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

REPORT

REGIONAL WORKING GROUP ON WATER SUPPLY MANAGEMENT

Kuala Lumpur, Malaysia

5 - 9 November 1990

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REPORT

REGIONAL WORKING GROUP ON WATER SUPPLY MANAGEMENT

Convened by the

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NOTE

The views expressed in this report are those of the temporary advisers in the working group and do not necessarily reflect the policies of the World Health Organization.

This report has been prepared by the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) for governments of Member States in the Region and for the temporary advisers in the Regional Working Group on Water Supply Management held in Kuala Lumpur, Malaysia, from 5 to 9 November 1990.

CONTENTS

1. INTRODUCTION

The meeting of the WHO Working Group on Water Supply Management was held at the WHO Western Pacific Regional Centre for the Promotion of Environmental Planning and Applied Studies (PEPAS) on the campus of the University of Agriculture, Malaysia (Universiti Pertanian Malaysia), Serdang, Selangor, Malaysia, from 5 to 9 November 1990.

The working group was sponsored by the Government of Japan and attended by ten members from eight countries in the Western Pacific Region, a representative from the Malaysian Water Association and two observers from Japan. A list of the members, representative, observers and secretariat members is given in Annex 1.

2. OPENING SESSION

On behalf of Dr S.T. Han, Regional Director, WHO Regional Office for the Western Pacific, Dr L.R. Verstuyft, WHO Representative for Brunei Darussalam, Malaysia and Singapore, welcomed the Working Group members. The address of Dr Han delivered by Dr Verstuyft expressed WHO's concern about the health risks associated with the deterioration of drinking water quality and water shortage encountered by the countries and areas in the Region due mainly to rapid urbanization and fast-growing water demand. The full text of the address is given in Annex 2.

On behalf of Prof. Dr Syed Jalaludin, Deputy Vice-Chancellor, University of Agriculture, Malaysia, Professor Dr Badri Muhammad, Dean, Faculty of Science and Environmental Studies, University of Agriculture, Malaysia welcomed the members to the University campus and said the University was pleased to host the meeting. Dr Badri emphasized the importance of the safety of drinking water to be secured through the adoption of suitable water quality guidelines and the application of the best available water treatment technologies.

3. OBJECTIVES

The objectives of the Working Group were as follows:

(a) to review the recent advances made in water treatment technologies and the application of such technologies to cope with the new challenges faced by the water supply industries;

(b) to identify the newly emerging problems associated with drinking water quality in the Member States of the Region, and to assess the adequacy of existing national drinking water quality standards, including the WHO Guidelines for Drinking Water Quality;

(c) to discuss ways of strengthening the mechanisms of technology transfer in all aspects of water supply management; and

(d) to recommend specific projects and activities to be undertaken by WHO to ensure sustainable management of water supplies, taking into consideration the newly emerging problems and recent advances made in water supply management.

4. BACKGROUND

In the past, the water supply industry in many countries of the Western Pacific Region has had little difficulty in obtaining adequate drinking water, both in terms of quality and quantity. However, this is no longer the case. Rapid population growth and industrial development in some countries of the Region, such as China, Malaysia, the Philippines and the Republic of Korea have led to shortage of water and significant deterioration in its quality. There are many instances where water suppliers have to accept water of poor quality and treat it as necessary to produce safe drinking water.

While industrialization has brought about economic prosperity, it also has generated many toxic and hazardous chemicals. Some of these chemicals which are carcinogenic, mutagenic and teratogenic, have found their way into the water environment including public water supply sources. Many groundwater sources have been contaminated by leachates from waste disposal sites, underground storage facilities, injection wells and careless or accidental spills, posing great health risks to those who use the water for drinking purposes. Even chemicals used for water treatment can cause health hazards, e.g. trihalomethanes (THMs) resulting from chlorination of drinking water containing natural organic substances.

Today, the water supply profession is faced with the new challenge of controlling and removing the many new toxic and hazardous chemical contaminants. The conventional treatment processes are often directed towards improving aesthetic characteristics and ensuring microbiological quality of water. However, they are not effective in removing many of the toxic and hazardous chemicals. In recent years, great advances have been made in water treatment technologies and many new treatment processes have been developed specifically to control such chemicals. Significant improvements have also been made in water treatment unit processes enabling the treatment of heavily polluted water.

Many existing drinking water standards have become out-dated and do not adequately protect the public from consuming water contaminated with toxic and hazardous chemicals. To cope with the newly emerging drinking water quality problems, WHO has taken the initiative to revise its Guidelines for Drinking Water Quality published in 1984, taking into consideration the new scientific information which recently became available. Despite the fact that many advances have been made both in water treatment technologies and improving water quality standards, many countries in the Region are still unaware of such progress, presumably due to the deficiency in technology transfer mechanisms. To ensure that the less developed countries also benefit from these new developments, technology transfer mechanisms must be expanded and strengthened in the future.

In consideration of the above concerns, WHO decided to convene a working group to specifically address the problems of application of technologies and administrative skills related to water resources management, water treatment, and water distribution. In particular, the working group was charged with the responsibility of drawing up recommendations regarding future activities to ensure the safety of drinking water and efficient management of water supply facilities in the Western Pacific Region.

5. WORKING GROUP PROGRAMME

The following officers were elected from the members:

Chairman	-	Mr S.C. Tay (Malaysia)
Vice Chairman	-	Dr Y. Magara (Japan)
Rapporteur	-	Dr R.A. Ramm (Australia)

The provisional agenda, as proposed, was adopted. The agenda and the list of working papers, background material, etc. provided to the members are given in Annexes 3 and 4 respectively. The Chairman invited the members to present their country reports so as to review the status of preparedness and response to the application of technologies and management skills needed for coping with the new challenges as well as to identify particular constraints and progress made in recent years in respective member countries. The country reports were followed by a series of working papers. Each presentation was followed by questions and discussions. Brief summaries of the country reports are given in Annex 5.

Following the plenary sessions, the members were divided into six groups to consider the following topics:

<u>Group 1</u>

Strategies to assure suitable development and management of water resources in terms of quality as well as quantity.

Moderator	:	Mr E.G. Fox (New Zealand)
Rapporteur	:	Mr K. Tomono (WHO Consultant)
Members	:	Mr T. Ohkubo (Japan)
	:	Mr S.C. Tay (Malaysia)
	:	Mr C.C. Lai (Malaysia)
	:	Mr D. Gonzales (Philippines)
	:	Mr Ong Ho Sim (Singapore)

<u>Group 2</u>

Development of national drinking water supply monitoring and surveillance programmes and related activities in line with the WHO Guidelines

Moderator	:	Dr Y. Magara (Japan)
Rapporteur	:	Mr S. Pillay (Malaysia)

Members	:	Dr R.A. Ramm (Australia)
	:	Mr M. Nii (Japan)
	:	Mr S. Imai (Japan)
	:	Dr M. I. Yaziz (Malaysia)
	:	Mr K.H. Kwak (Korea)
	:	Mr B.W. Fisher (WHO)
	:	Mr C. de Groot (WHO)

Group 3

Human resources development and technology transfer

Moderator	:	Mr D. Gonzales (Philippines)
Rapporteur	:	Mr S. Pillay (Malaysia)
Members	:	Dr Y. Magara (Japan)
	:	Mr M. Nii (Japan)
	:	Mr T. Ohkubo (Japan)
	:	Mr S.C. Tay (Malaysia)
	:	Mr H.S. Ong (Singapore)
	:	Mr K. Tomono (WHO Consultant)

Group 4

Appropriate technologies required for development of the water supply sector and necessary WHO assistance.

