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REPORT

**WORKSHOP ON
MANAGEMENT OF URBAN WATER SUPPLY
AND SANITATION SYSTEMS**

Kuala Lumpur, Malaysia

21 - 25 August 1995

Kuala Lumpur, Malaysia

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REPORT

**WORKSHOP ON MANAGEMENT OF URBAN WATER SUPPLY
AND SANITATION SYSTEMS**

Convened by:

**WORLD HEALTH ORGANIZATION
WESTERN PACIFIC REGIONAL
ENVIRONMENTAL HEALTH CENTRE (EHC)**

Kuala Lumpur, Malaysia
21-25 August 1995

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NOTE

The views expressed in this report are those of the participants in the Workshop on Management of Urban Water Supply and Sanitation Systems and do not necessary reflect the policies of the Organization.

This report has been prepared by the World Health Organization Western Pacific Regional Environmental Health Centre (EHC) for governments of Member States in the Region and for those who participated in the Workshop on Management of Urban Water Supply and Sanitation Systems, which was held in Kuala Lumpur, Malaysia from 21 to 25 august 1995.

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Key words

Urban water supply and sanitation - management / operation / maintenance /
workshop

SUMMARY

Objectives of the workshop:

The objectives of the Regional Workshop on Management of Urban Water and Sanitation Systems were:

- (1) to review the latest management information tools in relation to urban water supply and sanitation systems;
- (2) to discuss solutions to specific management problems, in particular those related to operation and maintenance including unaccounted for water; leak detection methodologies; metering; mapping; and preventive maintenance; with a view to developing strategies for more effective implementation of operation and maintenance/management programmes at both the national and local levels;
- (3) to identify more appropriate ways for external support agencies to collaborate with governments in their efforts to improve operation and maintenance services; and
- (4) to develop guidelines for a model action to improve the management of water supply and sanitation facilities.

Summary of proceedings and conclusions:

The workshop was attended by 19 participants from 15 countries and areas in the Western Pacific Region, six participants from three countries (Bangladesh, India and Nepal) in the South East Asia Region and two observers from two countries (Malaysia and Western Samoa) in the Western Pacific Region. The proceedings comprised presentations of country reports by participants, presentation of nine technical papers, group discussions and plenary discussions. A half-day field demonstration on different equipment used in leak detection was undertaken on the third day of the workshop. An evaluation by the participants showed that the workshop served its purpose well and the above objectives had been successfully achieved.

Various conclusions were made as a result of the presentations and group discussions. Operation and maintenance aspect of management was regarded as one of the greatest constraints for sector development and it should be given priority by both national governments and external support agencies. Training activities, cost recovery systems and political commitment were identified as aspects requiring most emphasis. Follow-up include national group educational activities to provide additional depth of training in all aspects of management of urban water supply and sanitation systems, especially operation and maintenance in their respective countries.

1. INTRODUCTION

The Workshop on Management of Urban Water Supply and Sanitation Systems was held at the WHO Western Pacific Regional Environmental Health Centre (EHC) on the campus of the University of Agriculture, Malaysia (Universiti Pertanian Malaysia), Serdang, Selangor, Malaysia from 21 to 25 August 1995.

The workshop was organized by WHO and funded by the Government of Japan through the Special Programme on Technology Transfer.

1.1 Objectives

The objectives of the Workshop on Management of Urban Water Supply and Sanitation Systems were:

- (1) to review the latest management information tools in relation to urban water supply and sanitation systems;
- (2) to discuss solutions to specific management problems, in particular those related to operation and maintenance including unaccounted-for water, leak detection methodologies, metering, mapping and preventive maintenance, with a view to developing strategies for more effective implementation of operation and maintenance/management programmes at both the national and local levels;
- (3) to identify more appropriate ways for external support agencies to collaborate with governments in their efforts to improve operational maintenance services; and
- (4) to develop guidelines for a model action plan to improve the management of water supply and sanitation facilities.

1.2 Organization

The workshop was attended by 19 participants from 15 countries and areas in the Western Pacific Region (WPR), six participants from three countries (three from Bangladesh, two from India and one from Nepal) in the South East Asia Region and two observers from two countries (Malaysia and Western Samoa) in the Western Pacific Region. A list of the participants, observers and secretariat members is presented in Annex 1. The programme comprised nine technical papers, 18 country reports, group discussions and plenary sessions, and a half-day field demonstration on equipment used in leak detection. Dr A. Basaran, Regional Adviser in Environmental Health, WHO/WPR presented five topics; Mr J. Hueb, Sanitary Engineer, WHO Headquarters contributed seven topics and Dr P. Guo, Director, EHC presented one topic. The meeting was chaired by Dr P. Guo except for the group discussions. Time was taken for discussions after each presentation.

The workshop programme 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, EHC made a few introductory remarks. This was followed by the welcome speech by Professor Dr Mohd Zohadie bin Bardaie, Deputy Vice Chancellor (Development Affairs), University of Agriculture, Malaysia. He considered the workshop very appropriate, particularly for developing countries. Dr Mohd Zohadie mentioned that the management of water supply and sanitation systems should progress proportionately to attain a higher standard of living, both economically and environmentally. He welcomed the participants' visit to Malaysia and the University of Agriculture and wished the workshop success.

Dr Guo then delivered an opening address on behalf of Dr S.T. Han, Regional Director for the WHO Western Pacific Region. The address noted the problems associated with the management of urban water supply and sanitation, particularly those related to operation and maintenance. The key factors contributing to poor operation and maintenance of urban water supply and sanitation systems were highlighted and the need to solve the problems by Member States was stressed. He urged all to actively participate in the workshop and hoped that the workshop would lead to the development of policy, institution and legislation to improve the management of urban water supply and sanitation systems.

A copy of the opening address is given in Annex 4.

2. PROCEEDINGS

2.1 Summary of country reports

Participants from each country presented a report on management of urban water and sanitation systems in his/her country. These reports showed a great diversity in the status of development and management of urban water supply and sanitation systems in the Region.

Common features included excessive amounts of unaccounted for water (ranging from 6 to 60%), inadequate cost recovery, lack of properly trained manpower, low priority given to operation and maintenance, lack of local funds, design deficiencies, lack of community involvement, lack of good management practices and interagency coordination including external support agencies (ESAs), and lack of national policy and guidelines as well as non-compliance to these by both national agencies and ESAs.

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

After the presentation of the 18 country reports by the respective participants, Dr Basaran summarized and presented the salient features of the reports. In essence, the country reports confirmed the findings presented by Dr Basaran under the topic "Review of management of urban water supply and sanitation systems in the Western Pacific Region" (see Section 2.2.1).

2.2 Summary of working papers/discussions/activities

2.2.1 Review of management of urban water supply and sanitation systems in the Western Pacific Region

Dr Basaran presented a review of management of urban water supply and sanitation systems in the Western Pacific Region. He pointed out that specific data on various aspects of management is not available to assess the effectiveness but the limited information available clearly shows its importance.

Dr Basaran highlighted some of the constraints to effective management of urban water and sanitation systems in the Western Pacific Region. These included low priority given to operation and maintenance, lack of funds, inadequate cost recovery, design deficiencies, lack of community involvement and lack of good management practices.

The presentation prompted a question from Bangladesh concerning the severe constraints on a city like Dhaka with over 8 million inhabitants. Dr Basaran's reply included a reminder that the "megacities" conference report was one resource which addressed the question.

Malaysia followed with questions about the timing for an environmental health impact assessment and also with questions on WHO's willingness to support the private sector. Drs Guo and Basaran both responded noting in particular that WHO does support the private sector in various ways but that the support is sometimes indirect and always via the member country's health agencies.

2.2.2 Activities of the Operation and Maintenance Working Group of the Water Supply and Sanitation Collaborative Council

Mr Hueb introduced the objectives and scope of work of the WHO Operation and Maintenance (O&M) Working Group. The participants were informed about the activities under implementation by the Group including the preparation of selected tools (manuals, guidelines, training packages), training activities, national and international workshops and the possible mechanisms for use and application of tools at the country level. Details were provided about the findings and experience of the O&M Working Group over the past years. A brief explanation on each of the O&M tools, concepts involved, etc., was presented and further discussed with the participants.

Mr Hueb informed that the WHO O&M Working Group is succeeding in demonstrating to the international community of ESAs and Member States that this issue must be addressed properly if the water supply and sanitation agencies are expected to achieve adequate levels of productivity and effectiveness. The O&M Working Group's members are representatives of ESAs active in the sector and representatives from water supply and sanitation agencies.

2.2.3 Management of water supply and sanitation

Mr Hueb's presentation was based on the recent WHO document "Operation and Maintenance of Urban Water Supply and Sanitation Systems - A Guide for Managers". According to this document, management of water supply and sanitation facilities should be viewed under a "system" perspective. The systems approach to management enables managers to describe and reorganize the service framework of a water supply and sanitation agency and to allocate resources so that targets can be achieved efficiently. According to this approach, each water supply and sanitation agency can be described as an overall agency system within which is a range of organizational systems. Six major

organizational systems were described: planning, operational, commercial, financial, human resources administration and development, administration support and management information systems.

The presentation was followed by questions on how countries could assess strengths and weaknesses of their internal and external environments. Dr Hueb explained that this was the purpose of the planned group exercises yet to come.

