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IMPROVED EFFICIENCY IN THE MANAGEMENT OF WATER QUALITY

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INTRODUCTION

It is generally agreed that water is one of the world's most precious resources, and that it must be managed - effectively and efficiently - around the world. The needs, policies, and practices vary significantly in developed and developing nations. But, an adequate supply of safe water is a basic human need, and an unmet goal.

The United Nations (UN), through numerous programs and conferences, has focused attention on the issues pertinent to water quality management. It has established goals, and provided support services. The UN Water Conference in Mar del Plata produced an action plan for meeting the goal of providing safe drinking water and sanitation for all human settlements by the year 1990.

The state of development is important in the context of current status and future needs. Assume that the world's population has reached 5 billion. (The United Press International (UPI) reported that it would on July 7, 1986.) Nearly 80 percent live in Third World countries. In developed nations, 90 to 100 percent of the people have reasonable access to safe drinking water and sanitation facilities. More than 25 percent of the people in developing countries do not. ("Reasonable access to safe drinking water" is defined[1] in urban areas as piped to a housing unit or a public standpipe within 200 meters. In rural areas, it implies that a disproportionate part of the day need not be spent in fetching. "Safe" includes treated surface water, and untreated water from protected springs, boreholes, and sanitary wells. "Access to sanitation facilities" is defined as being served by public sewer; or, by household systems, such as pit privies, pan-flush latrines, septic tanks, commercial toilets, etc.)

The UN International Drinking Water Supply and Sanitation Decade (1981-1990) has achieved measured success to date. By the end of 1986, some 530 million people will have new "reasonable access to safe drinking water," and 86 million will have acquired adequate sanitation.

Pollution remains a major concern in water quality management. The human contribution from the 1.2 billion persons without adequate sanitation is apparent. Additional pollutant loading attributes to inadequate and malfunctioning municipal, package, and individual wastewater treatment systems. Growth in urban areas commonly exceeds design capacity of the treatment facility; correction may not be easily - or quickly - realized. Onsite systems are all too frequently not monitored and malfunctioning.

Industrial wastes are significant pollutants in Third as well as First-World countries. In developing countries, they are traceable to agro-industries, including brewing, slaughtering and sugar refining (Nigeria); coffee and tanning (Kenya); sugar and palm oil processing (Thailand); and palm oil plantations and processing (Malaysia). In urban areas of the developing world, examples of significant pollution include wastes from

[1] By the World Health Organization (WHO).

nations develop their water quality strategies. Because industrial water demand in developing countries tends to be less important than drinking water and sanitation issues, management plans, institutions, and financial and human resources tend not to be directed at industrial pollution problems as they are in developed countries.

It is important to keep these differences in perspective in considering the major issues addressed in this paper: changes since Mar del Plata; current institutional structures and management approaches; rigidities in the current structures; and alternatives for improvement in the management of water quality.

CURRENT INSTITUTIONAL STRUCTURES AND MANAGEMENT APPROACHES

Effective institutional structures and water quality management programs are essential for all nations. Included are formal planning, consistent with local and individual needs; national and regional laws and regulations; agencies with clear responsibility for oversight; and provisions for funding and economic incentives.

Laws, Regulations, and Policies

The initial step in effective water quality management is formulating sound, national policy; that is, the strategies and action plans for achieving national goals. Ideally, policy will be established at the highest level of government, and administered by a single, national authority.

National policy is supported by a legislative and regulatory framework. Since Mar del Plata, it is clear that many nations have recognized the need to adopt or amend their laws. Most of the developing countries have adopted water laws; however, many are not within the cultural realities of their jurisdictions. In general, the Economic and Social Council for Asia and the Pacific (ESCAP) countries are operating with effective, high level authority. The Constitutions of Papua (New Guinea) and Vanuatu include sections protecting natural resources. A Presidential Decree (No. 1951) is in effect in the Philippines. India, Indonesia, and the Republic of Korea include a chapter on environmental management in their five-year social and economic development plans, and Malaysia and Thailand have adopted formal policy statements. There are comprehensive laws and dominant institutions in Columbia, Mexico, and Venezuela. The Caribbean countries have made little progress with water laws.