Moderator	:	Mr E.G. Fox (New Zealand)
Rapporteur	:	Mr C. de Groot (WHO)
Members	:	Dr R.A. Ramm (Australia)
	:	Dr Zou Ping (China)
	:	Mr S. Imai (Japan)
	:	Mr C.C. Lai (Malaysia)
	:	Mr K.H. Kwak (Korea)
	:	Mr B.W. Fisher (WHO)

Group 5

Water treatment technologies.

Moderator	:	Mr R.A. Ramm (Australia)
Rapporteur	:	Dr Y. Magara (Japan)
Members	:	Mr M. Nii (Japan)
	:	Mr T. Ohkubo (Japan)
	:	Mr S. Pillay (Malaysia)
	:	Dr M.I. Yaziz (Malaysia)
	:	Mr C. de Groot (WHO)
	:	Mr K. Tomono (WHO Consultant)

Group 6

Strategies required for reliable operation and maintenance including control of non-revenue earning water.

Moderator	:	Mr H.S. Ong (Singapore)
Rapporteur	:	Mr B.W. Fisher (WHO)
Members	:	Mr S. Imai (Japan)
	:	Mr C.C. Lai (Malaysia)
	:	Mr E.G. Fox (New Zealand)
	:	Mr D. Gonzales (Philippines)
	:	Mr K.H. Kwak (Korea)

The views expressed in the discussion groups were summarized by their respective moderators at a plenary session of the working group. These are reflected in the Findings and Recommendations section of this report.

A field visit was made to the Sungai Linggi water treatment plant where the members had the opportunity to observe the operation of the plant. Features of this plant were the highly polluted raw water and the proposals to introduce an ozonation system and to upgrade the existing filters to dual media filters.

6. SUMMARIES OF PAPERS PRESENTED

6.1 Overview of water supply in the Western Pacific Region

Mr B. Fisher, Sanitary Engineer, PEPAS gave an overview of the status of community water supply in the Region. His paper summarized the progress and problems of water supply development in the Region (countries in the Region were divided in groups of similar characteristics) as follows:

In group A, comprising Australia, Japan and New Zealand, water and sanitation baselines are provided to cover over 90% of the population with excellent standard of service. In group B, consisting of Malaysia, Philippines and Republic of Korea, all attained high levels of water supply coverage in their urban centres and their rural programmes have been successfully expanded in recent years. Group C countries, comprising islands in the Pacific Ocean, have made steady progress during the International Drinking Water Supply and Sanitation Decade, and many of them will achieve close to full coverage by the end of the Decade although operation and maintenance (O & M) problems will need to be solved.

The achievement of the group D countries, comprising Papua New Guinea, Solomon Islands and Vanuatu, have remained at comparatively low levels. The progress made by group E countries, i.e. Laos and Viet Nam, has been marginal due to economic difficulties. Although having the problem of shortage of water resources, group F countries consisting of Brunei Darussalam, Hong Kong, Macao and Singapore, have achieved high levels of water and sewerage services. These countries are well staffed with competent personnel and require little WHO support in the sector.

China, listed separately from other countries because of its extremely large population, has indicated steady progress during the Decade. It would be misleading to give overall totals for the Region due to the heavy weighting of the figures adopted for China.

The major sector constraints are shortage in trained personnel, weak O & M including inadequate cost containment and recovery, and funding limitations. Inappropriate technologies used are still a problem although the issue at present is not as serious as earlier in the Decade. A major problem in virtually all the urban areas in the Region is unaccounted-for water, which in some instances amounts to 50% of water distributed.

6.2 WHO water supply programmes in the Western Pacific Region

Mr de Groot, Associate Professional Officer, WPRO, described the broad aims of WHO in the water supply sector in the Western Pacific Region. The provision of safe drinking water supply is the largest single component of the environmental health programme under the WHO Western Pacific Regional Office (WPRO). As concluded and reaffirmed at the Asian and Pacific Regional Consultation, held in Manila on 4-8 June 1990 and at similar consultations held in other regions, WHO supports the overall objective of these consultations, namely, "To maintain Decade momentum beyond 1990 and accelerate the provision of water supply and sanitation services to all with emphasis on the unserved rural and periurban poor."

One of the major issues pertaining to community water supply (CWS) is the inequitable distribution of CWS funds between water supply and sanitation, and between rural and urban areas. Other issues include:

(i) inadequate long-term O & M and frequent and general occurrence of system losses;

(ii) insufficient cost containment/recovery procedures;

(iii) poor water quality management;

(iv) inappropriate human resources development in the sector and, as a result, shortage of adequately trained personnel;

(v) insufficient community participation;

(vi) weak, incomplete water legislation related to water rights and pollution control, etc.; and

(vii) lack of coordination and cooperation between donors.

To help the member countries solve these problems, WHO has prepared the General Programme of Work and the Regional Medium- Term Programme. The objective of the Programmes is: "to control diseases through the promotion and development of community water supply and sanitation services, thereby leading to improvement in the quality of life." Hence the targets of the programmes aimed at by 1995 are:

(i) attainment of national goals by most countries with respect to safe drinking water supply and adequate sanitation;

(ii) establishment by most countries of comprehensive national plans for adopting water quality surveillance procedures and standards; and

(iii) active implementation of these plans and monitoring of water quality by a majority of the countries.

6.3 Modern trends in water resources development and management

Mr Tomono, WHO Consultant, presented an introductory paper on the above topic.

In many countries and areas in the Region, although water resources are basically abundant, there have been significant changes with respect to water resources in the past few decades. In many locations, water resources are inadequate both in quality and quantity due to rapidly growing water demand and deterioration of the source quality by wastewaters from urbanized areas and farmlands.

Development of surface water sources, especially in large urbanized areas, has become more and more expensive as nearby cheap sources have all been used. Even when a new source is available by means of dam construction, the deterioration in quality of stored water because of pollution and eutrophication is a major problem.

Groundwater is a cheap, excellent source, if available, especially in rural areas. However in some areas no more groundwater can be extensively developed owing to the problems of water table drawdown or land subsidence caused by excessive groundwater abstraction. A recent challenge in the use of groundwater is the contamination by halogenated hydrocarbons such as trichloroethene (TCE), tetrachloroethene (PCE) and 1,1,1-trichloroethane (TCET). Contamination of shallow wells is still a major health risk in rural and urban areas.

Proper management of surface water resources requires the following measures:

(i) control of the application of hazardous pesticides or excessive use of pesticides and fertilizers on farmlands;

(ii) prohibition or regulation of mining;

(iii) control of urbanization in the watershed; and

(iv) provision of wastewater treatment facilities and preservation of the watershed.

