers, mechanics, fitters and turners. Sanitary engineers have to be recruited from overseas when required. Most of the equipment and materials needed to operate and maintain the systems are not available locally. In rural sanitation projects, water, beach sand and gravel can be supplied locally even though they may not be of best quality from purity point of view.

Imported materials and equipment are procured with funds from external donors. The multiplicity of types of equipment makes operation and maintenance a very complicated and discouraging task. The materials are frequently supplied to complete the construction of new water supply and sanitation systems but no provision is made to include spare parts. As a consequence of this situation, there is a great reduction in the useful life of facilities.

Lao People's Democratic Republic

The Lao People's Democratic Republic has a population of 4.1 million (1990). The population living in rural areas is 3.6 million (87% of the total population), of which 32% count on water supply facilities. Only 5% of the rural population is served with sanitation facilities (latrines). In urban areas, 5% of the population is attended by water supply services of classical standard (treatment plant, distribution system, house connection). Approximately 45% of the urban population count on sanitation facilities (latrines).

The national government is giving great priority to water supply and sanitation in rural and urban areas. Efforts are being exerted for training of personnel, particularly in activities regarding construction of tube wells, gravity systems, latrines, etc. These training activities are being supported by international organizations (70%) and national government (30%). There is availability, locally, of gravel, sand and timber used in the construction of rural water supply and sanitation facilities. Other required materials such as steel rod, cement, pipes, fittings, etc. are not available locally and are usually imported.

Several constraints at the country level have been identified and some major plans of action have been formulated. One of these plans of action includes the strengthening of the training centre administered by the Central Water Supply and Environmental Health Department. The training activities conducted by the Centre should be intensified so that every district can count on 1 to 2 skilled technicians.

Water and sanitation related diseases are the major causes of morbidity and mortality in the country.

Malaysia

Malaysia is a federation of thirteen states, eleven of which are located in Peninsular Malaysia and two on the Island of Borneo. It has a multi-racial population of 17.8 million. The national annual population growth rate is 2.6%. However, the urban population grows at a much higher rate of 4.2% per annum and amounts to about 7 million (40% of the total population). The average annual rainfall varies between 3 000 mm and 4 000 mm.

In terms of coverage, 96% of the urban population has access to piped water supply and this figure is expected to increase to 98% in 1995. For the rural population, the present coverage of 66% is expected to increase to 79% in 1995. Under the constitution of the Federation of Malaysia, water supply issues come under the jurisdiction of the State Governments. The development of water resources in each state for public supplies and the operation and maintenance of such supplies are the responsibility of the respective State Governments. Generally, water supply is available throughout the day. Water quality meets the World Health Organization guidelines for drinking water. In the majority of cases, rural water supplies are of the same standard as that of urban supplies with the exception of those where the house connections are not metered and water charges are not levied.

The average per capita consumption is 259 litres per day for urban areas and 160 litres per day for rural areas.

On the use of pipe materials, asbestos cement pipes of sizes 100 mm to 400 mm diameter are extensively used for reticulation and transmission mains which do not require pumping. Mains of larger sizes are usually of steel, grey cast iron, or ductile iron. For internal house plumbing, both galvanized iron and unplasticized polyvinyl chloride (UPVC) pipes are commonly used with copper and stainless steel

pipes used to a smaller extent. Water Supply Rules require all taps and fittings in a house to be fed from a storage cistern with the exception of the kitchen tap which is fed directly from the public mains.

In terms of sanitation, the mid-term review of the Fifth Malaysia Plan 1986-1990 indicates that 4.9% of the total population of Malaysia is served by sewerage system whereas 19.1% is served by unacceptable methods of sanitation or have no sanitation facility at all (1988). Operation and maintenance of the urban sewerage systems is carried out by the local authorities and private developers/contractors. In rural areas, operation and maintenance of sanitation facilities is carried out by the communities themselves. The major constraints in the country with regard to operation and maintenance are the following:

(A) Water supply

- With the exception of a few states, the shortage of personnel is found in all categories of staff from management, through accounts to operation and maintenance personnel.
- Due to budgetary limitations, the water supply organizations are able only to meet the cost of energy, chemicals, materials and wages necessary for the operation of water supply. As far as maintenance of water supply is concerned, these organizations will have only sufficient fund to meet the cost of emergency repairs of mains and equipment. There is little or no provision made for the replacement of old pipes and equipment, or to undertake other preventive activities.
- Although the mapping system is adequate, the reliability of the existing information has deteriorated due to accelerated expansion of distribution systems and lack of updating of the mapping system.
- Most of the water supply systems are operated under deficit and therefore have to be subsidized by the State Governments. There is, thus a need to review tariffs to pave the way towards increasing of water charges and in consequence to achieve self-finance.
- Most water authorities have expressed increasing difficulty in meeting the desired level of service due to lack of trained manpower. Realizing the importance of training, the Public Works Department has set up training schools at Bangi and Johor Baru and will be setting up three more regional training schools at Kuantan, Kuching and Kota Kinabalu. The major training school in Bangi will be further upgraded in its training facilities, at a cost of about US\$4 million.