2.2.4 Managerial and technical aspects of optimization of water supply and sanitation systems

In his presentation, Mr Hueb emphasized the need for viewing programmes for the optimization and improved operation and maintenance facilities as a set of actions involving all areas of the institutions, under the perspective of a comprehensive institutional development framework. Three major programmes are commonly considered of greater priority for the optimization of water supply and sanitation facilities: loss control programme; programme for the control of the production and quality of drinking water; programme for the operation and maintenance of sewage collection, treatment, re-use and disposal.

A programme for control of water loss comprises the activities carried out by an agency to achieve and maintain the lowest possible level of loss (from leaks, overflows, illegal use of water, waste, operational consumption, special consumption, errors in metering or estimation). Projects and activities aimed at the control of water loss extend to all the organizational systems of the agency, though most are concentrated in the operational and commercial systems. Mr Hueb's presentation therefore emphasized projects and activities in these two systems.

A programme for the control of the production and quality of drinking water for human consumption comprises elements and procedures aimed at identifying and controlling factors that directly and indirectly affect the quality and efficiency of the water supply.

A programme to optimize the operation and maintenance of sewage systems aims at the implementation of procedures for the operation and maintenance of such services in such a way that the agency can provide the widest coverage, the biggest capacity for disposal and the best quality continuous service, with cost kept to a minimum.

2.2.5 System performance assessment

Mr Hueb's presentation emphasized the importance of conducting applied network survey techniques in water production and distribution systems as a means to carry out technical diagnosis of these systems. Field tests such as trunk main, pump, loss-of-head tests, etc., using appropriate portable equipment, are of fundamental importance for a better understanding of the hydraulic performance of the systems. Such studies lead to the adoption of measures of crucial importance for the optimization of water supply and sanitation systems.

The presentation prompted comments and questions concerning the choice of materials and standards for materials to be adopted and specified. Mr Abrams encouraged participants to stand firm behind their authority in the choice of materials. Malaysian participants followed with a question concerning scheduled and unscheduled maintenance. Mr Hueb answered that like corrective and preventive maintenance, each authority would develop its own definition to suit its needs. Examples were given. Fiji's question on the same topic was also answered by Mr Abrams with an example concerning submersible

pumps maintenance. Participants from India asked for titles of manuals which Mr Hueb said could be provided by his office.

2.2.6 Management of unaccounted-for water

Dr Basaran delivered a presentation on unaccounted-for water (UFW). It comprised definition, components, estimation methods, and factors influencing control of UFW. He elaborated on effects of and factors influencing leakage, "water audit" concept, why and how to conduct a water audit, benefits of water audit, etc. Finally, he presented the elements of an efficient and effective water system and water supply and sanitation agency.

The presentation was followed by questions from Malaysia on the definition of unit cost of production and how it could apply to leakage costs. Bangladesh provided more recent figures than those contained in Dr Basaran's presentation for Dhaka.

2.2.7 Operation and maintenance problems of water and wastewater treatment systems - case studies

Dr Guo presented two case studies, one on a water supply system and the other on a wastewater treatment system. He highlighted the operation and maintenance problems associated with the two systems.

In the water supply system, pollution of water source, hydraulic overloading, lack of skilled operators and maintenance crew, malfunction of process control and monitoring equipment and poor housekeeping were the major reasons for the poor performance of the system.

The major problems associated with the wastewater treatment system were high inflow/infiltration, breakdown of grit chamber, comminutor, bar screen, air-lift pump, scum hopper and sludge scraping device, insufficient mixed liquor suspended solids in the aeration chamber, excessive aeration, and lack of skilled operators and laboratory facilities for process control and monitoring.

The case studies prompted questions regarding the possible remediation of the two plants. Dr Guo was able to display remedial measures for both short and long term which were recommended. Further discussion included the current status of the case study plants, residual chlorine levels and the advisability of installing easy to maintain instrumentation and plant equipment. Oxidation ponds instead of activated sludge wastewater treatment plants was an example provided.

2.2.8 Case study of successful management approach

Mr Hueb introduced his presentation by indicating that amongst the case studies described or presented internationally, he found that a project developed in the city of Sao Paulo, Brazil, several years back had the greater significance for the theme of the workshop. In this city, a five-year programme was implemented to improve the management performance of the water authority responsible for the local water supply and sewerage services and to reduce the unaccounted-for water which was originally 37%. Such a programme included aspects of management improvement, implementation of a systematic leakage control service, applied network survey, improvement of the methods for controlling the distribution system including telemetering and telecontrol, improved metering practices, more reliable maps, etc.

The implementation of such a comprehensive programme resulted in the reduction of unaccounted-for water from 37% to 26% over a time frame of five years. It also led to a substantial increase in the overall amount of water billed and to a great improvement in the hydraulic conditions of the distribution system. During this time, the number of house connections was expanded from 1.0 million to 1.5 million, practically without the need for expansion of the water production system.

Mr Hueb affirmed that despite the differences between the constraints and overall conditions of Sao Paulo as opposed to those of the participating countries, the lessons learnt from the latter programme might be very useful to some of the countries attending this workshop.

In the discussion that followed, Bangladesh asked about the role of staff motivation. Mr Hueb replied with examples confirming the importance of encouraging staff with positive steps.

Viet Nam asked how the accuracy of macrometers installed in the water supply systems could be checked. Mr Hueb replied that there are several options to conduct field accuracy tests. These tests consist of the installation of calibrated portable meters (turbine meters, Pitot tubes, electromagnetic meters, etc.) in series with the permanent meter and comparison of the reading of both under different rates of flow.

2.2.9 Demonstration on equipment used in leakage detection

A field session was conducted by Mr Khor Thiam Chay, Assistant Director, Water Supplies Branch, Public Works Department of Malaysia for demonstration of some of the common equipment used in leak detection. Mr Khor started this practical session by explaining the use and limitations of the manual listening stick which is one of the simplest equipment for leak location available in the market. Demonstrations were also conducted on more sophisticated equipment for leak detection and location including electronic listening stick, electronic leak noise detector and leak noise correlator. The latter type of equipment is very effective, is of a considerable degree in sophistication and requires highly skilled technicians to operate and maintain.

Mr Khor also demonstrated the use of pipe and valve locators as this type of equipment is of great importance to support leak detection activities. Demonstrations were conducted on the following equipment: metallic pipe and live cable locators, non-metallic pipe locators, surface box and valve locator.

A great interest was demonstrated by all participants in the development of this practical session of the workshop. A lively discussion took place following the field session when many questions were raised by the participants which were properly addressed by Mr Khor, his staff and WHO resource persons.

2.2.10 Roles of external support agencies in improving operation and maintenance services

Dr Basaran recalled a number of major ESAs that are active in providing technical and financial support to the water supply and sanitation sector including WHO. He gave examples of country-ESA collaboration based on his personal experience in the last 25 years as a professional working in this sector. He pointed out that countries also have important roles which could affect the roles of ESAs positively or negatively, in this mutual concern.

Dr Basaran also gave a comprehensive presentation on WHO Western Pacific Regional Office (WPRO) collaboration in the sector emphasizing WPRO's organization, resources, objectives and methods of collaboration, priorities, new horizons in health, regional environmental health strategy and priority activities, its strengths and shortcomings, and finally the procedure to be followed to request WHO collaboration.

Bangladesh and Fiji both responded to the presentation with concerns for how ESAs seem to control the delivery and direction of their support. Messrs Abrams and Hueb both concurred with Dr Basaran that countries must decide what they want and express requirements accordingly to ESAs, with the country's priorities spelled out clearly. Examples of China's re-lending of ESA grants and of Bangladesh's use of revolving funds were two examples given of countries taking a strong role in guiding ESAs.

2.2.11 Leakage control

Mr Hueb gave a short presentation on the current methods of control of leakage in distribution systems which include the following:

Pressure control: The pressure in the distribution system is proportional to the flow of water through leaks in pipelines and vice-versa. Therefore, an average pressure reduction in the piped distribution system would lead to a reduction in the amount of water lost through these leaks. Amongst the various measures to achieve pressure control in the distribution systems are: sectorizing, installation of pressure reducing valves, etc.

Passive leakage control: The leaks are repaired when they are reported by the users or the staff from the water utilities. Considering that most of these leaks are visible, they produce major water losses.

Regular sounding: Leaks are located by deploying teams of inspectors who systematically work their way around the system sounding all meters, stopcock, hydrants, valves and other convenient fittings, listening for the characteristic noise of leaking water.

Zone or district metering: The piped distribution system is divided into zones, such that all flow into and out of each zone can be measured by strategically placed flowmeters. The level of demand during the early hours of the morning when demand is at its lowest (the "night line") is used to monitor the level of leakage. Should the level of night consumption be higher than expected, then further investigation is conducted to identify the causes of such unusual consumption. This investigation might require the conducting of consumption surveys in smaller subdistricts of the zone under study and direct sounding on the lengths of pipelines likely to be affected by leaks.

Considerably, more discussions followed on the topic of unaccounted-for water and loss control. Mr Hueb noted that there is no single percentage of, or particular percentage of unaccounted-for water that is practical to achieve. He illustrated this with examples where considerable money was spent to gain only slight reduction in unaccounted-for water in Switzerland and elsewhere. Even 20% unaccounted-for water could be considered to be acceptable.

Dr Guo then led participants from Hong Kong, Japan, the Republic of Korea, Samoa and Singapore into commenting on their unaccounted-for water percentages. The unaccounted-for waters ranged from 6% to 30% (reported by Singapore). Mr Hueb concluded that unaccounted-for water was clearly understood by all participants.