To combat the deterioration of source water quality, monitoring and surveillance of water resources should include the following items:

(i) provision of source water quality standards;

(ii) establishment of sampling networks and communication systems; and

(iii) provision of laboratories.

It is very important to employ reliable, efficient technologies and experienced engineers and machine operators in the development of groundwater sources. Many cases have been observed, in which much time and resources were wasted due to unsuccessful aquifer prospecting and well drilling. Careful selection of location and design of shallow wells is also important for the safety of water.

Excessive abstraction of groundwater results in not only reduction in yield but can also cause serious problems of land subsidence or saline intrusion. To prevent groundwater pollution by such chemicals as TCE, PCE and TCET, public awareness of their danger, and systematic quality monitoring of groundwater are needed.

6.4 Water treatment plant upgrading

Dr Y. Magara, Director, Sanitary Engineering Department, the National Institute of Public Health, Japan, presented his overview on the issue of water treatment plant upgrading, which would have to be considered in certain locations in the Western Pacific Region. The following is a summary of his paper presented to the meeting.

In 1981, the Ministry of Health and Welfare (Japan) set drinking water standards for trihalomethanes (THMs); in 1985, similar standards were provided for trichloroethene (TCE), tetrachloroethene (PCE) and 1,1,1-trichloroethane (TCET). In addition to them, there appear to be certain other hazardous or obnoxious substances such as odor caused by algal blooms in source water. The government developed two strategies to counter the problem: a water source conservation programme and advanced water treatment development. The Japan Water Works Association in 1982 formed an advanced water treatment system development committee sponsored by the Ministry. Various findings of this committee were summarized by Dr Magara.

The biological film oxidation process was developed to overcome the disadvantages of a slow sand filter while retaining its advantages. Typical designs of biological film oxidation units are: (i) rotary disk contactor, and (ii) honeycomb tube filter.

The biological activated carbon filter (BAC) is a process that absorbs soluble organics using granular activated carbon and removes solid or colloidal substances in raw water by micro-organisms growing in the filter. Experiments made with a pilot plant were fully described. The trihalomethanes formation potential (THMFP) removal rate was recorded between 50% and 80% depending on the granular activated carbon used. It has yet to be determined whether biological regeneration of activated carbon or biological degradation of the precursors in the filter was the predominant mechanism for THMFP removal.

6.5 Technology transfer for water supply management

Mr K. Tomono then presented a working paper on Technology transfer for water supply management.

Technology transfer is necessary not only internationally but also within individual countries. Technology transfer in a particular field should be repeated when technologies become obsolete and better technologies become available.

It can be carried out in diverse forms. The most simple form is the importation of a readymade factory or system together with operators. In such a form, there will be no chance for local staff to learn about the design of the system or its underlying basic concept to enable adaptation to other systems. An opposite example is construction of a system using rather rudimentary technologies and gradual upgrading of the system over time while transferring technologies at stages. There may be various forms of technology transfer between the above two. The following examples of technology transfer were described:

1) Technology transfer through construction projects:

   (a) An improvement in design using existing local labour and materials (e.g. pit latrine to VIP).

   (b) Importation of equipment and materials and the use of local expertise and labour.

   (c) Importation of expertise as well as equipment and materials and the use of local labour.

   (d) Turn-key contracts.

2) Technology transfer through training programmes and expert services:

   (a) On-the-job training.

   (b) Training programmes by local expertise using materials provided by external aid agencies.

   (c) Training programmes by expatriate expertise.

   (d) Construction and operation of a training centre under an external assistance programme.

   (e) Individual and group training in the donor country.

There are deficiencies and constraints in the field of technology transfer on not only the recipient side but also the donor side. Major constraints with recipients in general are:

1) Scarce trained and experienced human resources.

2) Lack of resourceful, efficient training institutions.

3) Lack of sectoral and inter-sectoral organization for policy-making on technology development and transfer.

4) Poor communication systems.

5) Deficient logistics for supply and installation including introductory training, and service of equipment.

6) Rigid social structure inhibiting flow of technical knowledge from experienced senior to junior personnel.

Major constraints with donors in general are:

1) Insufficient number of experienced personnel in the international field.

2) Lack of site-level knowledge on the part of national level administrators responsible for aid programmes.

3) Lack of sectoral and inter-sectoral movement of human resources.

4) Inflexible employment structures giving promotional disadvantages to employees who work abroad.

5) Redundancies of efforts for assistance due to sectionalism.

6) Language barriers on the part of field personnel.

7) Difficulties in living conditions experienced by field personnel.

6.6 Water quality monitoring and surveillance

This subject was introduced jointly by Mr S. Pillay, Chief Public Health Engineer, Ministry of Health, Malaysia and Mr B. Fisher.

The speakers emphasized the need for the Health Department to maintain an overall check on the quality of water supplies produced by the water authorities. This will become a priority activity if water supplies in a country are privatized. The frequency of testing of water quality depends on a variety of conditions in the country. Normally it is practical to rely mainly on sanitary surveys in rural areas rather than routine analytical testing. Sub-professional staff often have difficulty performing bacteriological tests in the field and these programmes are not usually feasible. A simple bacteriological field test kit for use in rural areas needs to be developed. However if sanitary surveys are carried out at least once a year in rural areas, the need for remedial measures will normally be evident.

6.7 Human resources development

Mr K. Tomono presented his working paper on Human resources development (HRD).

It was stressed that HRD is vital to the sustainability and development of water supply utilities just as for other industries. HRD is required at all levels of the personnel structure. The common form of training is a course at a special training centre or college. Responsiveness and absorbing capacity of trainees are important for successful training. Training should be provided in administration and in particular accounting and financial administration. Whenever possible, training should be part of the proposals for consultancies and projects.

6.8 Operation and maintenance

Mr Fox, Environmental Health Engineer, Department of Health, New Zealand, presented an overview of the principles of good operation and maintenance. The need to include these principles into the planning, funding and implementation stages was emphasized. Mr Fox outlined the structure of maintenance teams necessary for good maintenance and various computer software and hardware factors. The deterioration of asbestos cement pipes, in particular, and the properties of other types of pipes were described.

Various aspects of control of non-revenue earning water were stressed by both Messrs. Fox and Tomono. There is a wide range of reported water losses in urban areas in the Western Pacific Region. Some countries have only approximate figures as consumers' water supplies are not metered. The role of water pressure was agreed to be of major importance and needs careful attention during design of the scheme.

7. FINDINGS AND RECOMMENDATIONS

The following listing is a summary of the findings and recommendations of the six discussion groups established at the meeting.

(1) At many locations, especially in large urban areas of the Region, water demand is sharply rising owing to rapid population growth, higher living standards, industrialization, etc. As a result, surface water resources have become significantly scarce.

Recommendation 1: WHO should support Member States by providing technical cooperation in water demand forecasting and water resources development and management.

(2) In almost all the urbanized areas, the quality of surface water sources is threatened due to wastewater discharge, solid wastes dumping, deforestation, pesticides and fertilizer uses, etc.