(B) Sanitation

- A significant problem of septic tanks which are the most commonly used system in the urban areas is that the tanks are not desludged on a regular basis and in some cases not at all.
- Operation and maintenance of completed sewerage schemes in the urban areas have rarely received the attention they deserved and failures are traceable to the lack of planning of institutional frameworks, administrative procedures, technical and financial mechanisms. Development in data gathering, storage and retrieval system is limited and mechanisms for feedback of information to planners and designers from the field are inadequate.

- There is shortage of trained staff in the sanitation sector, from planning, engineering, management to operation and maintenance. No specific training programmes exist and the training that has taken place has been on an ad hoc basis:
- Urban sewerage recurrent costs are not covered by revenues and thus, increase the financial deficit of local authorities. Loans available from the Federal Government are largely insufficient. Currently, there is no legal provision to authorize Federal Government to provide grants for sewerage.

Marshall Islands

The total population of Marshall Islands is 46 188 (1988 census). The rural population is about 22 188. It is estimated that at the end of the year 2000, the total population of the Marshall Islands will be 68 415. Approximately 80% of the urban population is served with piped water supply and 56% is connected to public sewer systems. In the rural areas, barely 10% of the population has access to safe water supply.

The infant mortality is 34 per 1 000 and the incidence of waterborne diseases is 76 per 100 000.

The water and sewer operations have been contracted to a private firm. The contractor has taken some action directed towards a better regulation involving the water agency and users. The National Environmental Protection Authority has also established standards concerning the operation of water and sewage facilities. One of the major constraints is the lack of community participation in the planning process and in the operation and maintenance of the existing facilities.

Federated States of Micronesia (FSM)

The Federated States of Micronesia (FSM) is located in the Western Pacific and consists of 4 states which, from west to east are: Yap, Chuuk, Pohnpei and Kosrae. With the exception of Kosrae, each state consists of numerous inhabited islands (over 600 islands). Each state is responsible for its own water supply and sanitation facilities. The total population of the country is approximately 100 000 inhabitants (1989).

The following are major points regarding the current conditions of the urban water supply and sanitation facilities, in the four states of FSM.

A. Yap

(i) Water supply

Several activities have been implemented in the past concerning training, leak detection and improvement of service connections. A recent leak detection study conducted on the Colonia system indicated that the public distribution system had minimal losses. Where leaks were located, repairs were implemented. Household leakage and public building were identified as responsible for significant losses. The flat rate charge for water, lack of mandatory bill collection and free water services to the government are factors which are affecting water conservation. Personnel at the treatment plant seem to be motivated and reasonably well trained.

(ii) Sanitation

The sewer system in Yap is in reasonably good condition. The system is relatively easy to operate and maintain. The pumping stations are properly maintained and the treatment tanks and collection sewer are periodically cleaned. The wastewater treatment plant is under normal operating conditions, except for a sludge dump valve that requires repairs.

(B) Chuuk

(i) Water supply

The operation and maintenance activities are not being carried out properly due to insufficient financial resources and lack of training programmes. Presently, only 10 of 30 wells are functional. Due to insufficient amount of produced water and high unaccounted-for water, the system operates intermittently. Chlorination facilities are in many cases inoperative or non-existent. There is a flat charge for water, a low rate of collection and no charge to government buildings.

(ii) Sanitation

In spite of limited resources in manpower, spare parts, and materials, the maintenance of operational units in both the plant and the collection system are accomplished to acceptable standards.

(C) Pohnpei

(i) Water supply

The State of Pohnpei receives about 5 000 cu.m. of rainfall a year. Owing to this abundant natural source of water, it is difficult to motivate people to conserve water. Despite this, based upon recommendations of a thorough study conducted in 1986, an important programme is under implementation, dealing with several aspects linked to efficiency and effectiveness of the service. The major elements of this programme are the ongoing leak detection programme and the improvement of the billing and collection system.