2.2.12 WATNET: Network analysis and simulation presentation

This presentation was made by Mr Hasnul Mohd Salleh, one of the participants from Malaysia. The network analysis essentially calculates pressures, flows and associated values at a single point in time under specific demand conditions. The network simulation is a series of network analysis over an entire period of simulated time.

The WATNET 4 programme is a computerized modelling software that performs the hydraulic analysis for the distribution system. The model provides the flows, pressures, sources, demands and the status of network control equipment for either a required instance in time or over an entire period. The software is developed by WRC Engineering of England.

The sequence of analysis is (1) a simplified schematic of the distribution system showing critical mains is produced; (2) domestic, commercial and industrial demands are allocated to nodes in the system; (3) information relating to the reservoir capacity and levels, pump curve, and network control equipment is collected; and field data are collected and the model verified.

Principal uses:

Network analysis:

- Design of new systems and reinforcement of existing networks
- Assessment of network capacity
- Design of district metering schemes for leakage control
- Design of pressure control schemes
- Investigation of pumping schedule to reduce operating costs
- Effect of pipe deterioration on the distribution system.

Network simulation:

- Detailed pumping simulation
- Assessment of diurnal effects of demand and operation
- Assessing reservoir performance
- Monitoring of supply and distribution with field measured values.

2.2.13 Management information systems for improving performance of water supply and sanitation systems

This presentation by Mr Hueb focused on the impact to the efficiency and effectiveness of water supply and sewerage services, from the development of information systems to support the various levels of management decisions within the sector agencies. The efficient and effective performance of an agency depends upon the appropriate definition of the interrelationship between managerial activities (planning, organization, selection and development of staff, coordination, direction and control) and the functions of the organization (organizational systems). Mr Hueb indicated that the interaction

between individuals at different management levels together with the use of information in the decision process are of great importance for an adequate agency performance.

2.2.14 Management information systems - WASAMS

Dr Basaran started his presentation by stating that "If you cannot measure something you cannot manage it" to emphasize the importance of monitoring to improve management.

Dr Basaran presented over 30 years of WHO experience in this field. He highlighted WHO's work in 1980s and the lessons learned from it which led to the development of performance indicators for the 1990s as well as future thrust of monitoring. He elaborated on the purpose and major elements of monitoring as a management tool. He urged the participants to study carefully several articles provided to them on the subject.

He presented the WHO/UNICEF Joint Monitoring Programme (JMP) as an excellent example of monitoring, processing, analyzing and reporting water and sanitation sector information.

One of the Malaysian participants asked about the use of qualitative versus quantitative indicators with WASAMS software. Dr Basaran responded with examples of how the answers depended upon the situation and need in the country.

2.2.15 Group discussions

The participants were divided into three groups to discuss various aspects of management of urban water and supply and sanitation systems.

The first group focused on the development of action plans to improve water supply and sanitation systems. The second group devoted themselves to develop strategies to control/reduce unaccounted-for water and the third group dealt with the identification of pragmatic ways for ESAs to collaborate with governments in improving O&M services. The results of the group discussion were presented by the leader of each group in plenary sessions.

The issues/constraints/strategies which were identified and developed by the individual groups are highlighted in Annex 6. Their recommendations to solve the problems associated with and to improve the management of urban water supply and sanitation systems are presented in Section 3 under "Conclusions and Recommendations".

2.3 Evaluation of the workshop

Evaluation questionnaires were completed by each participant. The participants generally agreed that the objectives of the workshop had been adequately achieved. The participants were satisfied with the presentations although they felt that the technical presentations were too short and not enough time was spent presenting these aspects of the topic. The time spent on the country papers was too long and that this aspect should be streamlined in future workshops. Nearly all of the participants would have liked some kind of field activity and the demonstrations of the equipment used in Malaysia was highly appreciated.

The administrative aspects of the workshop were considered as adequate and most participants wished to thank the administrative staff for their efforts.

3. CONCLUSIONS AND RECOMMENDATIONS

The workshop has identified a number of issues/problems associated with urban water supply and sanitation systems. Many people still do not have access to safe drinking water and appropriate sanitation services. Water supply in some countries are often intermittent and of inadequate quantity. Unaccounted-for water are unacceptably high in some municipalities. Inadequate sanitation services and discharge of untreated or partially treated human and industrial wastewaters are causes of drinking water source contamination and water resources pollution. Inadequate O&M has led to breakdown of many existing urban water supply and sanitation systems.

The workshop served the objectives of reviewing the latest management information tools in relation to urban water supply and sanitation systems; developing action plans to improve the management of urban water supply and sanitation systems; formulating strategies for control/reduction of unaccounted-for water; and, identifying appropriate ways for external support agencies to collaborate with governments in their effort to improve O&M services.

Based on the results of presentations and discussions, the workshop made the following recommendations:

Financial aspects

- Keeping in view the importance of the water supply and sanitation services, the governments should step up the allocation of financial resources to the sector.
- The water supply and sanitation agencies should strengthen their financial basis by obtaining financial resources from local institutions and external support agencies.
- The water supply and sanitation agencies should be given sufficient autonomy to conduct their management duties.
- Managers should be entrusted with the mandate to manage budgets with autonomy and responsibility according to established control criteria.

Human resources

- The performance of the agencies' staff should be monitored and evaluated. Incentives should be provided where improved work performance is identified.
- Training policies and programmes addressing the needs of the staff at all levels should be formulated and implemented. Such training policies and programmes should include on-the-job training for technicians and labourers.
- The staff susceptible of having a greater contact with the users should receive special training addressing relevant information about the agency, techniques for effective communication, etc.
- Interaction and exchange of information and experience between water supply and sanitation agencies should be promoted.

Institutional frameworks and planning mechanisms

- Master plans taking into account the mandate, mission statement and the established targets of water supply and sanitation agencies should be prepared and updated.
- The water supply and sanitation agencies should have appropriate organizational charts and a clear description of posts and responsibilities at all levels.
- The water supply and sanitation services within the same city should not be fragmented or apportioned to different institutions. A single institution should be responsible for these services.
- Management information systems which support the management process within water supply and sanitation agencies should be developed. Management indicators as well as the responsible areas for their generation, processing and distribution should be clearly defined.

Legal frameworks

- Municipal by-laws should be enacted to support the water supply and sanitation agencies in the accomplishment of their duties and responsibilities with regard to their customers.
- Effective mechanisms for the enforcement of by-laws should be adopted.

Operation and maintenance

- Operation and maintenance programmes and strategies taking into account the different factors affecting the effectiveness of these services should be formulated and maintained.
- Preventive maintenance programmes should be implemented and strengthened.
- Prepare operating manuals in simple language for the use of the operational staff of water supply and sanitation agencies.
- Water quality control programmes should be implemented to ensure that the water used for human consumption is according to national standards.
- Regular leakage control programmes should be implemented to ensure the optimum use of the water produced, increase revenues and protect the water distributed.
- International agencies such as WHO should collaborate with Member States to develop country specific leakage detection and control strategies.

Water resources

- The water supply and sanitation sector should be accorded greater priority in the allocation of water resources.

Technologies used in the water supply and sanitation sector

- Proper technologies, suitable to local conditions, should be adopted to make the schemes technically sound and environmentally friendly.
- The water supply and sanitation agencies should be made responsible for the purchasing of the materials and equipment required for their operations according to the desired standards of quality.

External support agencies (ESAs)

- ESAs should be provided with a water supply and sanitation master plan prioritizing projects and programmes.
- Governments should formulate clear cut policy and guidelines on water supply and sanitation for ESAs and vice versa.
- A close communication network between ESAs, line agency and government should be established. Line agencies should be involved in negotiation with ESAs.
- An independent water and sanitation authority to deal directly with ESAs should be established.
- Frequent tripartite reviews between ESAs, government and consultants should be carried out.
- The government should develop local resources to meet ESAs requirements and to efficiently utilize ESA funds.
- All externally-funded projects should include O&M provisions and others.
- ESAs should have a flexible attitude and play a balanced role in project management and monitoring.
- ESAs should recognize the roles of local experts and promote their total involvement in every situation.