Recommendation 2: WHO should encourage and support Member States to.establish means for watershed management such as (i) water resources monitoring, (ii) land use plans, (iii) preservation of catchment area, (iv) reforestation, (v) sewage treatment, and (vi) treatment of industrial wastewater and/or relocation of industries. To make such efforts effective, WHO should also recommend that Member States establish stringent legislation and administrative bodies for control of watershed pollution.

(3) Groundwater resources in the Region as a whole are diminishing in terms of quantity and quality due to excessive abstraction, contamination by hazardous chemicals, and saline intrusion.

Recommendation 3: WHO should coordinate with Member States in the development and management of groundwater resources in such ways as: (i) preparation of a master plan on development and management of groundwater resources, (ii) monitoring of groundwater quality and quantity, (iii) development of legislation for groundwater management and prevention of its contamination, and (iv) provision of guidelines on prevention of excessive groundwater abstraction.

(4) Water treatment plants in the Region are often aged and deficient in functioning, overloaded or incapable of increasing source water pollution.

Recommendation 4: WHO should support Member States in the upgrading of water treatment plants applying new technologies, if needed, to cope with increasing water demands and deteriorating water source quality.

(5) There are many countries in the Region where cost recovery associated with water supply service is inadequate, disabling proper operation and maintenance.

Recommendation 5: WHO should support Member States in setting up effective funding programmes including cost recovery to fully support operation and maintenance through billing and collection systems, with an option of privatization where applicable.

(6) The discussion group felt it necessary that national water quality standards should be set up using WHO Guidelines as a guide.

Recommendation 6: WHO should support Member States in the development of national drinking water quality guidelines and related water supply monitoring and surveillance programmes in collaboration with water supply and health agencies. WHO should also collect views and comments from national governments on the existing Drinking Water Quality Guidelines to be incorporated in the new Guidelines which are being revised.

(7) With respect to the urgent need for monitoring and surveillance of drinking water quality, Member States need to establish systems for such activities using effective and inexpensive methodologies including field test kits.

Recommendation 7: WHO should collect information on experience with the use of field test kits and carry out comparative studies on them.

(8) In many countries in the Region, deterioration of water quality in distribution systems is a serious concern. This is caused by improper pipe materials, inappropriate construction methods, defective storage tanks, etc. Deficiencies related to operation of water supply facilities are often caused by an inadequate database of operational experience. There are also certain deficiencies in design and operation of water treatment facilities, largely, due to lack of guidelines for selection and operation of water treatment processes.

Recommendation 8: WHO should support Member States in the development of technical guidelines on water system design, operation and maintenance. Such guidelines should include regulations and/or recommendations for materials used in water supply systems such as pipes, tanks and chemicals for water treatment, and the collection of appropriate data to establish an effective database on operation and maintenance. WHO should also develop guidelines for water treatment processes and their operation including in-plant laboratory tests and a checklist on water treatment plants.

(9) There has been a lack of national plans for human resources development (HRD) for the water supply and sanitation sector. There are many cases of inadequate resources (qualified personnel, training facilities and funds) for

HRD in the water supply and sanitation sector. In some areas of the Region, technology transfer is often impeded due to inadequate management succession plans.

Recommendation 9: WHO should support the development of coordinated and integrated national plans for human resources development (HRD) covering long, medium and short term requirements in the sector. WHO should also encourage Member States in the setting up of a clear organizational structure with explicit job responsibilities and descriptions for the sector together with effective management succession plans.

(10) Mechanisms for technology transfer in the water supply and sanitation sector are inadequate. There has also been a lack of coordination in effective use of external as well as domestic training facilities. Although new technologies have been or will be introduced in the developing countries, there are a number of cases in which no subsequent technology transfer related to the new technology takes place.

Recommendation 10: WHO should enhance technology transfer activities in the sector through workshops, seminars, field visits, pilot projects, on-the-job training, etc. with the participation of other donor agencies and NGOs. WHO should also collaborate with Member States to implement training programmes with respect to new technologies when they are introduced in the water supply sector in their countries.

(11) In view of trihalomethanes (THMs) resulting from chlorination of drinking water containing natural organic substances, the use of chlorine and other disinfectants needs to be reexamined.

Recommendation 11: WHO should examine the potential health risks associated with chlorination and alternative disinfecting agents used for the treatment of drinking water.

(12) Although there is clear evidence that fluoridation of drinking water is effective in the prevention of dental caries, it has only been practised in limited locations of the Region.

Recommendation 12: WHO should draw the attention of Member States to the fact that fluoridation improves dental health, and, therefore, should recommend them to consider the inclusion of fluoridation in their water treatment processes if dental caries are a problem, and the logistics requirements and necessary operating standards can be met.

(13) In the Region as a whole, water conservation measures, especially prevention of water leakage, are weak, and lead to a waste of resources and insufficient revenues.

Recommendation 13: WHO should promote the formulation by Member States of water conservation programmes with an emphasis on leakage prevention. For curbing water losses, long-term programmes should be formulated with the provision of effective equipment and on-the-job training for operators. For conservation of water, the programme should include public awareness campaigns, use of water saving devices, employment of progressive tariff structures, etc.

8. CONCLUDING SESSION

At the invitation by the Chairman, each discussion group moderator presented issues identified and recommendations made by his group. The initial number of recommendations made by all the discussion groups totalled more than 50. The participants discussed fully each of the proposed recommendations and after eliminating duplications and grouping several others, the final recommendations in the preceding section were adopted.

The Chairman thanked the members for their participation in the meeting and congratulated them on their valuable contributions which had resulted in a clearer understanding of the major issues pertaining to water supply management, and useful recommendations to WHO to plan its activities for coping with such issues.

Dr P. Guo, Director, PEPAS thanked the working group members for their active participation. The findings and recommendations would provide valuable guidance to WHO in the development of efficient water supply management. For successful implementation of actions recommended by the working group, active collaboration between WHO and the relevant national authorities would be necessary. He hoped that the members would actively pursue any necessary follow up activities when they returned to their countries.

Dr Guo also expressed appreciation to the consultant and the secretariat members for the organization of a most successful meeting.

ANNEX 1

LIST OF MEMBERS, REPRESENTATIVE, OBSERVERS AND SECRETARIAT

Temporary Advisers		Designation and address
1.	Dr R.A. Ramm	Chairman Water Quality Committee National Health and Medical Research Council c/o Division of Environmental and Occupational Health Queensland Department of Health G.P.O. Box 48 Brisbane, Queensland 4000 Australia
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5.	Mr S. Pillay	Chief Public Health Engineer Engineering Division Ministry of Health Block E, Office Complex Jalan Dungun Damansara Heights 50490 Kuala Lumpur Malaysia

6.	Mr Tay Soon Chuan	Director of Water Supply Branch Public Works Department Headquarters Jalan Salahuddin 50582 Kuala Lumpur Malaysia
7.	Mr E. G. Fox	Environmental Health Engineer Department of Health P.O. Box 5013 Central Wellington New Zealand
8.	Mr Delfin Gonzales	Environmental Sanitation Unit Department of Health San Lazaro Compound Sta. Cruz Manila Philippines
9.	Mr Kyul Ho Kwak	Director Water Supply Division Water Supply and Sewerage Bureau Ministry of Construction 28 Jung-Dong, Jung-ku Seoul Republic of Korea
10.	Mr Ong Ho Sim	Director Water Department Public Utilities Board 111 Somerset Road PUB Building Singapore 0923 Republic of Singapore