(ii) Sanitation

The sewerage system in Pohnpei consists of a sewer collection system, a wastewater treatment plant and an outfall into the bay between Sokeh's Island and Kolonia.

The water and sewer facilities have a single supervisor who oversees both operations. There are 16 persons specifically assigned to operation and maintenance tasks. The wastewater system is not operating properly. One of the reasons, is the lack of qualified persons to deal with management, supervision and operative tasks.

(D) Kosrae

(i) Water supply

There are three different types of water supply facilities in Kosrae: rooftop catchments, groundwater wells, surface water diversions from rivers. The population centres of Tofol-Lelu, Tafun-sak, Malem and Utwa depend to a limited extent on surface water. The principal municipality of Lelu has two distribution systems. An older system relies on water taken from the Pukusrik River. The new system, constructed in 1985 consists of a traditional water treatment

plant/distribution system. The plant has not been effectively used since its completion in 1985. The major reason is the existence of great water losses in the distribution system. Despite the installation of meters, no charge was established for the water service as there is no systematic reading procedure. Thus, there is great wastage of water and as the treatment plant cannot meet the present demand, it is being bypassed with the river diversion going directly into the distribution system.

There are five persons from the Department of Public Works, assigned to operation and maintenance activities.

(ii) Sanitation

Maintenance activities in Kosrae consist of the removal of weeds at the oxidation ponds and removal of solids from septic facilities. Completion of facilities currently under construction will generate the need for cleaning the collection sewers, maintaining the pumping station, etc.

With regard to the rural facilities, the following are major aspects which reflect the present situation in the country:

I - Water supply

The most common rural water supply technology in Kosrae is rainwater catchment and storage. The most common type of rainwater storage tank is a ferrocement type made by plastering mortar over perforated flat tin that is wired to a reinforcing rod formwork. The maintenance of these systems is simple and is performed properly by the owners.

II - Sanitation

Prior to approximately 10 years ago, rural sanitation consisted of the use of pit or over-water toilets or direct use of the beach or bush. With the advent of a cholera epidemic in Chuuk in the early 1980s, water sealed toilets have been adopted throughout the FSM. However, there is still a high percentage of people who do not count on this type of facilities.

Papua New Guinea

Papua New Guinea has an estimated population of 4 million who speak about 700 different languages. Three departments are responsible for the water supply and sanitation sector: House Affairs Department, Health Department and Department of Works. The Department of Works looks after aspects of design, construction and maintenance of water supply and sanitation systems. Town authorities were created to exert activities regarding operation and maintenance under the direction and supervision of the Department of Works. A "National Capital District Commission" was created to administer and maintain the water supply and sanitation systems in the city of Port Moresby. A Waterboard was created in 1983 to plan, implement and operate water and sanitation schemes in Papua New Guinea. The Waterboard is currently responsible for major towns such as Lae, Madang, Wewak and Mt. Hagen, as well as seven other small towns. The Department of Works looks after smaller towns.

The carrying out of operation and maintenance activities in the country is experiencing great difficulties chiefly because of insufficient funds made available by financial agencies internally and abroad. The revenue generated by water charges does not meet the operation and maintenance costs.

Philippines

The Philippines has a population of 61.4 million, 42.7% of which are urban dwellers and 57.3% are rural inhabitants. The annual rainfall is 2 400 mm. Health indicators show that waterborne related diseases per 100 000 population for the year 1990 is 1 665 (13 districts).

The coverage of water supply and sanitation are:

<u>Water</u>	<u>%</u>
*Urban connections and urban standpipe	90
Rural water with reasonable access	73
<u>Sanitation</u>	
Urban sanitation by sewer connection, pit privy or septic tank	36
Rural sanitation with adequate facilities	71

*It should be noted that the number of households connected to sewers is 355 741 in limited locations.

The state of the existing systems is poor with relatively little operation and maintenance to allow in situ upgrading. The rapid increase of squatter slums in urban areas has created serious water supply and sanitation problems. Production is limited at present by alternate source pollution e.g. Laguna Lake near Metro Manila. Polluted river areas such as Tenajeros-Tullahan-Malabon, Navolas and Pasig Rivers have raised problems of contamination and are the subject of River Revival Programmes. Distribution by house connection is 17 134 000 with standpipe access to 4 786 000 with a consumption level which cannot be accurately measured because of water loss and wastage. An estimation of usage is:

	<u>Per capita</u>
Urban	60 - 100 litres/day
Rural	30 - 60 litres/day

Rural areas rely on wells and small piped supplies, with handpumps added. Piped sewage is only available to a small number of households. The direct cause of pollution in water supply areas is lack of adequate facilities plus the contamination by toxic wastes. The water quality in general is poor, ranging from fully treated in some urban areas to untreated at well heads.