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WORKSHOP PROGRAMME

Monday, 21 August 1995

- 0900-0930 : Opening session
- : Introductory remarks by Dr Paul Guo, Director, EHC
- : Welcome address by Professor Dr Mohd Zohadie bin Bardaie, Deputy Vice-Chancellor (Development), University of Agriculture, Malaysia
- : Opening address by Dr P. Guo, Director, EHC
- 0930-1000 : Group photograph
- : Refreshments
- 1000-1005 : Administrative briefing by Ms L.Y. Chan, Administrative Officer, EHC
- 1005-1020 : Introduction of participants and briefing on workshop sessions by *Dr Paul Guo*
- 1020-1040 : Review of management of urban water supply and sanitation systems in the Western Pacific Region by *Dr Ali Basaran, Regional Adviser in Environmental Health, WHO Western Pacific Region*
- 1040-1100 : Activities of the Operation and Maintenance Working Group of the Water Supply and Sanitation Collaborative Council by *Mr Jose A. Hueb, Sanitary Engineer, WHO Headquarters*
- 1100-1200 : Country Reports (15 minutes each)
- Bangladesh
 - Cambodia
 - China
 - Fiji
- 1200-1330 : Lunch
- 1330-1430 : Country reports (*contd.*)
- Hong Kong
 - India
 - Japan
 - Lao People's Democratic Republic

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- 1430-1530 : Country reports (*contd.*)
- Malaysia
- Micronesia, Federated States of
- Nepal
- Papua New Guinea
- 1530-1600 : Refreshments
- 1600-1700 : Country reports (*contd.*)
- Philippines
- Republic of Korea
- Western Samoa
- Singapore

Tuesday, 22 August 1995

- 0900-1000 : Country reports (*contd.*)
- Solomon Islands
- Viet Nam
- 1000-1030 : Summary of country reports
by Dr Ali Basaran
- 1030-1100 : Refreshments
- 1100-1200 : Management of water supply and sanitation
by Mr Jose A. Hueb
- 1200-1330 : Lunch
- 1330-1430 : Operation and maintenance problems of water and wastewater
treatment systems - case studies
by Dr Paul Guo
- 1430-1530 : Management of unaccounted-for water
by Dr Ali Basaran
- 1530-1600 : Refreshments
- 1600-1700 : System performance assessment
by Mr Jose A. Hueb

Wednesday, 23 August 1995

- 0900-1000 : Managerial and technical aspects of optimization of
water supply and sanitation systems
by Mr Jose A. Hueb
- 1000-1040 : Case study of successful management approach
by Mr Jose A. Hueb
- 1040-1100 : Refreshments

- 1100-1200 : Roles of external support agencies in improving operation and maintenance services
by Dr Ali Basaran
- 1200-1330 : Lunch
- 1330-1630 : Demonstration on equipment used in leakage detection
by Mr Khor Thiam Chay, Assistant Director, Water Supplies Branch, Public Works Department of Malaysia
- 1630-1700 : Refreshments

Thursday, 24 August 1995

- 0900-0930 : Leakage control
by Mr Jose A. Hueb
- 0930-0950 : Management information systems for improving performance of water supply and sanitation systems
by Mr Jose A. Hueb
- 0950-1040 : Management information systems - WASAMS
by Dr Ali Basaran
- 1040-1100 : Refreshments
- 1100-1110 : Briefing on Group Discussions
by Dr Paul Guo

The participants will be divided into three groups to discuss various aspects of management of urban water supply and sanitation systems

Group 1:

To develop action plans to improve the management of water supply and sanitation systems

Group 2:

To develop strategies to control/reduce unaccounted-for water

Group 3:

To identify pragmatic ways for external support agencies to collaborate with governments in improving operation and maintenance services

- 1110-1200 : Group discussion
- 1200-1330 : Lunch
- 1330-1530 : Group discussion (*contd.*)
- 1530-1600 : Refreshment

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1600-1700 : Group discussion (*contd.*)

Friday, 25 August 1995

0900-1030 : Presentation of results of group discussions

1030-1100 : Refreshments

1100-1200 : Presentation of results of group discussions (*contd.*)

1200-1230 : Summary, evaluation and closing of workshop
by *Dr Paul Guo*

1230-1400 : Lunch

LIST OF DOCUMENTS DISTRIBUTED DURING THE WORKSHOP

Working papers

- WPR/RUD/EHC(2)95.1 Review of management of urban water supply and sanitation systems in the Western Pacific Region
by Dr Ali Basaran
- WPR/RUD/EHC(2)95.2 Activities of the operation and maintenance working group of the Water Supply and Sanitation Collaborative Council
by Mr Jose A. Hueb
- WPR/RUD/EHC(2)95.3 Management of water supply and sanitation
by Mr Jose A. Hueb
- WPR/RUD/EHC(2)95.4 Management of unaccounted-for water
by Dr Ali Basaran
- WPR/RUD/EHC(2)95.5 Managerial and technical aspects of optimization of water supply and sanitation systems
by Mr Jose A. Hueb
- WPR/RUD/EHC(2)95.6 Roles of external support agencies in improving operation and maintenance services
by Dr Ali Basaran
- WPR/RUD/EHC(2)95.7 Demonstration on equipment used in leakage detection
by Mr Khor Thiam Chay
- WPR/RUD/EHC(2)95.8 Management information systems for improving performance of water supply and sanitation systems
by Mr Jose A. Hueb
- WPR/RUD/EHC(2)95.9 Management information systems - WASAMS
by Dr Ali Basaran

Country situation reports

- WPR/RUD/EHC(2)/95/INF./3 Bangladesh
by Mr Kazi Mohammad Sheesh
- WPR/RUD/EHC(2)95/INF./4 Cambodia
by Dr Mom Ky

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WPR/RUD/EHC(2)95/INF./5	People's Republic of China by Mr Ruan Ru-xin
WPR/RUD/EHC(2)95/INF./6	Fiji by Mr Sosiveta Turagaiviu
WPR/RUD/EHC(2)95/INF./7	Hong Kong by Mr Tang Wai Wan
WPR/RUD/EHC(2)95/INF./8	India by Mr V.B. Rama Prasad
WPR/RUD/EHC(2)95/INF./9	Japan by Mr Toshiaki Shimazaki
WPR/RUD/EHC(2)95/INF./10	Lao People's Democratic Republic by Dr Soutsakhone Chanthaphone
WPR/RUD/EHC(2)95/INF./11	Malaysia by Mr Mohd Jalal bin Bongkik
WPR/RUD/EHC(2)95/INF./12	Federated States of Micronesia by Mr Joakim Kaminanga
WPR/RUD/EHC(2)95/INF./13	Nepal by Mr Anand Mohan Lal Das
WPR/RUD/EHC(2)95/INF./14	Papua New Guinea by Mr Sibona Vavia
WPR/RUD/EHC(2)95/INF./15	Republic of the Philippines by Mr Huberto V. Jimenez
WPR/RUD/EHC(2)95/INF./16	Republic of Korea by Mr Joo Bong-Hyeon
WPR/RUD/EHC(2)95/INF./17	Western Samoa by Mr Graham Costin
WPR/RUD/EHC(2)95/INF./18	Singapore by Mrs Ang-Tan Seow Kiak
WPR/RUD/EHC(2)95/INF./19	Solomon Islands Mr Donald Makini
WPR/RUD/EHC(2)95/INF./20	Socialist Republic of Viet Nam by Mr Le Van Duc

Publications/hand-outs

1. Operations and maintenance of water supply and sanitation systems: case studies:
A publication by the World Health Organization and the Water and Sanitation Collaborative Council
2. Tools for the assessment of operation and maintenance status of water supplies:
A draft report by the World Health Organization Operation and Maintenance Working Group and the Water and Sanitation Collaborative Council
3. Operation and maintenance of urban water supply and sanitation systems - A guide for managers:
A publication by the World Health Organization
4. Systems approach:
by Mr Jose A. Hueb
5. Evaluation of extended aeration activated sludge package plants:
by Paul H.M. Guo, D. Thirumurthi, B.E. Jank
6. Components of an action plan to improve the management of water supply and sanitation systems
7. Bangladesh : Geography : Climate
8. Fiji : Water supply and sanitation systems
9. Hong Kong : Flushing water supply of Hong Kong
10. Malaysia : Kota Bharu non-revenue water control project
11. Papua New Guinea : The Water Board performance indicators (June 1995)
12. Philippines : Water supply and sanitation systems

OPENING ADDRESS

On behalf of Dr S.T. Han, WHO Regional Director for the Western Pacific, I am pleased to welcome you to this five-day workshop on management of urban water supply and sanitation systems, and extend my best wishes to all of you.

It is evident in many countries of the Region that the management, and particularly 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 stems from countries' wishes to provide 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 perception in many countries that water supplies, including their operation and maintenance, are the government's responsibility. This is particularly true in rural areas where the population is often reluctant to help maintain the systems provided by the government. It is interesting to note that, in a recent survey carried out in this Western Pacific Region, most countries rated the lack of an adequate cost recovery framework as the greatest 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 the sector's development, the past ten years have not witnessed any substantial progress in this field. In urban areas of developing countries, 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 are forced to use alternative water sources of doubtful quality.

The key factors contributing to poor operation and maintenance of water supply and sanitation systems have been identified as: (1) absence of data on operation and maintenance, (2) inefficient use of funds, (3) poor management of water supply and sanitation facilities, (4) inappropriate system design, (5) low profits from operation and maintenance, (6) inadequate policies and legal frameworks, (7) overlapping responsibilities, and (8) political interference.

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

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I hope the workshop will enable you to review your own national sector policies and practices on operation and maintenance. This in turn should lead to the establishment of improved policies and legal and institutional frameworks. These frameworks will 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. Finally, I would like to express our appreciation to the Government of Japan for their support in financing this workshop, and to our hosts, the Government of Malaysia and the University of Agriculture, Malaysia for their valuable support in making the workshop possible.

With this remarks, I now declare open the Workshop on Management of Urban Water Supply and Sanitation Systems.

Thank you.

SUMMARIES OF COUNTRY SITUATION REPORTS

1. Bangladesh

The total population of Bangladesh is estimated to be 111 million in 1991. Of these, 23 million (22% of the total population) are living in urban areas (i.e. 64 district towns) and it is expected that this amount will increase to 40 million (25% of the total population) by the year 2000. About 30% of the urban population live in the Dhaka metropolitan area, the capital city.