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3.	Mr Lai Cheng Cheong	Honorary Secretary-General The Malaysian Water Association c/o Office of Director of Water Supplies Public Works Department Headquarters Jalan Sultan Salahuddin 50582 Kuala Lumpur Malaysia
4.	Dr Mohd Ismail Yaziz	Lecturer Faculty of Science and Environmental Studies Universiti Pertanian Malaysia 43400 UPM Serdang Malaysia

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2.	Mr B.W. Fisher	Sanitary Engineer, PEPAS
3.	Mr C. de Groot	Associate Professional Officer, WPRO
4.	Mr K. Tomono*	WHO Consultant
5.	Ms L.Y. Chan	Administrative Officer, PEPAS
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ANNEX 2

OPENING ADDRESS

On behalf of Dr S.T. Hàn, WHO Regional Director for the Western Pacific, I have the pleasure of welcoming you all to attend this five-day Regional Working Group Meeting on Water Supply Management. As Dr Han is unable to attend this opening today, he has asked me to convey his best wishes to you all.

The International Drinking Water Supply and Sanitation Decade, which was launched almost exactly 10 years ago in November 1980 during the 35th session of the UN General Assembly draws to a close at the end of this year. It is therefore an opportune time to look at what has been achieved, including lessons learned, and find ways and means of solving existing problems and increasing coverage of water and sanitation in areas still unserved in the Region.

Coverage figures for the Western Pacific Region indicate there is still room for improvement. Excluding China and the fully developed countries, it is apparent that coverage of water supply and sanitation in rural areas of the Region only benefits about two-thirds of the population. On the other hand, 83% of the urban population have access to water supply and 92% to sanitation facilities. These service coverage levels compare favourably with the rest of the world, but it should be possible to improve them further in the next few years. It must be kept in mind, however, that new approaches and technologies must be introduced if programmes are to be more effective in the post-Decade era than they have been in the past.

New technologies are also needed to cope with emerging problems caused by rapid population growth and industrial development which have led to shortage of water and significant deterioration in its quality in some countries of the Western Pacific Region. Industrialization has generated many chemicals which are toxic and hazardous to health. Many groundwater sources run the risk of becoming contaminated by leachates from waste disposal sites and thereby posing health risks to those who use them for drinking water. Even chemicals used for water treatment may pose health hazards to consumers and the water supply profession today is faced with the new challenge of controlling and removing toxic chemical contaminants that are not easily eliminated by conventional processes. In recent years, great advances have been made in water treatment and improving water quality standards. However, many countries in the Region are still unaware of this progress, presumably owing to deficiencies in existing technology transfer mechanisms. Therefore, this working group should also study ways to improve technology transfer.

To cope with the emerging drinking water quality problems, WHO has already taken the initiative to revise its Guidelines for Drinking Water Quality published in the early 1980s, taking into account the toxicological and microbiological data which have recently become available. It is hoped that you will assess the adequacy of existing national drinking water standards in the light of these guidelines.

This working group meeting has objectives which mainly concern the identification of newly emerging problems and solutions associated with water quality in Member States of the Region and technology advances in water treatment. However, in view of the expertise available at this meeting I hope the discussions will also be directed at current problems and technological advances in other aspects of water supply management and how best WHO and other agencies can support country programmes in this sector.

I would like to take this opportunity of acknowledging the role of the Japanese Government in funding this meeting. The original proposal was formulated at the seventh meeting of the Advisory Committee on the Special Programme on Technology Transfer of Japan. The framework and subject of the meeting was then finalized between the Japanese Ministry of Health and Welfare and WHO, and virtually all operational costs of this meeting have been provided by the Japanese Government. We hope that this collaboration will continue on future occasions.

I wish you all a fruitful week of discussions and a pleasant stay in Malaysia.

Thank you.

ANNEX 3

PROVISIONAL AGENDA

Monday, 5 November 1990

0900 - 0930	Introductory remarks Dr P. Guo, Director, PEPAS Opening speech Dr L.R. Verstuyft, WHO Representative for Brunei Darussalam, Malaysia and Singapore on behalf of the Regional Director Welcome address Professor Dr Badri Muhammad, Dean, Faculty of Science and Environmental Studies, University of Agriculture, Malaysia
0930 - 1015	Group photograph and coffee/tea break
1015 - 1030	Administrative briefing L.Y. Chan
1030 - 1100	Introduction of meeting consultant and temporary advisers. Election of officers B. Fisher
1100 - 1115	Adoption of provisional agenda
1115 - 1200	Overview of water supply in the Western Pacific Region B. Fisher
1200 - 1330	Lunch
1330 - 1500	Country reports - Australia China Japan
1500 - 1530	Coffee/tea break
1530 - 1700	Country reports - Korea Malaysia New Zealand

Tuesday, 6 November 1990

0900 - 1000	Country report - Philippines Singapore

1000 - 1030	WHO water supply programmes in Western Pacific Region De Groot
1030 - 1100	Coffee/tea break
1100 - 1200	Modern trends on drinking water resource management and development K. Tomono
1200 - 1330	Lunch
1330 - 1420	Water treatment plant upgrading Y. Magara
1420 - 1500	Technology transfer for water supply management K. Tomono
1500 - 1520	Coffee/tea break
1520 - 1600	Water quality monitoring and surveillance S. Pillay/B. Fisher
1600 - 1700	Human resources development for water supply management K. Tomono

<u>Wednesday, 7 November 1990</u>

0900 - 1000	Operation and maintenance problems in the water sector E.G. Fox
1000 - 1030	Coffee/tea break
1030 - 1130	Control of non-revenue earning water K. Tomono
1130 - 1230	Lunch
1230 - 1700	Field visit to Sungai Linggi water treatment plant B. Fisher

<u>Thursday, 8 November 1990</u>

0900 - 1000	Selection of topics for group discussions (Each working group topic will include action recommendations)
1000 - 1030	Coffee/tea break
1030 - 1200	Group discussions

1200 - 1330	Lunch
1330 - 1500	Group discussions (Cont'd)
1500 - 1530	Coffee/tea break
1530 - 1700	Group discussions (Cont'd)

Friday, 9 November 1990

0900 - 1000	Group presentations and discussions
1000 - 1030	Coffee/tea break
1030 - 1200	Group presentations and discussions (Cont'd)
1200 - 1330	Lunch
1330 - 1430	Formulation of recommendations and conclusions
1430 - 1500	Finalization of recommendations
1500 - 1545	Closing Dr P. Guo
	Coffee/tea served