Future planning intentions encompass operation and maintenance in water supply and sewage systems to give in situ plants extended life. Pollution and the removal of toxic wastes is an ongoing programme by the Department of Public Works and Highways with Metropolitan Waterworks and Sewage System assisting in the urban areas. The intensification of industry requires legislative controls to protect water sources.

Republic of Korea

The Republic of Korea has an interpolated population of 43.8 million as at 1990. Seventy-eight percent of this population are urban dwellers. The annual rainfall is approximately 1 400 mm. Sixty percent of precipitation is between June - September.

No health indicators regarding waterborne or water-related diseases were reported on but it is noted that previous reports have shown that the male death rate per 1 000 declined from 13 in 1960 to 5.9 in 1988 showing a marked improvement in health, a proportion of which is sanitation and water supply related.

The coverage of water supply ranges from the sophisticated urban to the simple rural systems, serving 75% of the population. However, sewage plants only serve 28% of the population (1989).

The sources of water are both surface and ground, with surface water resources supplying mos.ly urban areas. The daily water use per head ranges from 223 litres (Chungnam District) to 426 litres (Seoul), with an average of 339 litres. The number of persons serviced is 32.97 million.

Distribution of water in urban areas is by standardized systems with advanced water treatment methods in some cases e.g. pre-chlorination and ozonation. The rural areas are served by Simple Piped Water Supply Systems (SPWSS) and shallow wells.

During the period 1967 to 1987, 34 356 SPWSS were constructed using mainly groundwater sources, where disinfection was the only treatment. Pollution in surface water has been identified as a major problem.

Sewage systems serve 28% of the population. The number of major sewage plants is 20 at the present time. A number of nightsoil treatment plants (156) have been constructed. The future developments for water supply are increased operation and maintenance for existing plants and a series of control measures to protect new water quality.

In future planning, wastewater treatment is to be increased to service 65% of the population as a target ratio by 1996, and includes the construction of 42 major plants having a total capacity of 3.8 million m³/tonnes/day with a further 48 minor plants adjacent to the water supply sources. The plants are to be the activated sludge type. Construction of 21 treatment plants for livestock wastewater in the Paldang and Daechung reservoir areas, with 34 500 small treatment facilities for small farms is seen as a necessity to prevent surface water pollution. A special management activity for the protection of water quality is underway.

Western Samoa

The population of Western Samoa is 165 000 with 21% residing in urban areas. The average annual rainfall figures range from 3 200 mm at mean sea level to 5 000 mm at 140 m.

Health indicators show that water related diseases incidence is 83 cases per 1 000. The only urban system is located in Apia where there are three existing plants producing 16 900 m³/day. The plants are of standard design with post chlorination. Urban households are served by house connection. The average consumption should be 230 litres per day. Factorial considerations show that the demand is 3 890 m³/day above production, causing infrequent supply and topping up with untreated water. The rural areas are mostly supplied by spring, rainwater catchment, wells and small piped systems, mostly untreated.

There is no reticulated sewerage system in Western Samoa at present. Septic and Imhoff tanks are in use but soakage is a problem. In rural areas, there is general use of dry pit and water-sealed toilets.

The existing water system is not coping with demand mostly due to leakage and wastage, and the entry of untreated water into the system is causing health problems.

Future planning includes a reticulation and sewage plant for wastewater in Apia. Operation and maintenance needs to be placed on a higher priority to lessen the unaccounted water loss and the introduction of water meters should lessen the demands on the water supply system by preventing waste.

Solomon Islands

The population of the Solomon Islands is interpolated at 318 000. The annual rainfall is 3 000 mm - 5 000 mm. No health indicators were provided in the report.

The coverage of water supply in the urban areas is poorly designed and inadequate in growth areas where extension has placed supply beyond reliability. In rural areas where 80% of the population lives, water supply is available to 62% of that population either in small piped supplies or improved supply sources. In sanitation coverage, the urban areas are in minor part, piped systems mostly public with the majority of wastewater treated by septic or Imhoff Tank and soakage disposal. The rural areas have poor sanitation facilities with only 9% having access to improved wastewater disposal. The state of the existing systems is poor and hardly functional in the tidal and estuarine areas. Raw sewage outfall is causing pollution in the coastal and estuarine area of Honiara.