A very high incidence (one of the highest in the world) of diarrhoea and other water borne diseases reflects the extent of contamination in the surface water and the extensive use of untreated water from streams, rivers, and shallow tube-well. Every year, approximately 250,000 children under five years of age die from diarrhoeal diseases which constitute about 30% of all under five child mortality. Groundwater sources however, require little or no treatment and is used by public water utilities and private institutions as a major source of supply.

It is estimated that 42% of the urban population have access to reasonably safe piped water supply but the remaining 58% depend on contaminated traditional sources. Out of the 64 urban areas, only Dhaka and Chittagong have separate authorities for urban water supply management and only Dhaka has both water supply and sewerage system.

In the urban areas, Department of Public Health Engineering (DPHE) is responsible for design, planning and construction water supply systems including development of source and construction of reticulation and storage facilities. The source of supply is groundwater. After construction by DPHE, the facilities are handed over to the urban authorities or municipalities for operation and maintenance of the system. The emphasis is being given to completion of ongoing aided projects and new projects are being taken up in important towns which have not been covered or which need expansion of water supply facilities. The relevant coverage in towns has been proposed to be raised to 75% during the fourth five-year plan period.

In urban areas it is estimated that about 40% of the urban areas have access to sanitary waste disposal services. There is no sewerage system in these urban areas and on-site sanitation methods are used. The untreated effluents are discharged to a nearby water course and low lying area. Drainage in the urban areas is also the exclusive responsibility of DPHE. In most of the urban areas, drainage of storm water is through surface drains and natural canals. Package programmes are being taken up to integrate water supply, sanitation and drainage in urban areas. Special consideration is being given to providing water supply and sanitation facilities to the urban population of slums and fringe areas.

While there is a defined policy for management of water resources of the country as a whole, policy for management or use of water in urban areas has not been formulated yet. There is no adequate legislation to enforce the pollution control standards, thus untreated wastewater is discharged directly into water courses by the urban areas except Dhaka city which treats about 50% of its wastewater.

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Severe operational and maintenance problems of the water distribution system are due to inadequate system pressure, leakage, wastage, power failure, high population growth rate, low cost recovery or accounts receivable.

Sewer operations are plagued by infiltration from illegal pipe joints and clogging of sewers due to dumping of garbage in the manholes.

Steps taken to reduce unaccounted-for water include consumer survey, metering, utilization of billing, ensure delivery of bills, reduction of technical system losses. Cost recovery for water supply in urban/municipal areas is done mainly in the form of municipal taxes. There is no direct cost recovery for drainage facilities.

2. Cambodia

The population of Cambodia is estimated to be 10 million, with 88% living in the rural areas.

Urban water supplies

The main city is Phnom Penh with a population of 900,000. Three treatment plants have in the past served the city but due to lack of maintenance, there are only two plants in operation with a total capacity of 72,000 m³ per day, water demand is estimated at 138,000 m³ per day. Urban water supplied is managed by the Phnom Penh Water Authority which is a government supported organization. All of the infrastructure was installed during the French colonial government and following a long period of war in the country has slipped into disrepair. Water borne diseases in Cambodia are of a major concern and cholera, diarrhoeal diseases and typhoid are endemic in Cambodia. Many of the problems in the urban centres are illegal connections and collection of water charges.

Sanitation

Phnom Penh has a combined storm water sewage disposal system interlinked with septic tanks and in the peri-urban areas. There is no formal sewage disposal system and the waste is drained into wetland areas for disposal.

Issues and concerns

Major rehabilitation on both water and sewerage systems is needed.

There is a lack of trained professional and maintenance staff.

There is lack of funding.

3. People's Republic of China

The total population of the People's Republic of China was approximately 1,100 million of which 187 million were living in 517 cities/urban areas in 1992. Of these, 173 million (92.5% of the total urban population) are served by urban water supply systems. All the cities have established their own water supply and there were 1,478 waterworks at the end of 1992. Average per capita domestic consumption of water is about 180 litres per person per day (l/p/d) and the maximum is around 300 l/p/d. The report does not present any statistics related to water and sanitation related diseases in the country.

There is now 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. There is no information regarding water charges, operation and maintenance, etc. in the country report presented.

Existing water supply facilities are lagging behind the water demand. There are 300 cities lacking water and of these, 50 are seriously short of water by about 10 million cubic metres per day. Sixty percent of the cities are supplied from surface water after treatment. In general, drinking water in big- and medium-size cities meet the Chinese national standards for turbidity, residual chlorine, total bacteria and coliforms published in 1985. Most of the water laboratories are inadequately equipped to carry out all the analysis indicated in the national standards. This deficiency covers up some of the water quality problems.

Main problems include leakage, breaking pipes and power outages. Design guidelines require that during power failures, etc. the supply should be kept at no less than 70% of the normal flow. Power consumption is about 0.329 kwh per cubic metre and it constitutes about 30-40% of the total water production cost.

There are two types of service pressure levels: one that meets the requirements of three storey buildings; and the other five or six storey buildings. Research has been carried out in the field of network optimization and increasing pump efficiency.

The Ministry of Construction appointed the China Urban Water Works Association to prepare a master plan to meet year 2000 demand. This effort includes promotion of water quality, safeguarding water supply reliability and lowering the consumption of chemicals, power and leakage.

Since 1978, the responsibility of the construction of water projects has been given to local governments. Water projects involving inter basin transfer of water however are still handled by the central government. The yearly average investment has increased from 0.46 billion yuan in the sixth 5-year development plan to 3.93 billion yuan in 1992.

Administration of urban water supply systems is shared among central government, provinces and cities. The city governments are responsible for specific administration (construction and management) of their facilities. National Economic Plan Committee and the Ministry of Construction supervise the construction of all water facilities and are responsible for the administration aspects.

4. Fiji

Fiji is a country of 715,000 situated in the south west Pacific Ocean comprising more than 100 inhabited islands. The bulk of the land area of 18,000 square kilometres is on the two main islands. Viti Levu, the largest island, also includes the capital city, Suva has a population of 100,000. The climate is tropical. Windward areas generally receive generous rainfall.

Water supply/sewerage systems fall under the responsibility of the Public Works Department. The Departments of Health and Rural Development share responsibility in rural areas for water and sanitation services. Forty public water supply systems serve

Annex 5

approximately 570 000 people in urban areas and settlement through 95 000 connections, representing 80% of the population.

In rural areas the estimate is that only 22% of the rural population are served by Government-installed water supply schemes. Surface water provides most of the urban schemes with water to be treated for distribution. Fiji has been fortunate that most catchments remain free of conflict over water use and free of pollution, though risks are noted to be increasing. The Public Works Department has successfully localized a number of positions held previously by expatriates though initial hopes of 100% localization have been delayed following political events of 1987.

New, regional water supply schemes in the second and third largest cities, Nadi and Lantoka, have been recently completed. Other smaller urban centres await renewal of works that are proposed. Unaccounted-for water is presently as high as 35% at some centres. External support is now at hand to reduce this figure. As well, improvements to metering, billing and financial management is desired but staffing is the listed constraint. A reorganization for the Public Works Department water supply and sewerage organization into an autonomous, self-accounting body may one day eventuate. At present, the water supply operation is only 50% financially self-sufficient and is subsidized by the Government accordingly.

5. Hong Kong

The total population of Hong Kong was about 6.15 million at the end of 1994.

Incidence of water and sanitation related diseases are reported to be minimal.

Main sources of water are rainfall from natural catchments and supply from China. There are separate systems supplying sea water for flushing purposes in the majority of urban areas and the new towns, and fresh water to meet the demand. About 99.7% of the urban population are served by water supply through some 2 million customer meters.

More than 2 million cubic metres of wastewater per day drain into Victoria Harbour or the surrounding coastal waters from the urban areas following pre-treatment by screening and through submerged pipelines/submarine outfalls.

Environmental Protection Department assumed the duty of planning sewage treatment and disposal facilities in 1986. A sewerage master plan has been developed in recent years to strengthen the sewage collection system to separate domestic waste and storm water systems with the objective of reducing water pollution in the harbour and on the bathing beaches.

Water Supplies Department (WSD) is responsible for planning water resources and design, construction, operation and maintenance of water supply systems. The WSD had 5 600 employees (300 professionals, 2 000 technicians, 800 general service and 2 500 skilled, semi-skilled and junior staff) in 1994. It consists of administrative and planning branch, new works branch, China water supply branch, the supply and distribution branch, mechanical and electrical branch, and financial management branch.

Drainage Service Department (DSD) is responsible for the task of providing an efficient approach to resolving the sewage and flooding programmes. The DSD's responsibilities also include design, construction, operation and maintenance. It has 1 600 employees (180 professionals, 480 technical, 170 general service and 770 direct labourers).

A "trading" fund was introduced in DSD for the provision of sewage services to cover government services which can be paid for with revenue collected from those who use the services rather than with the general revenue.

Both WSD and DSD have been developing and using computer applications as well as commercially available software to assist in and to improve the delivery of services for many years. The WSD started implementing an "Electronic Meter Reading System" in 1993 to eliminate possibility of errors arising from the manual recording and transferring of data. There is a regular leakage reduction and control programme as well as flood warning, prevention and protection programme backed up by legislation.

Hong Kong has adopted a preventive maintenance approach rather than crisis management. It has also developed specific performance indicators and targets to review the achievements of both WSD and DSD. The water supply is continuous and meets international standards. Unaccounted-for water is about 28% at present but efforts are continuing to reduce it to a more acceptable level.

6. India

The population of India based on the 1991 census was 844.33 million of which 217.18 lived in urban areas and 627.15 million in rural areas.