The trend has generally been to integrate national legislation into one, comprehensive statute covering all aspects of water use and protection. Egypt has been successful in enacting and enforcing a comprehensive water quality law. The government sets standards and issues permits for all waste discharges. The regulated levels are carefully monitored, and strictly enforced. There is effective interface and support between the regulatory and judiciary authorities in enforcing the requirements and punishing the violators. This is an important element in Egypt's successful experience. Laws and regulations at any level of government - regional, national, state, or local - are ineffective without enforcement.

Water Quality Monitoring

Initial and ongoing assessments - both quantity and quality - are critical water resource management needs. This implies the development and continued updating of a comprehensive data base through effective monitoring programs, interpretation of the data, and coordination and communication to all interests. Interpreted data are essential elements of planning, implementing, enforcing, cost recovery, and applying compliance incentives.

There are two basic methods for monitoring the quality of surface waters: analyzing pollutant levels in point source discharges, and monitoring the receiving water for changes in quality. Effluent (permit source) measurements are necessary for enforcing discharge permits. Monitoring the surface water justifies permit decisions, and adds important data for non-point source pollutants, like agricultural chemicals. Each approach is important; used together, they provide the greatest opportunity for planning and management.

Spain has ten regional water commissions which oversee a monitoring network of 383 stations. The USSR is using automated instruments to provide early warnings of pollution in areas known to be "at risk."

In most developing nations, water quality monitoring systems are either inadequate or nonexistent. In the Asian-Pacific region, Indonesia is one of the only countries which maintains a comprehensive, nationwide water quality monitoring system.

Until relatively recently, there was widespread failure to recognize the consequences of discharging industrial wastes to surface rivers and streams. The River Elbe in Central Europe is but one example. In just over 100 years, the Elbe was changed from Hamburg, Germany's source of drinking water (untreated) to a source unsuitable for drinking water treatment. The result is reliance on groundwater, much of which is also contaminated.

Data on groundwater quality are far less available than data on surface water. There is need for improvement worldwide in groundwater monitoring programs and practices; few developing countries have comprehensive monitoring programs. In part, this may relate to cost of instrumentation. But, a general belief that groundwater was protected by natural barriers to contamination has delayed effective protection and planning worldwide. There is no doubt that aquifers are polluted, and that the causes - malfunctioning septic tanks, deliberate disposal of hazardous and toxic wastes, accidental spills and leaks, and agricultural chemicals - represent "unrecognized risk." In the US, groundwater provides 50 percent of the total supply of drinking water. In 1980, this was 88.5 billion gallons per day (BGD) (up from 34 BGD in 1950, and 68 BGD in 1970). Groundwater is also important to industrial and irrigation uses.

Even larger numbers of people may be affected by contaminated aquifers in the developing countries. In the developed countries, modern technology and quality of life goals have imposed a potentially infinite burden on the groundwater resources. In the US, monitoring is mandated under the relevant water laws. Compliance monitoring of municipal and industrial wastes

Typically, standard setting and strategic planning for effluent and groundwater standards present problems for developing countries. Effluent standards may be established as acceptable levels of contaminants at an outfall site. These levels tend to be universal for a particular pollutant, regardless of the quality of the receiving water. The alternative, "ambient" standards for the receiving waters, consider waste assimilative capacities of the water rather than pollutant levels discharged.

The current trend appears to favor ambient standard setting. This involves a somewhat more technical scheme for regulating polluters, but, if done correctly, it will confirm that water quality goals are met. It may, however, be a difficult approach for developing nations, where expertise to understand industrial processes, their wastes, and the impact of pollutants may not be available.