The production of water is limited to Honiara, the remaining urban areas relying on small piped or tank storage systems, along with rural areas. The systems are prone to breakdown and the supply of spares intermittent. There is no formally structured water or wastewater authority to improve existing systems through revenue or to plan and execute capital works.

Future planning already includes assessment of needs for operation and maintenance by computerized status summaries. It is expected it would include an operation and maintenance programme for both urban and rural areas, along with manpower development, to solve future problems.

Singapore

Singapore has a population of 2.7 million in an urban/rural mix. The annual rainfall is 2 370 mm. No health indicators of waterborne disease were reported on.

The coverage of water supply is 100% piped service, fully disinfected and chemically balanced.

The sewerage system was not reported on.

The entire water system is fully metered. Constant surveys and leakage control is carried out, with the unaccounted-for water being 9% (1990). Stringent pollution control measures are enforced along with a programme to monitor quality of water resources. A number of measures for water conservation are in operation. The installation of water saving devices, industrial reuse and recycling measures, along with use of industrial water, contribute to water conservation. Continuing programmes to educate the young and remind the population that water must be conserved are commonplace.

Future activities include refinements of an already effective operation and maintenance process.

Tonga

The population of Tonga is 98 300 adjusting the 1986 census by a yearly increment of 1%. The average rainfall is 1 820 mm per annum with an average of 202 mm per month (December/April) and an average of 115 mm per month during May/November. No health indicators were given but previous publications show a continuing raised morbidity factor from rural areas where shallow wells and ground catchments are used.

The main urban water supply area is at Nuku'alofa and serves 98% of that population with a basic water supply under continuous chlorination. The supply comes from a lens and is pumped into the system. The rural populations rely on groundwater and rainwater catchments except for 'Eau which has a surface catchment area. These sources are generally untreated unless unsatisfactory bacteriological tests are taken, then batch processing is applied. Sewage and wastewaters were not reported on.

The maintenance of the urban and rural water supply systems presents problems - skilled manpower, the availability of spare parts and finance for operation and maintenance. Community involvement in relation to operation and maintenance is limited in planning and design. However, the community is active in meeting obligations in regard to minor maintenance providing spare parts are available, on a continuum.

Staff changes within the "community water committee" cause problems such as a lack of stationary engine operators. There is at present no adequate records within the water supply industry for operation and maintenance planning and there is an identified problem of collection of water fees.

The Government is providing a regular budget for the maintenance of rural supply. This is hampered by lack of spare parts and skilled supervisors/operators.

Vanuatu

The population of Vanuatu is 140 000. The annual rainfall is approximately 2 300 mm.

Health indicators show there are no confirmed cases of waterborne disease. However the incidence of diarrhoeal outbreaks is prevalent. People prefer to drink rainwater and be selective about water sources where no improvements exist. At the end of 1987, approximately 61.4% of the population had access to adequate water supply. The urban water supply at Port Vila is groundwater raised by pumping and treated with chlorine gas. Weekly testing is undertaken. 95% of the population are connected and metered to the service. Approximately 5% have no access to supply. Actual usage rates were not stated. But it was noted that a form of leakage control was carried out.

Rural water supplies are mostly groundwater with some rainwater catchment, shallow wells and small piped systems. The urban sewage disposal and treatment is not systematized. Small septic/Imhoff tanks, some raw sewage outlets and pit toilets are in existence. These pit toilets are at present being replaced by water-sealed toilets.

Future plans include increasing the coverage of piped rural supply schemes and upgrading existing rural schemes not meeting Government specifications. Urban schemes are to have increased distribution and improved supply, along with a sanitation programme.

Socialist Republic of Viet Nam

The population of Viet Nam is 62 million with 80% of that population living in rural areas.

The annual rainfall is 1 332 mm to 2 303 mm.

Health indicators were not reported on in regard to water related diseases. Service coverage of urban water supply per capita is low. Of the 436 urban centres with populations over 5 000, only 100 have piped supply indicating that 53% are dependent on shallow wells and rainwater collection. The rural population is served by various types of supply with varying levels of water quality. Only a few inhabitants have access to the safer systems such as handpumps or standpipe distribution. The sanitation systems in urban areas allow for only 23% of that population to be connected to a sewer system. The remainder are served by septic tanks, double vault latrine types and nightsoil removal. Systems in the northern part of the country date from pre-1954 and those in the southern part from pre-1975. Most sanitary sewers are combined. Sewer/stormwater and inundation are common, often polluting shallow wells in delta areas.