General statements made in the report indicated that there were still significant illness related to water-borne diseases especially related to lack of adequate water and sanitation facilities in both rural and urban areas. Figures quoted in some reports speculate that 80% of all illness can be attributed to inadequate water supply and sanitation.

Coverage reports on water supply with "safe" water

85.3% urban coverage

Coverage reports on sanitation

46.6% urban coverage

These coverage figures do not meet the government target figures which were set at the start of the "Decade". The Government has launched a centrally-sponsored programme which is heavily sponsored and supported by both the central government and state governments. India has a well developed classification system for water supplies/sources which categorizes each source/supply giving a much simplified description process for the facilities.

Pollution is a major concern and some action is being taken in certain areas and government/state governments are taking action to reduce the amount of pollution especially caused by industry. Action plans and activities taken by government to clean up areas which have been or are being polluted.

India has a major unaccounted-for water programme and estimations range from 20 to 40%. Some cities have embarked on reduction programmes and are carrying out extensive training to improve and inform professionals on ways to reduce water losses. India recognizes its water and sanitation problems has adopted or is adopting strategies to improve coverage and efficiency in this sector.

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7. Japan

The population of Japan is 123.93 million based on the 1993 census report. Japan has a very low population increase of 0.4% and due to a falling birthrate, is the lowest since the end of the war.

Japan is a well-developed country and water supply service reaches 95.3% of the population, also based on the census document of 1993. There are still some remote fishing villages which do not have water supplies and some action is being taken by the Ministry of Health and Welfare to rectify this. 70% of all Japan's water comes from surface sources, groundwater use is limited because of over extraction.

Sanitation

Pollution of rivers and streams has been virtually eliminated but there are still some problems with lake water and stationary water bodies which are heavily contaminated by organic pollutants from mainly domestic sources. Japan has a well developed sanitation system in the large cities and varying types of sanitation ranges from the full water-borne systems to septic tanks and nightsoil in the small communities.

Operation and maintenance

Operation and maintenance is well developed in most towns and cities in Japan and the levels of sophistication in the technology used is advanced and effective. Japan has implied that over sophistication has many disadvantages and careful thought should be given to systems becoming too complex. Leakage control of the system is carefully monitored and defects repaired promptly. National policies call for 90% utilization, currently the published figures nationally are 81% utilization.

Issues and concerns

Emergency situations in Japan are considered a high priority. Natural disasters such as earthquakes are of a major concern to the Japanese authorities as Japan is in a high risk seismological zone in the world. Replacement of ageing networks is also of concern and the capital cost of replacement is weighed against the continuing cost of high maintenance. Water quality is deteriorating and closer monitoring for bacteria and pollutants is considered necessary. The major concerns are listed as guidelines and procedure manuals, consolidation of managerial organization, security and funding for operation and maintenance, training, and cautious approach to automation.

8. Lao People's Democratic Republic

The Lao People's Democratic Republic has a population of 4.474 million in 1993. The population living in rural areas is 3.6 million (80% 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 a classical standard (treatment plant, distribution system, house connection). Approximately 45% of the urban population count on sanitation facilities (latrines). The population annual growth rate is 2.6%.

Administration

Urban water supply and sanitation

Two government organizations are responsible for urban water supply and sanitation:

- Lao Water Supply Company (Nam Papa Lao) under the administration of the Ministry of Communication, Transportation, Posts and Construction;
- Institute for Clean Water for the Peoples, under the Ministry of Health.

Current situation

There are two water treatment plants in Vientiane, namely Kaolieo and Chinaimo, which has a total capacity of 60 000m³ per day. Drainage programme is being supported by government to connect all the septic tanks to a wastewater treatment plant to treat water before discharging into a natural lake.

Vientiane is being supported by ADB to prepare a Integrated Urban Development Project. This will support a loan of US\$20 000 000. This loan is to upgrade and develop water supply, sewerage, drainage and solid waste in Vientiane. Cholera is of particular concern in the rural areas of Lao People's Democratic Republic.

Government priorities

The government has a copy to improve the water and sanitation facilities to both the urban and rural population of Lao People's Democratic Republic.

9. Malaysia

The population of Malaysia is 19 million, with food and water-borne diseases still occurring in some of the states.

Water supply and sanitation

The State Water Authorities are responsible for the design, planning and administration of all public water supplies. During the period 1985-1995, there has been a rapid growth in all aspects of water supply development and capacity within the system. The average growth in production of treated water during this period is 9.5% per annum while the average growth of demand was 8.1%. The figures quoted above indicate surplus capacity but still some areas (where development has been limited) experience shortages.

Coverage

99% urban and 81% rural.

Sanitation management is gradually being transferred to Indah Water Konsortium to operate and maintain. Many of the public utilities in Malaysia is being considered for privatization, although the government is still closely monitoring the availability of components to ensure that the service is still maintained. Most of the sanitation in Malaysia is by septic tank disposal except in the densely populated urban areas. There was not coverage data available on sanitation coverage for Malaysia.

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10. Federated States of Micronesia

The Federated States of Micronesia (FSM) consists of 607 islands dispersed over an area exceeding 1 million square miles of the western Pacific Ocean between the equator and 14° north latitude. The islands are either of a high topography reflecting volcanic origins, or else of a low type formed atop reef building corals in the small and often elongated shapes that characterise such atolls. Atolls tend to be less than 20 feet above sea level. High islands comprise 92% of FSM's total land area of 250 square miles. The population of the country is about 110,000 and is divided among the four states of Chuuk, Kosrae, Pohnpei and Yap.

FSM is characterized by major structural imbalances - between consumption and production for example - and relies very heavily on external grants which finance government and development activities, among them being water and sanitation services.

FSM's second National Development Plan gives priority to improving the country's economic and social infrastructure, including the water supply sector. High rainfall on the 'high' islands and good hydrologic data are available for exploitation of surface streams. Groundwater is generally less exploitable than are the surface sources.

About 40 centralized water supply schemes operate in FSM. These serve 49 000 of the 110 000 population. Only nine of the 40 systems provide treated waters to users. The remaining 61 000 population rely mainly upon roof catchments or hand-dug wells. All systems suffer to some extent during the dry season. High losses due to leakage and taps carelessly left open are characteristic. FSM health officials estimate that 60% of the diseases in the country are related to poor water supply and sanitation.

Generally, the public works departments of the state or municipal governments are responsible for the water supply sector. The semi-autonomous Pohnpei Utilities Corporation (PUC) is a recently-formed authority which has already led to substantial improvements. Country-wide serious improvements are much needed to overcome the shortage of truly safe water supplies which are available to only 25% of the population at present. One of the problems that has emerged is the absence of specific objectives and a clearly defined policy framework for the sector. A sector development plan is identified as one essential step for FSM.

11. Nepal

The total population was about 18.5 million in 1991. Of this, about 1.7 million (9.2% of the total population) lived in urban areas.

Water supply and sanitation sector involves many agencies, often with overlapping functions, particularly at local levels.

Formed in 1972, the Department of Water Supply and Sewerage (DWSS) is the lead government implementing agency for the water supply and sanitation sector, responsible for sector planning, coordination and technical standards. The DWSS is assisted by a number of external support agencies which tend to manage their own programmes within the DWSS scope of operations.

Most water supply systems are operated on an intermittent basis, providing generally low service levels. It is estimated that over 40% of the water in all systems is unaccounted-for. Financial position has been poor mainly because of delays in raising tariff rates,

increasing operating costs, decreasing availability of water sources and deterioration staff efficiency due to unattractive incentives and low/below market rate salaries.

Target for urban water coverage is 73% and sanitation 50% by mid-1997; and similarly 100% and 75% by mid-2002. A review of the effectiveness of the existing programmes, condition of the completed projects, capacity of the institutions and available funding, especially under the current inflationary pressures, clearly suggest that these targets are overly optimistic.

The majority of urban water supply systems are large with Nepal's standards and were not designed or constructed for community maintenance. Many of the pumping schemes with overhead tanks are not financially or economically viable.

The concept of cost recovery and sustainability was given little or no consideration in the design and implementation of these schemes. Communities were not involved or consulted during planning and implementation and now the communities are reluctant to take over these large schemes. Furthermore, most of these schemes do not provide the level service for which they were designed due to the lack of adequate operation and maintenance and skilled personnel. The majority of the large complex schemes provide intermittent service and require rehabilitation. Therefore, these are viewed as a hindrance to the transfer of the larger and more complex schemes.

12. Papua New Guinea

Papua New Guinea is located in the south west Pacific and has a population of 3.6 million people. The country, independent since 1975, is characterized by rugged topography and relatively isolated islands. The climate is tropical with annual rainfall exceeding 2 500mm in most areas and as much as 9 000mm in some places. Papua New Guinea is rich in natural resources such as timber and minerals, with some of the world's most biodiverse forests. The population is 85% rural with significant drift to urban areas, especially to the capital city for Port Moresby now with 200 000 inhabitants.

Papua New Guinea has abundant water resources due to the relatively high rainfall. However, urbanization and industrial developments are having impacts. Sanitation is very basic. Most of the 20 far-flung urban areas are only served by reticulated water supply and sewerage.

The National Water Supply and Sewerage Board or the Water Board was created under an Act of Parliament in 1987 and has been mostly successful in consolidating water and sanitation efforts for eleven of these urban areas. Still the National Capital District, which included Port Moresby and several smaller urban centres, remain outside of the Water Board's jurisdiction. Consequently, Water Board coverage is only 37% of the urban population.