Malaysia sets effluent standards and attaches them to discharge permits. In the US, effluent standards are required under the CWA, via the National Pollutant Discharge Elimination System (NPDES) for permits. Discharge of wastes into groundwater by treatment, storage, and disposal facilities is regulated by permit under HSWA. Substances which could pose a threat to groundwater are regulated during manufacture and use under FIFRA and TSCA, with provision for inspections and surveillance. Standards for discharges are developed by the USEPA, considering best treatment technology, receiving water quality, and public health concerns. Ambient standards are commonly established in addition to effluent standards. Comprehensive effluent, surface, and groundwater water quality monitoring programs are undertaken at all levels of government, and by countries and industries discharging wastes.

The United Nations Industrial Development Organization (UNIDO) has produced a series of reports dealing with the environmental effects of industries currently expanding in the developing world, including agro-industries, cement, edible oil, fertilizer, iron and steel, petrochemicals, and inorganic and organic chemicals. These reports explain what discharges to expect, their control possibilities, the industrial processes, and many potential impacts of the wastes. They are important both in monitoring the effects of current industries, and in planning and siting future industrial development. In effect, the reports help to fill institutional gaps when the expertise to set and enforce standards is formally lacking.

It is not uncommon to find mandates for environmental impact assessments (EIAs) for all projects with real or perceived potential for affecting the quality of natural resources. By statute or by policy, EIAs are required by governments in the Philippines, Malaysia, Thailand, India, Indonesia, Pakistan, Singapore, and Sri Lanka. They are used in the US, and may be required even at state and local levels. They are not widely used in the Latin American and African countries.

ACTION: Encourage the use of EIAs as an environmental planning tool, especially in Latin America and African countries.

FUNDING AND INCENTIVES

In addition to legal and administrative techniques for managing water and sanitation resources around the world, sources and types of funding, and

user charges to encourage industrial growth and economic development than to collect them as a resource for water quality improvement goals.

Direct charges to implement the principle, "the polluter pays" have been used successfully in Europe. France passed legislation in 1964, Czechoslovakia in 1967, and Germany in 1976. Other countries using pollution charges (effluent charges and/or user charges) include Hungary, and The Netherlands. Perhaps the best known example is the system of eight water authorities (Genossenschaften) in the Ruhr district of West Germany, which controls all central wastewater treatment facilities along the Ruhr, and imposes effluent charges on all industrial dischargers, based on both quantity and strength of wastes.

When water authorities have complete control over all waste discharges, their effluent charges can provide a complete incentive structure to the industrial user. They can directly affect the degree to which waste reduction measures are implemented, the degree to which pretreatment is undertaken prior to discharge to a central wastewater treatment plant, and the degree of treatment provided by direct discharge treatment plants operated by industries. In this way, they can produce an optimal mix of waste treatment strategies as a function of overall quality of the receiving water.

Important user charges considerations include:

1. Basis for the charge;
   Charges should be related to type and strength of wastes and related treatment costs. Ideally, the charge should be slightly greater than the cost of treatment.

2. Contaminants measured;
   The number of parameters analyzed should be a cost effectiveness decision. France bases its charge on suspended solids (SS), biochemical oxygen demand (BOD), dissolved solids, and toxic matter. Germany measures SS, chemical oxygen demand (COD), mercury, cadmium, and toxicity to fish. Czechoslovakia measures SS and BOD.

3. Coefficients applied;
   The analytical data may be multiplied by a coefficient that reflects the location of discharge. In France, high and low priority areas have high and low coefficients, respectively. In Czechoslovakia, a surcharge is added to the pollution charge according to the impact on ambient water conditions.

4. Use of collected revenues;
   Revenues generally are used to offset administrative costs and subsidize pollution abatement projects.

5. Use of a progressive increase in effluent charge;
   Both France and The Netherlands instituted relatively low charges, but increased their fees over the years.

the individual states through a primacy arrangement. The Federal government provides some funding subsidy to the states. Local funds for construction, operation, and maintenance of water utilities are derived primarily from users of the water systems.

ACTION: Provide assistance with local water quality managment and planning and develop interaction with related national and regional agencies. Recognize the need for and provide trained specialists to assist at the local level.