ANNEX 4

DOCUMENTS DISTRIBUTED DURING THE WORKING GROUP MEETING

Working papers

WPR/RUD/PEPAS(4)/90.2	OVERVIEW OF WATER SUPPLY IN THE WESTERN PACIFIC REGION By Mr B. Fisher
WPR/RUD/PEPAS(4)/90.3	MODERN TRENDS ON DRINKING WATER RESOURCE MANAGEMENT AND DEVELOPMENT By Mr K. Tomono
WPR/RUD/PEPAS(4)/90.4	WATER TREATMENT PLANT UPGRADING By Dr Y. Magara
WPR/RUD/PEPAS(4)/90.5	TECHNOLOGY TRANSFER FOR WATER SUPPLY MANAGEMENT By Mr K. Tomono
WPR/RUD/PEPAS(4)/90.6	HUMAN RESOURCES DEVELOPMENT FOR WATER SUPPLY MANAGEMENT By Mr K. Tomono
WPR/RUD/PEPAS(4)/90.7	CONTROL OF NON-REVENUE EARNING WATER By Mr K. Tomono

Country reports

WPR/RUD/PEPAS(4)INFO./1	AUSTRALIA By Dr R.A. Ramm
WPR/RUD/PEPAS(4)INFO./2	JAPAN By Dr Y. Magara and Mr M. Nii
WPR/RUD/PEPAS(4)INFO./3	MALAYSIA By Messrs S.C. Tay and S. Pillay
WPR/RUD/PEPAS(4)INFO./4	NEW ZEALAND By Mr E.G. Fox
WPR/RUD/PEPAS(4)INFO./5	PHILIPPINES By Mr D.R. Gonzales
WPR/RUD/PEPAS(4)INFO./6	REPUBLIC OF KOREA By Mr E.H. Kwak
WPR/RUD/PEPAS(4)INFO./7	SINGAPORE By Mr H.S. Ong

ANNEX 5

SUMMARIES OF COUNTRY REPORTS

1. Australia

Dr Ramm gave a detailed overview of the situation in Australia stressing the difficulty of providing the complete area with sufficient water supply because of Australia's large semi-arid land mass. Most large cities and many smaller ones rely on storage dams. Recent dams for the major cities tend to be sited further from the cities concerned. Many smaller towns pump directly from rivers, whose supplies may or may not be controlled by dams. Many smaller towns draw their water exclusively from groundwater. The retreatment and use of wastewater from sewerage plant is used occasionally for irrigation. Roof drainage is still used sparingly in farm situations.

As of 1985, the major cities of Sydney, Melbourne, Adelaide, Perth and Brisbane, having populations of 3.4, 2.7, 1.0, 1.0 and 0.7 (million) respectively, and consumed water quantities of 495, 404, 165, 167, 169 (1 000 ML/a), of which domestic uses were 263, 280, 120, 120, 121 (1,000 ML/a) respectively. Water supplies to smaller communities involve a trade-off between cost, water quantity and quality. About 440 000 people live in communities with a population of less than 1 000 persons, of which 35% have no piped water supplies.

The traditional treatment systems for the capital cities consist of sedimentation, filtration, pH adjustment, disinfection and fluoridation. In Melbourne, only disinfection and fluoridation applied to water from protected catchments.

Surface waters in Australia are often highly saline during periods of low flow. The clearing of vegetation in catchments has resulted in widespread soil loss, increasing the sediment load and turbidity. Excessive blooms of algae and other aquatic plants is increasing in many parts of Australia due to nutrient enrichment within aquatic ecosystems. Australian waters are relatively free from major chemical pollution although pesticides and fertilizers used in intensive agricultural and wastewaters from mining and industrial activities are significant in some locations.

2. Japan

As of 1988, piped water supply systems cover 94% of Japan's population. Japan's water supply systems are divided into:

- Large scale public water supplies: systems with a design population served of more than 5 000.

- Small scale public water supplies: systems with a design population of between 101 and 5 000.

- Private water supplies: systems with a population of more than 100 serving for private dormitories, apartment houses, etc.

- Bulk water supplies: water supply systems which supplies treated water to other large or small water supply systems.

- Small private water supply systems: water supply systems for buildings which possess a receiving water tank of a capacity of more than 10 cubic meters and receives potable water from large or small water supply. There were 17 131 water supply systems and 118 688 small private water supply systems as of end March 1989.

Sources of Japan's water supply are mainly surface water (71% in quantity), groundwater (27%) and others (2%). There has been a large increase in abstraction of surface water due to the increase in water demand as a whole and significant shifts from groundwater sources largely aiming at the prevention of landsubsidence in some areas. In Japan, the recent trend in water supply is characterized by reorganization of water supply utilities, which were needed for a rational use of newly developed water resources and advantages in operational and management.

Financial independence is the principle governing water supply utilities in Japan. In a few cases, however, funds are transferred from a general account of a municipality which owns the water supply utility. In Japan, all the services are metered. There are large differences in average per-cubic-meter water charges among water suppliers.

Industrial development and growing urbanization in Japan have increased the number of contaminants in both surface and ground waters. The contamination of source water by trace hazardous chemicals has become a public concern. The first national water quality standards were promulgated by the Ministry of Health and Welfare in 1958, which was revised in 1978. Japan's Water Works Law stipulates the 26 examination items of water quality requirements, e.g. nitrite and nitrate nitrogen, chlorine ions, organic substances, coliform group bacterial count, mercury, organic phosphorus, pH, odor, taste, color, turbidity, pheno, and several metal ions.

Although, ozone, etc. besides chlorine, are being introduced as part of water treatment, the Water Works Law requires that certain amount of residual chlorine should be present in tap water; so final disinfection should always be done by chlorine. The tentative guidelines on THMs was established in 1981, setting the maximum contaminant level at 0.1 mg/lit. Most water suppliers have met this guideline. Cases of pollution of groundwater by organic solvents such as TCE, PCE and TCET have been reported. Maximum contaminant levels of such chemicals have been established.

In Japan, 73% of water supplies use the rapid sand filtration system, 5% use the slow sand filtration system, and the remainder (22%) use only disinfection. To cope with the increasing source water pollution, several water utilities have introduced advanced methods of water treatment, including activated carbon adsorption, ozonation, and biological treatment. Other methods such as membrane and ultra filtration and UV radiation are being studied.

The renewal of aged water mains is of major concern to most water utilities in Japan. The renewal of mains is an important part of efforts to keep the level of non-revenue earning water low, which is at present around 15% as the overall average in Japan. Of 400 000 km of total length of water mains in Japan, about 20% are of asbestos cement pipe (ACP). Although early replacement of ACP is mandated, smaller water utilities are experiencing financial difficulties.

3. Republic of Korea

The Republic of Korea had a population of 42.3 million people in 1989. Two-thirds of its land area of 99 200 sq km is mountainous. It is one of the most urbanized of the developing countries. The urban population was 77.8% in 1989. Rapid urbanization has overextended most urban services including water supply. Water supply coverage reached 78% in 1989. The remainder of the population, mostly in rural areas, rely mainly on deep or open dug wells. Korea's overall water production increased from 256 lpcd in 1980 to 339 lpcd in 1989. This rapid growth reflects the progressive alleviation of water shortages, rapid industrialization and urbanization, and rising living standards.