The lack of safe drinking water in rural areas remains a problem, contributing to a high incidence of diarrhoea, hepatitis, typhoid and skin diseases. Urban areas, while normally served 24 hours per day, face risks nonetheless when poorly maintained and leaking water systems become contaminated.

Other areas of concern for water supply and sanitation in Papua New Guinea include inconsistent Government efforts which have led to a fragmented and uncoordinated sector.

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13. Philippines

The total population was about 61.5 million in 1990 and 43% lived in urban areas (60 cities and over 1 500 in other urban districts).

Water-borne and sanitation related diseases are significant causes of morbidity and mortality in urban areas of the Philippines. Cholera and typhoid fever are endemic. Diarrhoea ranks as the second leading causes of morbidity (1 301 per 100 000 population) and forth leading causes of infant mortality (1.19 per 1 000 live births) in 1991. The total coverage of water supply and sanitation were 81% and 69% (87% and 77% in 1993). The coverage of water and sanitation in urban areas were 92% and 87% in 1992.

Only 15% of the total population are fully sewered. About 10% of the 15% are found in most urbanized region in the country, namely the National Capital Region (NCR) which has three wastewater treatment plants. Metropolitan Waterworks and Sewerage Systems (MWSS) and Local Utilities Water Administration (LUWA) are two government agencies mandated to develop water supply systems to serve in highly urbanized areas of the country. The MWSS has 9 000 employees to take charge of the production and distribution of safe water to about 8 million people in Manila as well as management of wastewater.

Water surveillance is the responsibility of the Department of Health to ensure safe and potable water to people. A total of about 9 500 water samples were collected and analyzed in the NCR. About 2.5% of these were unsatisfactory initially and after taking immediate corrective action, the quality became satisfactory by international guidelines and national standards.

Some of the issues in management of urban water supply and sanitation facilities are high percent of non-revenue water because of illegal connection, leaks, unauthorized use of fire hydrants, illegal meter tampering; lack of public awareness on the need for water and sanitation facilities and their importance to public health; inadequate funding to support construction of new facilities; and laxity in the implementation of zoning ordinance especially in urban areas.

The non revenue water is about 52% in the MWSS (1955). Of the 683 362 meters installed, 13 622 are defective and 44 221 are doubtful. In addition, there are 24 642 unmetered connections. (1994).

A remarkable increase of water and sanitation coverage was recorded between 1980 and 1990 (water from 59% to 80%, sanitation form 50% to 70%). However, despite this achievement, still a large number of population has no access due to rapid increase in population and urbanization. Operation and maintenance of the facilities are poor. The government needs to formulate a national strategy plan to address water and sanitation projects in urbanized areas. Efforts are ongoing to reduce the unaccounted-for/ non-revenue water.

14. Republic of Korea

The Republic of Korea occupies the southern part of the narrow peninsula of East Asia that is shared with North Korea, its slightly large neighbour to the north. The country's population is 45 million. The economy is strong with a per capita GNP of US\$8 483 growing at 8.2%. The climate is distinguished by four seasons with hot summers and long, cold and snowy winters.

As of the end of 1993, the urban population served by piped water supplies was 81.1% and the per capita water supplied was 394 litres per day per person for urban areas. Public health has benefited from the increasing availability of city water. Water-borne diseases including typhoid have declined steadily as piped water coverage increased from 71% to 81% over the recent period from 1987 to 1993.

The name of the Government agency responsible for water supply is not indicated within the report. However it is apparent that both water supply and sewerage services are benefiting from Government subsidies.

Water shortages are on the increase, especially in southern areas of the country, giving importance to alternatives for water acquisition. Included are small dams, river bank infiltration and groundwater schemes. These will help make up for shortfalls in the existing river sources. Groundwater is expected to increase from 7% to a target of 30% as a drinking water resource. Leakage, estimated at 18.5% is also targeted for improvement under the current plant and distribution line improvement budget.

Sewage collection and treatment in the Republic of Korea has expanded from a pre-existing system of storm sewers and developed from a concern for protecting public waters. At the end of 1994, there were 57 sewage treatment plants in the country. Treatment of sewage is now provided for 42% of the urban population. The figure represents an increase of 35% over only 7% of the population served just 14 years ago in 1981. There are also in operation a number of nightsoil treatment facilities, 195 nightsoil treatment plants in 1994. Many of these are serving less populated areas outside the major cities. Forty-nine new nightsoil treatment plants are planned by 1996 to enable 100% treatment of nightsoil. Still the government subsidy for expanding sewerage is not assured. Moreover, leakage problems that stress existing plants also are just beginning to receive subsidy for needed repairs.

15. Western Samoa

Western Samoa is an independent nation of 195 000 people located in the South Central Pacific. The capital and only true urban area is Apia with a population of 41 000. The economy is based on a subsistence agriculture with modest exports of copra and cocoa and a small tourist industry. The climate is tropical with abundant rainfall and frequent cyclones. The population is settled along narrow coastal plains and live almost entirely within traditional Samoan village settings.

Access to safe water is estimated at 75% urban and 67% rural. Hepatitis, typhoid, diarrhoea and gastroenteritis are all reported water-related diseases which are responsible for thousands of illnesses per year.

The Western Samoa Water Authority (WSWA) was newly-formed in 1994 with approximately 16 000 connections in the capital, Apia. The city, however, is plagued by one of the highest per capita consumption rates for water which has limited progress in establishing proper treatment. Rural supplies also fall under the WSWA authority and are scattered among villages on both major Samoan islands. The schemes suffer from limited storage, salt water intrusion into bores and operation and maintenance problems.

16. Singapore

The Republic of Singapore lies just north of the equator and at the southern tip of Peninsular West Malaysia. The island state is 633 square kilometres in area, comprising

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one major and several smaller islands. The topography is generally flat. Singapore's population is over 2.8 million. The climate is tropical with rainfall averaging 2 600 mm/year.

Modern water supply and sanitation is available to virtually 100% of the country's population. The Water Department of the Public Utilities Board (PUB) was formed in 1963 as a statutory authority, taking over at that time responsibility for water supply in Singapore from the then City Council. Though population growth and very limited catchment area have placed strain on the island state's water resources, the Water Department has been successful in providing safe, potable tap water to 100% of the population.

The Sewerage Department is within Singapore's Ministry of the Environment. Also very successful in maintaining safe and efficient sewerage and sanitary facilities, the Department serves almost 100% of the population while also reclaiming sewage effluent and processed sludge for reuse.

Planning for water resources is well integrated with national planning for housing, industrial and other developments. The Ministry of the Environment monitors jointly with PUB the quality of streams, rivers and reservoir water throughout the island by means of an elaborate network of sampling points. Pollution of the city's water catchment areas has been successfully controlled and curtailed.

The PUB operates nine waterworks with a total of 1 800 employees. All of the 850 000 customers are billed for water used. "Unaccounted-for water" or UFW amounts to only 6% of the total demand, indicating a high standard of efficiency.

Similarly, the sewerage infrastructure comprises six major sewage treatment plants and 386 smaller plants apart from the major sewer networks. Computer-aided engineering and maintenance and other modern procedures like closed-circuit television inspection of sewers keep the sewerage services in pace with the pressures of growing population and development. Limited land area will mandate construction of even more innovative and environmentally-sound sewage treatment facilities in the future.

17. Solomon Islands

The Solomon Islands is an independent nation of 340 000 population located in the south-west Pacific Ocean. It comprises six main islands including the island of Guadalcanal with its largest city, Honiara, the capital. The major islands are of volcanic origin with numerous small islands of coral origin. The climate is tropical. Rainfall is abundant, averaging 3 000 mm/year. Cyclones are frequent at the country's latitudes of 15^o to 20^o south of the equator.

The population is 80% rural and the economy is largely one of agricultural subsistence. Exports include palm oil, copra and cocoa with increasing amounts of fishing and logging contributing to the economy. Timber harvesting in particular has had an impact on the existing water supply catchments.

Diarrhoeal diseases are common especially among children with related deaths estimated to be 14% of those seriously afflicted or two deaths per 1 000 children per year.

Water supply and sewerage systems in Solomon Islands are mostly old, undersized or obsolete. The newly-established Solomon Islands Water Authority (SIWA) is responsible

for water supply and sewerage nationwide with efforts concentrated on the capital of Honiara where a high inward migration is experienced. Coverage of the capital's estimated 50 000 population with piped water supply is about 94%. SIWA also has officially taken up operations in two provincial centres, Auki and Tulagi, where piped water is supplemented by rainwater tanks. Outside of Honiara, the piped supply is commonly less than 24 hours per day often as a consequence of unaccounted-for water, especially leakages. In Honiara, where data is available, unaccounted-for water ranges from 30% to 52% in the town's districts.

SIWA also has responsibility for sewerage in the country. There are no treatment plants. Even in the capital city, effluent is discharged - either by gravity or by pumping - via ocean outfalls, untreated. Significant steps have been taken, including developing a five-year engineering plan, toward improving both water supply and sewerage in the country. However, matching country priorities with those of several interested donors have proven awkward in recent years.

18. 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 to 2 303 mm.

Water supply coverage varies widely in big cities; probably 60-70% of the population receive water from the piped system, while in medium cities the coverage falls to 50% and in small cities to 30%.