National Level

To gain control of their water resources, most countries have realized the importance of a central agency to organize a comprehensive strategy. This action supports one of the principal resolutions of the Mar del Plata Action Plan, which called for the development of strong national programs, and institutions to implement national programs. From 1972 to 1981, the number of countries with national environmental agencies rose from 25 to 140. It is encouraging to note that 110 of these agencies are in developing countries, a tenfold increase from the number of agencies in developing countries at the time of the UN Conference on the Human Environment in Stockholm in 1972. Each national agency has a somewhat different approach to water management, but shares a common responsibility to support and coordinate the overall water policy. To accomplish their goals, a central agency must be capable of gathering and assimilating data for decision-making and planning. It must implement programs effectively, develop and administer a budget, efficiently deliver services to the field, continuously monitor water quality, establish enforcement mechanisms, and develop good interaction with the public.

The establishment of central agencies for water management doesn't necessarily mean these criteria are provided. In the Asia-South Pacific region, most countries have central water agencies and defined national water policies, but only about one-half have been able to develop master, national, water resource plans. The countries with master water plans often can't carry them out because of structural weaknesses in their central agencies. In developing countries, these weaknesses usually involve lack of staff, lack of financial support, and a judicial system unprepared to enforce the laws. Overcoming these weaknesses is necessary before substantial progress can be made in managing water quality and pollution control programs.

ACTION: Strengthen central water management agencies by adopting fee and charge systems to generate revenues. Set aside a portion of the revenues for staff training and program operation.

ACTION: Support legislation and actions to strengthen judicial institutions and systems so they can be effective in enforcing water laws.

Regional Level

National efforts may be ineffective unless they are coordinated with other nations sharing environmental resources. There are two basic management

In 1968, the US Congress passed the Water Resources Planning Act. This legislation provided a mechanism for states to form "river basin commissions" to address water resources planning and coordination on a hydrologic basis. Each commission included a representative from each affected state, and a representative of each relevant Federal agency. Six new river basin commissions were established in the US under this Act. (Two had previously been established by compact.) The US Water Resources Council was also established under the Act. Early in the 1980's, the six commissions and the Water Resources Council were abolished by administrative order. The Congress has recently considered legislation (at least for the Great Lakes basin) which would setup a new body to coordinate research and data needs on a hydrologic basis.

The most significant barriers to cooperative and effective use of international waters continue to be political difficulties in co-basin countries, and lack of willingness of some nations to reach an agreement.

Private Participation in Water Pollution Control

Since the Construction Grants Program was reduced, the major trend in municipal wastewater treatment in the US has been toward "privatization" - the ownership and/or operation of wastewater facilities (and water utilities) by private companies. A major advantage is the use of private versus public funding resources. In addition, local government is freed from O&M problems, and from meeting Federal standards. Advantages for the private participants include tax incentives not available to local governments, and less management overhead, especially when agreements can be reached with a number of closely located plants.

The US privatization movement bears some resemblance to the vertical integration that characterizes much of the water and wastewater treatment industry in France. Claims made for privatization are, in fact, said to be validated by the French example. A for-profit entity is argued to have stronger incentive to optimize both capital and O&M expenses, maximizing efficiency and eliminating waste.

In addition, a private owner/operator can be bound by contract to warrant that effluent quality standards will be met. The compliance status of municipal wastewater treatment plants in the United States has been notoriously unsatisfactory. Potentially, privatization may help in reaching compliance and realizing water quality goals.

ACTION: Consider privatization of water and wastewater treatment services, especially in countries where tax incentives make this approach economically feasible.

RIGIDITIES IN THE CURRENT STRUCTURE

Lack of Awareness

Few would argue that pollution exists, and is a problem worldwide. Public and professional awareness has been slow, and response to problems, often

Problems with Enforcement of Regulations

Implementing programs consistent with legislation is often no small task, especially in developing countries. Monitoring and enforcement impose large demands on a government's resources.