Starting in the 1970s, unlike before, progressively higher priority has been given to social investments, including those for water supply and sewerage. Consequently, water and sanitation services were greatly improved during this period resulting in improved people's health. For example, the crude death rate per thousand declined from 13 in 1960 to 5.9 in 1988. These improvements in water supply and sanitation sector activities have been firmly backed by Government budget allocations. Government objectives for the Sixth Plan include preservation for water quality, replacement of obsolete equipment, reduction in leakage, improved sector training, and expansion of water and sewage treatment. It is intended that the population served by house connection as percent of total reaches 80% by 1991.

No single agency has overall responsibility for the water supply and sewerage sector. The Ministry of Construction (MOC) is responsible for regional water systems and sewage treatment plants. The Korea Water Resources Development Corporation (KOWACO), a semi-autonomous public body, operates these regional systems providing water in bulk to groups of municipalities and builds multipurpose dams. The Ministry of Home Affairs (MOHA) oversees municipal water supplies through approval of bonds, loans and water tariffs. Municipal water supply utilities are semi-autonomous. The Ministry of Health and Social Affairs (MOHSA) sets water quality standards and monitor their enforcement. The Economic Planning Board (EPB) sets national guidelines for tariff increases, approves investment plans and allocates funds to the sector. Foreign financing is coordinated by the Ministry of Finance (MOF).

Sources of funds for the sector in 1989 totaled 1 070 billion Won, most of which was derived from water tariff revenues (45%). The main sector expenditure are for construction (31%), debt service (31%), and operation (35%, including 8% for personnel). The construction of regional bulk water systems is financed out of MOC's budget and foreign loans. That of municipal water supplies is financed by their water utilities either from internal cash generation or bonds. The rest is from local commercial loans through the Korea Development Bank (KDB) and a few foreign loans. The prevailing water tariffs in general are considered affordable, at less than 0.6% of average family expenditures. Sewerage tariffs for major cities were established in 1985 and are about 30% to 40% of the water charges.

In a view of rapidly increasing water pollution, the Government in 1989 formulated a National Water Improvement Program (NWIP) aiming at (a) ensuring that good quality water be available to the total population, and (b) improving the efficiency, monitoring and effectiveness of the sector. The NWIP comprises reorganization of the sector and financing of several priority investments to be implemented between 1990 and 1995. Under the NWIP, municipal water utilities will be replaced by Water Agencies in the six largest cities established in 1989 and similar ones to be established in other cities thereafter. After mid-1990 the design and construction of all new regional water projects will be transferred from MOC to KOWACO.

A report by MOE indicates that in most rivers tested, BOD, coliform or the presence of other pollutants was higher than the Korean standards. Of 26 000 industrial wastewater treatment plants, 19% were not in operation. To protect key water sources, the Government will finance the relocation of 550 industries before 1992 and provide 80% grant financing for the expansion of sewage treatment works.

In Korea, advanced water treatment methods such as pre-chlorination, activated carbon adsorption and ozonation have been introduced in addition to conventional methods. THMs have become a problem in Korea. In 1990, a guideline was set for THMs at 0.10 mg/litre as an annual average. Powdered activated carbon is commonly used for short periods and granular activated carbon filters have been provided in some cities. Ozonation has been used at some plants.

4. Malaysia

Generally, fully treated water supply is available throughout the day. Water quality meets the WHO Drinking Water Quality Standards. In most rural areas, water supply is of the same standard as that of urban supplies. The pressure in the mains in general varies from 10 meters to 24 meters. The average per capita consumption is 259 liters per day for urban areas and 160 liters per day for the rural areas. Water distribution is generally the gravity-fed type. Asbestos cement pipes are extensively used. Mains of larger sizes are of steel, grey cast iron or ductile iron. Both galvanized iron and uPVC pipes are commonly used for services. Water Supply Rules require all taps in a house to be fed from a storage cistern with the exception of the kitchen tap which is fed directly from a public main.

In the last decade, water demand and production increased rapidly at rates of 9.0% and 9.4% respectively. The demand in the country by 1990 is 4 979 MLD as compared with the production capacity of 6 442 MLD. Ninety-six percent of the urban population now has an access to piped water supply. The coverage of rural population at present is 66%, which will increase to 79% in 1995.

Constitutionally, water supply is a State matter. The States operate the supplies through either the State Public Works Departments (PWD), State Water Supply Departments (WSD) or Water Boards. The Federal Government finances water supply projects by its loans or grants. All completed water supply projects by the Federal Government are handed over free of charge to the States. The Federal Government is currently drafting a new water supply act for providing a uniform framework to be adopted by the States. The new act will contain provisions for protection of water supply catchment areas, privatization, etc.

With the implementation of the National Drinking Water Quality Surveillance Programme in 1983, the following documents have been prepared, i.e. (i) National Guidelines for Drinking Water Quality: (ii) National Programme on Drinking Water Quality Surveillance; and (iii) Manual on Drinking Water Quality Surveillance. The lead surveillance agency is the Ministry of Health. In setting the contaminant level limits (or free chlorine residual level), the 1984 WHO Guidelines for Drinking Water Quality were used.

Water treatment processes employed in most water treatment plants include aeration, flocculation, sedimentation, filtration, disinfection and pH control. In some plants, pre-chlorination is carried out. Fluoridation of water is also widely carried out.

In addition to conventional treatment processes, other processes being adopted are ozonation, activated carbon adsorption, dual media filters, shallow-depth sedimentation, etc.

The increasing pollution to water sources has resulted in difficulty in water treatment and higher costs of treatment. Furthermore, a large number of existing water treatment plants suffer from many problems. Causes are: defective designs, lack of preventive maintenance, inappropriate operation, and lack of adequately qualified operational staff. Hence, a major programme for treatment plant rehabilitation works has ben planned for implementation in the Sixth Malaysian Plan period (1991-1995).

The national non-revenue earning water in the country was 43% in 1987, which had been rising in the previous several years. The dominant component is leakage which is estimated at 32%. Major causes are the wrong choice of pipe materials, poor workmanship, age of the system, etc.

In most water supply authorities in Malaysia, there is generally a lack of personnel in accounting and enforcement to ensure high efficiency in financial management. For long-term goals, a commercial accounting system is necessary.

There is a growing awareness of the need for regional cooperation for promotion of technology and management in this region. To this end, the East Asia Water and Sanitation Network was established in 1990. Another example is the International Water Supply Conference organized by the Asia-Pacific Group (ASPAC) of the International Water Supply Association (IWSA) which is to be held in Kuala Lumpur in 1992.

5. New Zealand

Mr G. Fox presented his country report on New Zealand. Eighty-eight percent of New Zealand's population is served by piped water supply. Water supplies with served population of more than 50 000 persons cover 39% of the total population. On the other hand, many small communities now enjoy the benefits of piped water supply. However, at least 100 000 people in 1985 were judged to be served by unsatisfactory supplies due to either to inadequate water treatment or poor distribution practices. Most community water supplies are constructed and operated by local authorities. Water catchment control is vested in 14 regional councils.

Surveillance of water supplies is vested in 14 area health boards. Policy and direction are provided by Government through the Department of Health. There is a continuing five year rolling programme of chemical surveillance. Each supply is assessed throughout from its water sources through its treatment system to its distribution network. Some water supplies rely on catchment control and simple chlorination. Others use rapid sand filters without coagulants. Some systems have been inadequately designed to cope with waterborne protozoa. Some treatment plants will need significant upgrading and operational improvement. New treatment facilities will be required where no treatment is at present provided.