The per capita water consumption is not equal; in areas close to the water plants, pumping stations and water transmission mains the daily consumption and it can be as high as 600 - 1000 l/c/day while in the areas further away, it may fall to 50 l/c/day or less. The main reason for these large variations are excessive leakage in the old systems and wastage of water due to non-metering and low water tariffs.

Shortage of water and intermittent supply are usual and about 80% of the water supply network cannot meet the drinking water quality criteria. The type of water supply varies in different parts of the country. There are many more house connections in the south than in the north. Public taps are not commonly used in the south. In big cities, wells are rare, but some exist. In the smaller urban towns, wells are widely used. Supplementary water is taken from rivers, rainwater harvesting is common.

About 30% of the total urban water in Viet Nam is derived from groundwater sources.

Pressure is frequently low and leakages in the range of 40-50% of the water pumped into the system are relatively common in the north. Metering of water consumption is at present applied in few cities in the south and middle of Viet Nam and has been recently introduced in Hanoi and Haiphong in the on-going rehabilitation projects. Master metering at treatment plants is still very rare.

Based on information contained in a 1989 survey, 40% of the urban people in the north (57.2% in Haiphong) do not have any toilet facilities. The south is more developed, although nearly 30% of households do not have a toilet. Flush (water seal) toilets are still rare, except in the south. Two-thirds of households in Ho Chi Minh City use flush toilets.

SUMMARY OF ISSUES/CONSTRAINTS/STRATEGIES WHICH WERE IDENTIFIED/DEVELOPED AT THE GROUP DISCUSSIONS

GROUP 1- TO DEVELOP ACTION PLANS TO IMPROVE THE MANAGEMENT OF WATER SUPPLY AND SANITATION SYSTEMS

Issues and constraints

1. Lack of adequate and sufficient funds
 - Unrealistic pricing of water resulting in tariffs insufficient to meet operation and maintenance and capital costs
 - Lack of clear decisions for the formulation and implementation of realistic tariff policies
 - Lack of effective mechanisms and strict guidelines for collection of revenues
 - Excessive dependence on Government support through loans and grants
 - Lack of ability of the water supply and sanitation agencies to mobilize financial resources for investments in construction of works, rehabilitation and operation and maintenance.
2. Lack of action and effective strategies for human resources development
 - Lack of qualified manpower at all levels
 - Lack of adequate training programmes and facilities to upgrade the staff profiles according to the requirements established in the respective job descriptions
 - Lack of incentive to retain experienced staff
3. Government instability and political interference
 - Interference in planning, programming and development of human resources due to political reasons
 - Moral of staff affected by the adoption of decisions based on political reasons
 - Lack of continuity of plans and programmes due to modification of staff in the strategic and tactical management levels caused by political instability
4. Lack of appropriate institutional frameworks and planning mechanisms
 - Absence of clear objectives and mission statement of the water supply and sanitation agencies including the definition of medium- and long-term strategies

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and targets

- Lack of updated master plans which take into account short-term, medium-term and long-term targets. Where appropriate, such master plans should emphasize the need for achievement of universal coverage of water supply and sanitation services
 - The water supply and sanitation agencies lack appropriate organizational charts with clear description of posts and responsibilities at all levels
 - Fragmentation of duties and responsibilities in the water supply and sanitation sector resulting in overlapping between agencies, gaps, and poor use of the scarce resources available
 - Lack of adequate design tools including suitable electronic equipment and software and designing manuals
 - Insufficient delegation of authority to the distinct management levels resulting in bureaucracy and inefficiency in the overall operations of the agencies
 - Lack of suitable and effective management information systems to support the adoption of sound management decisions.
5. Lack of appropriate legal frameworks
- Lack of clear and effective by-laws to govern the use of water sources
 - Lack of proper municipal by-laws to support the water supply and sanitation agencies in the accomplishment of their duties and responsibilities with regard to their customers
 - Ineffective mechanisms for the enforcement of by-laws
6. Lack of appropriate O&M services
- Poor exchange of information and interaction between the different staff involved in operation and maintenance, planning and construction of water supply and sanitation facilities
 - Insufficient or inadequate standard O&M procedures
 - Lack of effective preventive maintenance services to enhance the useful life and reliability of equipment and facilities
 - Unavailability of suitable equipment and trained staff
 - Poor water quality control
 - Unavailability of spare parts
 - Lack of appropriate means of communication between the water supply and sanitation agencies and respective users, aggravated by poor mechanisms and systems for communication within these agencies

- Lack of updated maps and records of existing facilities
- 7. **Insufficient water resources**
 - Low priority for the water supply and sanitation sector in the allocation of water resources
- 8. **Inadequate technologies**
 - Use of technologies unsuitable to local conditions
 - Lack of standardization of materials and equipment
 - Poor quality control of materials, equipment and installations

GROUP 2 - TO DEVELOP STRATEGIES TO CONTROL/REDUCE UNACCOUNTED-FOR WATER

Issues and constraints

- Unaccounted-for water (UFW) is of worldwide concern with many countries reporting high percentage of UFW
- UFW could be caused by loss through leakages, non-metered consumers and meter inaccuracy
- Organization framework within which it is to function largely determines the success or failure of controlling/reducing UFW
- System environment comprising both hard and soft ware have to be carefully selected to suit users' need and application
- Lack of qualified and competent supporting staff, funds, equipment and commitment
- Institutional environment is crucial for the success of a project. Lack of adequate institutional framework will create problems in the detection and control of UFW programmes
- UFW could be used as a measure of the efficiency of a water distribution system
- Control/reduction of UFW could lead to economic savings, increased water sales and improved social and secondary benefits

Measures to monitor and reduce UFW include:

- Visual inspection
- Sounding (direct, indirect and advanced)
- District metering (district, waste and combined)

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- Passive leakage control
- Pressure control
- Calibration and meter replacement

Strategies

The control/reduction strategies of unaccounted-for water (UFW) are summarized as follows:

STRATEGIES	SHORT-TERM ACTION	LONG-TERM ACTION
Measurement of leakage	Macrometer Improve operation and maintenance Training of staff	Design practices (with monitoring) Permanent meter Training of staffs
Leakage reduction	Illegal connection Hardware Software Legislation/Enforcement Community/Staff education Public involvement Staff training	Leakage Improve operation and maintenance Rehabilitation/renewal Hardware Software Legislation/Enforcement Staff training Monitor and review
Funding	ESAs Billing system Staff training	Privatization Staff training Budget allocation

Some of the explanatory notes are presented as follows:

1. Community education
 - To educate the public on the importance of water conservations through talks and exhibition at schools and other private and public organizations
 - Water conservation to be included in school textbooks
 - Advice be provided to the customer
2. Illegal connection
 - To identify and install meters to all illegal connections
 - Illegal connections can be spotted by districts maintenance and meter reading staff
 - Internal reporting technique should be developed to take action on this
3. Operation and maintenance
 - To provide proper O&M of water supply systems
 - Failure to recognize the importance and lack of proper O&M management is a principal cause for the defective performance of many water undertakings
4. Legislation
 - To enact relevant water supply legislation to control/reduce UFW
5. Staff training
 - To provide training for all levels of personnel involved
 - Training of staffs is an important element in assuring successful implementation of UFW
 - Proper structured training courses will help to boost the levels of confidence and expertise
6. Monitor and review
 - To carry out performance checking, monitoring and review
7. Rehabilitation/renewal
 - To develop pipeline replacement/rehabilitation strategy both long-term and short-term to support the overall leakage control policy
 - Strengthening of supervision of workmanship in pipeline replacement, repairs, consumers connections and other works

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8. **Billing system**
 - To strengthen administration and meter reading activities to improve revenue
 - Rates must not be increased in order to increase revenue
 - The "ability to pay" criteria for low-income group must be met
9. **Budget allocation**
 - To allocate enough budget for UFW control programmes
10. **Privatization**
 - To relieve financial and administrative burden, one course of action is to bring in the private sector to play a greater and active role in the ownership, management and financing of public water supplies

GROUP 3 - TO IDENTIFY PRAGMATIC WAYS FOR EXTERNAL SUPPORT AGENCIES (ESAs) TO COLLABORATE WITH GOVERNMENTS TO IMPROVE O&M SERVICES

1. **Issues/constraints**
 - Each party has its own agenda and priorities
 - Loans and grants with strict terms of ESAs
 - Political interference in dealing with ESAs
 - No clear cut policies and guidelines to ESAs
 - Insufficient information dissemination among ESAs and national agency involved
 - No well defined roles among ESAs
 - Complex bureaucracy
 - Lack of coordination at national level of ESAs and National Water Supply and Sanitation Agencies
 - Inadequate counterpart funds
 - Lack of local experts as ESA counterpart
 - Low or no priority given to operation and maintenance
 - Mismanagement of ESA consultants by local agencies and ESAs

2. Strategies

- Formulation of policies and guidelines for every sector in water and sanitation sector
- Optimization and equitable distribution of resources
- Institutional development
- Human resource development
- Strengthen management information system
- Establish a revolving fund system
- Regular meetings among involved agencies



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In reply please refer to:

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... The Director, World Health Organization Regional Office for the Western Pacific, has the honour to enclose the report of the Workshop on Management of Urban Water Supply and Sanitation Systems, held at the Western Pacific Regional Environmental Health Centre (EHC), Kuala Lumpur, Malaysia from 21 to 25 August 1995.

Manila, October 1995

... ENCL.: As stated.