The problems with enforcement are illustrated by experience in the ESCAP region, which has been monitoring progress in implementation of environmental laws since, and as a result of, the Mar del Plata Action Plan. The results of two surveys indicate that most of the ESCAP countries have developed a general legislative framework for environmental protection, but enforcement is not satisfactory. Greater public involvement and strengthening of institutional systems are essential to effective legal enforcement.

Exceptions to the requirements can also be a problem, and have been cited in the failure of effluent charges to bring about substantial improvements in water quality in some parts of France. High pollution levels have been tolerated, especially where pollution reduction would be costly, difficult, or adversely affect an export market.

The lack of incentives in regulatory systems has also made enforcement of pollution standards difficult. Polluters often prefer to engage the government in lengthy legal battles, rather than to meet standards. A strong regulatory agency is key to a government's ability to enforce regulations, especially when economic incentives, such as effluent charges and tax benefits are not used.

Monitoring places a considerable burden on developing nations. It is costly and requires skills which may not be available. The rapid growth in population and industrial development in recent years has often left governments unable to cope with environmental issues.

Control Costs and Alternatives

In a December 1980 WHO survey, funding limitations along with insufficiently trained professional staff were listed as the greatest constraints to improving water quality. Reviews of conditions in the ESCAP nations and in Africa carry a similar message, that is, the price of protection of an undervalued resource in rapidly growing, impoverished countries is often simply too high to pay. Sanitation in developing countries is failing to keep pace with pollution abatement needs.

In contrast, the industrialized countries of Europe, North America, and Japan, have installed various treatment technologies at considerable cost, especially since 1970, generally resulting in improved water quality. But it is agreed that these investments may not have been cost effective.

Even when projects in developing countries have been financed by outside sources, sufficient funds often could not be generated within the countries to operate and maintain them. In some cases, capital-intensive treatment

a means of offsetting this perverse change in the existing US incentive structure. A comprehensive program combining standards, permits, and effluent assessments may offer the greatest opportunity for meeting goals and objectives. Regardless of the approach, there must be provision for cost recovery. Sri Lanka is an example of success, jumping from 5 to 25 percent in one year, resulting from charges in metering, user charges, billing and collection, and leak detection.

ACTION: Foster implementation of programs which combine standards, permits, and effluent assessments for cost recovery, and to achieve pollution abatement goals. The German system is an appropriate model.

Priority of Development Over Water Quality Control

Industrial pollution has been only a limited problem in developing countries, where usually less than 10 percent of the water use is industrial. Where the assimilation capacity of the receiving waters has not been overtaxed, the consequences of industrial expansion have been minimal. But rapid increases in industrial water use in developing countries are foreseen in the next two decades, and there are many examples of industrial pollution damaging water supplies in India, China, and Latin America.

The failure of Third World governments to regulate industrial expansion and its environmental effects indicates that water quality control is a lower priority concern than industrial growth. Until recently, the Third World has been suspicious of warnings from developed countries about the environmental consequences of unregulated industrial expansion, seeing these warnings as an attempt to limit industrial competitiveness of the poorer countries. But other limitations, such as lack of financial and human resources, planning, and coordination present large obstacles to regulation, even when water quality is deemed a high priority.

Lack of Adequately Trained Personnel

In 1977, the Mar del Plata Action Plan emphasized that, "Education and training are necessary for all levels of personnel dealing with water resources development." A 1980 World Health Organization (WHO) survey of 87 developing nations ranked the inadequacy of professionals and sub-professionals as the major constraint, along with insufficient financing, to advances in the area of water supply and sanitation. This may well be the area where goals set for the past decade have seen the least accomplishment.

Too often, donor groups have enthusiastically funded projects without considering the need for trained professionals to manage them. Almost as important as funding is the need for trained technicians to maintain and operate individual facilities. WHO estimates that 2 to 3 million additional staff will be needed to operate drinking water and sanitation facilities for those currently without these skills. This will require that necessary staffing be available before project implementation. This problem will not be solved rapidly even if training is improved.