In the country, past policies have encouraged the clearance of native forest to increase farmland. This has led to an increase in the natural erosion, which affects the quality of water supplies. Catchment control policies may have to be enhanced.

In New Zealand, water tends to be a cheap commodity, ranging in per cubic meter charges from US$0.10 to US$0.70. Until recently, domestic water metering has been regarded as uneconomic. Some local authorities, however, have applied domestic water metering. Where cities run close to the limits of their readily available, cheap, upland supplies, they give more attention to metering, use-related charges and water conservation measures. Funding is a problem for small communities. They have to finance their own schemes; unit costs tend to be higher for small systems.

New Zealand, in line with the WHO's Guidelines, has produced its own Drinking Water Standards in 1984. These may place too much dependence on the coliform group of bacteria as indicator.

6. Philippines

Mr D. Gonzales presented the Country Report on the status of the water supply sector in the Philippines. The Philippines, comprising 7 100 islands, has a population of 57.4 million persons. Eighty-six percent of urban population (8.2 million) in the Manila Metropolitan region has access to safe water; in other urban areas (15.4 million) 55% is covered; 62% of rural population is served; and 63% of total population has been covered. Sewerage service is available in very limited locations. Water supply service in the Philippines is given at three levels, namely Level I (handpump), Level II (standpost) and Level III (individual connection). The standard quantity of water to be served at each level is: Level I 30 lit.per cap. per day; Level II 60-75; and Level III 100. The drinking water quality is "good" only in 13% of instances; others are either "fair"(70%), "poor" (16%), or "very poor"(1%).

The problems for the Philippines' water supply management is associated with water resources contamination with fertilizer applied on vast farmlands almost all over the country. Contamination of surface and groundwater source with toxic and hazardous chemicals are becoming health and environmental problems. Enforcement of drinking water standards and pollution control laws and regulations are being implemented by concerned government agencies. Water quality criteria and standards are being updated to be more relevant to the country's development policies.

Water development for domestic water supply purposes are vested in the Department of Public Works and Highways, the Metropolitan Water and Sewerage System, the Local Water Utilities Administration, and the Department of Local Governments, and at the barangay (village) level in Rural Waterworks and Sanitation Association (RWSAs) or Barangay Water and Sanitation Associations (BWSAs). Under the "Accelerated Rural Water Development Programme", it is planned that at least one Level I water facility for every rural barangay should be provided with the construction of 100 000 wells. As to the safety of drinking water, "certificate of potability" is given by the Department of Health after analysis of water samples. For Level III water systems, raw water is treated by means of conventional processes, i.e. sedimentation, filtration and disinfection. For Level II, only disinfection is performed. For Level I, no treatment is given except for an assurance the well water is safe for drinking.

7. Singapore

Mr H.S. Ong presented his country report stressing their great efforts for securing and protecting water sources and curbing water losses.

The main island of Singapore has an area of 572 sq km and a population of 2.6 million people. The climate is equatorial. The annual precipitation is 2 370 mm. Public Utilities Board (PUB) was formed in 1963 as a statutory authority to provide services for electricity, water and gas for the citizens. The Water Department is responsible for potable water supply. The Republic's water demand of 1 096 000 cu m/day in 1989 was met by supplies from sources in the island as well as in the State of Johore in West Malaysia for about 50% of consumption. In the Singapore island, only the central hilly zone can facilitate inland reservoir construction. With limited land area, judicious landuse planning is a key factor in the development of water resources. Suitable catchments were earmarked and anti-pollution legislation with stiff penalties was enacted to control pollution of water bodies. For protection of water sources, the following policies have been implemented: (a) provision of a green belt in the periphery of reservoirs; (b) prohibition of the farming of hoofed animals within water catchments; (c) control and treatment of domestic and industrial wastewater, etc.

The quality of raw water varies with the source. The inland reservoir waters are generally good throughout the year. The water quality from Johore fluctuates depending on the rate of runoff and natural environment of the catchment. Water from the estuarine reservoirs and stormwater runoff from the urbanized catchments generally have higher organic and mineral content. Deteriorating quality of water has resulted in higher alum, lime and chlorine dosages. Conventional chemical and physical treatment processes used comprise: chemical coagulation, sedimentation, rapid sand filtration, disinfection by chlorine, and conditioning using hydrated lime. The use of activated carbon and polyelectrolytes has also helped keep the dosages down.

The Central Water Testing Laboratory tests water samples daily for monitoring the water quality throughout the water supply systems. Singapore's water supply is to conform to the WHO Guidelines. Treated water is pumped into service reservoirs situated on high ground, from which water is supplied by gravity to customers. There are 12 service reservoirs with a total capacity of 1 075 000 cu m. The total length of transmission and distribution mains, varying from 75 mm to 2 200 mm in diameter, is about 4 200 km. Smaller diameter mains (300 mm diameter and below) are of cement-lined ductile iron. Larger pipes are made of steel.

For smaller service pipes (28 mm to 54 mm), stainless steel, copper and uPVC-lined galvanized iron pipes are used. Only dezincification-resistant brass fittings are allowed for use in the system as such fittings have been found to pit when in contact with water of higher chloride content. To prevent pipe corrosion problems, PUB has prohibited the use of unlined galvanized iron pipes. Since 1980, only corrosion-resistant pipes made of copper, stainless steel and uPVC-lined (or high density polyethylene) galvanized iron pipes are allowed for use. PUB in 1983 embarked on replacement programmes for old unlined cast iron mains with cement lined ductile iron pipes and unlined galvanized service pipes with stainless steel or copper pipes in some locations where water from estuarine reservoirs is received. Replacement work in the central areas is under way. To improve water quality in the downstream ends of distribution network, liking-up of dead-end mains to form ring main system is also in progress.

The entire water supply system from waterworks to customer's taps is fully metered. Of 750 000 water accounts, 672 750 or 90% are domestic ones with the remainder being commercial and industrial accounts. All the meters are tested to ensure recording accuracy within 3% before installation. Current unaccounted-for water fluctuates between 10-11% of the total. Domestic meters are bulk-changed in a seven-year cycle. The recovered meters are re-conditioned at the meter workshop before reuse.

Until lately, Singapore's water demand had been growing at more than 5% per annum. Such growth is a great strain on Singapore's limited water resources. There is a need to control wastage and implement water conservation measures. Leak detection tests are carried out for the entire distribution network within eleven months, leaving one month to re-test the leak prone areas. Any registration of flow on the flow recording chart installed in an isolated region indicates the presence of leakage. Further tests are then carried out by using instrument to locate the leaks for repair. The Board has also implemented measures to conserve water in customers' premises such as water saving devices, substitution of potable water with non-potable water (e.g. treated sewage), recycling of process water, etc.

There are about 7 500 employees in PUB serving more than 800 000 customer accounts which include water, electricity and gas accounts. Employees are trained at the artisan training school which was set up in 1972. Another new training center has also been built to provide practical training for engineers and technicians. Engineers are also sent overseas for special training/courses.