Production of water ranges from 44 litres per day to 180 litres per day depending on plant reliability. Disinfection and chemical adjustments along with flocculation are haphazard. Supply is intermittent according to the availability of electric power for pumping. Wastewater treatment is constant only in septic or Imhoff tanks. Industrial waste water is discharged into streams and piped systems where treatment is mediocre.

The general water quality is poor having little or no disinfection through lack of chemical supply and the requisite treatment plant. A high rate of suspended solids is common.

Future planning is concentrating on new capital works for both sewage and water treatment plants, along with the continuing UNICEF programme for rural water supply. The establishment of operation and maintenance measures to reinstate older facilities is required but is hampered by lack of funding, trained and qualified manpower, and inadequate management procedures.

WORLD HEALTH ORGANIZATION



ORGANISATION MONDIALE DE LA SANTÉ

SUMMARY OF EVALUATIONS

REGIONAL WORKSHOP ON OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS

PEPAS, KUALA LUMPUR 6-10 MAY 1991

EVALUATION QUESTIONNAIRE

1. Educational gains

1.1 Were the following objectives met?

Yes No

(a) To discuss operation and maintenance problems and develop strategies for more effective implementation of operation and maintenance programmes at both national and local levels;

17 0

(b) To identify practical ways for external support agencies to support governments in their efforts to improve operation and maintenance services; and

15 2

(c) To discuss solutions to specific operation and maintenance problems, including unaccounted for water, leak detection methodologies, metering, mapping and preventive maintenance.

17 0

If no, please describe:

1.2 Have new skills or concepts been learnt at the meeting?

16 1

1.3 Can these skills and concepts be applied in your country?

16 0

2. Process and outcome

2.1 Were you able to express your ideas or problems at the meeting?

17 0

Yes

No

2.2 Was there enough opportunity to exchange knowledge and experience with other participants?

15

2

If response to any of the above is no, give comments as appropriate:

Two participants commented on time shortage.

2.3 Were you satisfied with all working papers provided?

17

0

If no, please explain for specific paper(s):

2.4 Specify which of the working papers distributed for the meeting are suitable for wider distribution:

(a) All papers mentioned.

(b) _____

(c) _____

2.5 Did you have enough time to study the working papers?

12

5

If no, did you receive the working papers sufficiently in advance?

2

3

2.6 Were methods of introduction and presentation of different topics satisfactory?

13

3

If no explain your response:

Three participants commented on the shortage of time available.

2.7 Were you fully satisfied with discussions -

(a) at the plenary session?

16 1/2

1/2

(b) at the group session?

17

0

If no, please explain:

Yes No

2.8 Field visits

2.8.1 If there were field visits as part of the meeting, were they useful to meet the objectives?

17

0

If no, explain your response

2.8.2 If there were no field visits, do you consider field visits would have been useful to meet the meeting objectives?

-

-

If yes, explain your response:

3. Organization of the meeting

Were the duration and scheduling of different activities - lectures, group discussions etc. - satisfactory?

14

3

If no, please describe:

Three participants considered one week to be too short.

4. Administrative aspect

Are organization or administrative arrangements for travel, accommodation, per diem, meeting room, secretarial support and interpretation satisfactory?

13

4

If no, please describe:

Three participants were concerned about payment of per diem for the homeward journey.

One participant's tickets arrived late.

Yes No

5. Your overall Conclusion

Do you feel that -

- (a) The recommendations/conclusions reflected the meeting consensus? 17 0
- (b) Such meetings should be held regularly? 17 0
- (c) Your attendance was worthwhile to you personally? 16 1
- (d) Your participation was worthwhile to your country? 17 0

Comments (if any):

- 6. Is there any better way to achieve the meeting objectives? 6 11

If yes, please describe briefly:

- Two recommended more time.
- Two recommended more field visits.
- One recommended more political awareness in their own country.
- One recommended more group discussions.
- One recommended follow-up sessions after the workshop.

- 7. What follow-up activities, if any, would you recommend:

(a) by national government -

5 participants recommended workshops at the national level.

(b) by WHO -

Four participants recommended training and nine specifically recommended training workshops in operation and maintenance. Two recommended technical support by WHO staff/consultants.

(c) by other agencies (specify type) -

- 8. How many meetings - WHO and others - have you attended in your professional capacity outside your country over the last twelve months?

Three had attended other such meetings.

8 signatures

Signature (optional)