- strengthening groundwater protection capabilities of the states;
- focusing on contamination sources of national concern, e.g., pesticides, toxic chemicals, and underground storage tanks;
- considering the vulnerability of groundwater to contamination in all environmental programs; and
- coordinating groundwater policies with all affected parties.

In addition to the national pesticide survey, a new regulatory program for underground storage tanks is in effect, a groundwater monitoring strategy has been developed, and state programs are being strengthened through financial support, direct technical assistance, and information resources.

There are several reasons why current water management institutions tend to neglect groundwater protection. The most obvious is insufficient financial resources. The limited resources available tend to be used for higher visibility surface water problems. But in the US and other developed countries, public attention is being focused on contamination of drinking water aquifers. This will result in higher priority spending for groundwater - protection and cure.

As important as it is, there is a danger in developing public awareness through the media, where sensational reporting may lead to scare in lieu of awareness. An informed press can greatly assist in achieving public awareness. Understanding relative risk is important to both.

ACTION: The highest priority must be given to groundwater protection activities in both developed and developing countries.

ACTION: Coordinate and implement inventory well log data records for developing countries as a first step in groundwater data collection.

IMPROVEMENTS IN MANAGEMENT OF WATER QUALITY

In reviewing progress over the last ten years, it is clear that more major changes are needed to meet water management goals.

There is no simple, common course of action which can be relied upon for worldwide water quality. Major tasks include resource planning and management, education and training, increased public awareness and participation, and funding and economic incentives. With these efforts, basic differences in needs and feasibilities between developed and developing nations are important considerations.

PUBLIC EDUCATION AND AWARENESS

The success of national efforts to improve environmental conditions, and the intensity with which environmental goals will be pursued are greatly affected by the public's awareness of the problems and its perception of their importance. Success is further assured with public participation.

regional center collects the national data, conducts regional quality assurance, and organizes training programs. The global center in Canada collects and processes all of the data, and periodically publishes data from the entire system. This level of cooperation and effort has never before been achieved in the water field. The success of this project is evidence that other programs can succeed on a global scale, with cooperation and commitment of the people and governments involved.

Acid rain is a recognized environmental pollutant; but, it is only marginally within the scope of this paper. Its impact is, indeed, international. There are established monitoring networks in the US (National Atmospheric Deposition Program - NADP), in Canada (Canadian Network for Sampling Precipitation - CANSAP), and in several European nations, but these programs are not currently networked. The Third World countries will be affected by acid rain as they become further developed and increase their uses of fossil fuels.

The International Hydrological Programs have aided many developing countries in collecting water and meteorological data, but success is limited when countries are unable to maintain them independently. Future aid should include building effective monitoring systems in the developing countries. Only with these systems can these nations independently plan the best use of their water resources.

In 1977, concern for the protection of groundwater was just beginning. Since then, its assessment and protection has become a major issue. There are still an inadequate number of groundwater monitoring systems in service. Complexity of the resource and the cost of sampling systems are the main constraints to groundwater monitoring. There are also too few laws and policies requiring these programs. Current monitoring focuses principally on protection of important aquifers, especially those supplying municipal drinking water. Monitoring the threats of toxic pollutants and saltwater intrusion are the reasons most often cited for groundwater monitoring. Seventy-two groundwater stations are included in the GEMS world network. These stations account for over 20 percent of the GEMS global system stations; but, when spread over the 50 participating countries, the average is less than two stations per country. Even with targeted expansion of the program, only a broad overview of global groundwater quality will be provided.

There is really no alternative to a large, sound data base for assessing needs and developing strategies. The options are parameter selection, frequencies, etc., which should be site - and case - specifically determined.

ACTION: Plan, install, and operate a network of water quality monitoring stations in the Asian-Pacific and African regions.

ACTION: Increase the number of groundwater monitoring systems in all regions.

ACTION: Encourage strong local participation in water resources activities (planning, designing, constructing, operating), especially in the developing countries.

ACTION: Establish mechanisms to limit redundancy of efforts among national, regional, state, and local agencies.

Assistance to Polluters

The Mar del Plata conference recommended that economic incentives be utilized for increasing the efficiency of water use. One of the principal "incentives" used by most nations is disincentive; that is, penalties assessed as a result of noncompliance with standards.

There are several disadvantages to using standards as the sole means of regulating pollution. Industries not in compliance are subject only to warnings and generally, to small fees, and they often find long court battles preferable to compliance. Typically, governments, especially in developing countries, often lack the resources for monitoring and enforcement. For these reasons charges may be considered a fee for the "right to pollute."

In developing countries, where there are limited resources for enforcement, a system of charges can provide a new source of revenue to be used to monitor polluters and enforce standards compliance.

Developed countries in Europe, and some developing countries, like Malaysia, use a combination of standards, effluent changes, and permits or licenses. Germany has a Federal Water Act, which calls for issuing short-term permits, uniform discharge standards, and a minimum national water quality goal. In addition, its Effluent Charge Law of 1976 levies charges on direct dischargers. When a discharge is in compliance with standards, the established effluent charge is reduced by half, providing an incentive.

The short-term permit alternative provides flexibility in meeting changing water quality needs.

ACTION: Promote user charges and effluent charge systems as regulatory tools and sources of pollution control funds. Successful approaches should reflect the specific cultural, social, economic, and technological conditions of individual countries.

ACTION: Focus regulatory approaches on economic incentives, including effluent charges and tax benefits. Set aside a portion of the revenues realized for remaining enforcement actions.

Other Alternatives

Particularly in the US, bottled water, and point-of-use (POU) and point-of-entry (POE) water treatment units using carbon filtration, ultraviolet disinfection, and reverse osmosis technologies, are being used as alternatives to public and private drinking water supplies. On-site generation of

3. Establish within agencies clear oversight responsibility with appropriate enforcement authority, and interagency liaison;

4. Expand the worldwide environmental monitoring network.

5. Develop, interpret, and communicate monitoring data through a networking system;

6. Provide funding and improvement incentives and opportunities for privatization commensurate with the tasks, including construction, operation/maintenance, and enforcement;

7. Educate, train, and invoke the affected populations;

8. Be aware and accommodate new issues and concerns; e.g., groundwater pollution;

9. Advocate research and demonstration programs for low cost alternative technologies.

10. Promote the use of standards for construction, products, and materials for public health protection and product performance.

Expansion of regional activities undertaken by the UN, WHO, and the International Reference Centre for Community Water Supply (IRC), which operates from The Hague, The Netherlands, is critically important and strongly recommended. Through programs provided by these organizations, expert guidance, meetings and conferences, technical papers, newsletters, demonstrations, training, and in some cases, funding provide continuing support for these recommendations, the Mar del Plata Action Plan, and the Decade goals. The Mar del Plata and New York UN conferences are valuable opportunities for assessing needs, showing experiences, and planning for future action. They, too, should be encouraged, and funding for them continued.

Clearly, water is the universal commodity. It must meet diverse individual needs, recognizing preferences and prejudices, cultures, and even religious concerns. It is expected to satisfy the poor as well as the affluent. It must be managed to the benefit of nations, and of the world. "Wise use of the world's natural resources means more than a clean and healthy environment. It also means sustainable economic growth in developing nations, and a stable world economy for developed and developing nations alike."[1] No other commodity brings greater personal satisfaction and hope for "a good life" to more people. The record since Mar del Plata and for the first half of the International Water Decade is testimony to improved management efficiency. Further improvement over the next five to ten years must be the shared goal of those who can help and, those who need help in realizing an adequate, safe supply of water for drinking, for industrial development, and for agriculture; and appropriate facilities for sanitation and water pollution control.

[1] Gro Harlem Brundtland, former Prime Minister of Norway and head of the World Commission on Enivironment and Development.

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