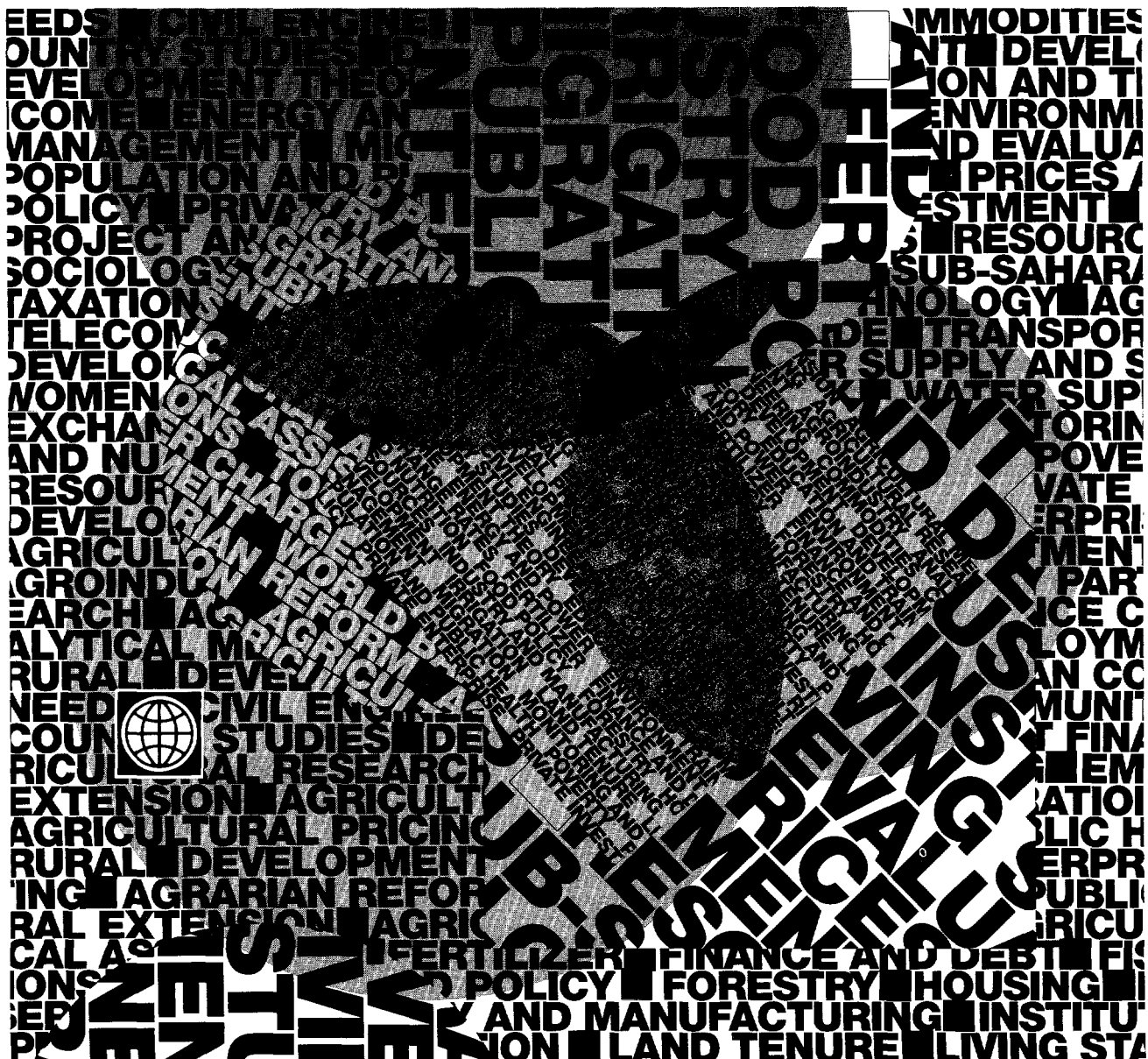


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## Some Principles and Practices

Harald D. Frederiksen



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# **Water Resources Institutions**

## **Some Principles and Practices**

**Harald D. Frederiksen**

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Washington, D.C.**

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## **ABSTRACT**

Major regions of the world are moving from a phase where water development dominated activities in the water sector to one where sophisticated water management and facilities maintenance dominate. Demands already are straining the resources. In many countries they will pit the needs of a doubling population against the existing demands in a mere twenty years. The rate and magnitude of changes affecting the water resources sector will force major new initiatives in the near future. Sound solutions may require substantial modifications in laws, policies and procedures and in the role of the government and the public. There is little time for debate, and indecision will be costly. Almost every country is grappling with the endless number of issues involved -- economic, environmental, social, technical, administrative and financial. They wish to devise new institutions to better deal with these issues and facilitate an orderly change. For it is the adequacy and appropriateness of institutions that will determine success or failure. Indeed, as countries around the world have addressed their ever more pressing needs in water management, several basic institutional principles have evolved. The administration of resources allocation, organizational structure, long-term and real-time management and the financing of essential activities follow similar paths in these countries. Examples in this paper illustrate the variations in application as influenced by the particular situations, including their history and stage of resources development.

## ACKNOWLEDGEMENTS

The concepts that are outlined in this paper are not new or original, but were evolved by water managers over time in the course of dealing with the ever more complex development and management of the resources. We are most indebted to the many individuals that helped create the existing institutions that underpin the examples of sound management for everyone to observe.

The author appreciates the information, comments and suggestions contributed by members of the Asia Technical Agriculture Division, staff of the regional units and numerous other individuals both within and outside the Bank. Officials of local, state and federal water agencies provided critical review and insights, in particular, Messrs. William Warne and Robin Reynolds, formerly of the California Department of Water Resources and Mr. Darrel Zimbleman of the Northern Colorado Water Conservation District. In particular, the author wishes to express his appreciation to the officials of water resources agencies in several countries who provided detailed information in response to specific questions posed to them regarding their institutions. This information is reflected in the text and in a separate paper "Water Resources Institutions of Selected Countries" by William Barber and Susanne Scheierling to be published at a later date.

Most importantly, Mr. Richard Grimshaw, Division Chief, ASTAG, who was instrumental in launching the Asia Water Resources Study (AWRS), under which this paper was prepared, provided continuing support and close, critical guidance to the work. Mr. Jeremy Berkoff reviewed this paper from the broad perspective of resources development and management and gave many helpful suggestions that greatly improved its scope and applicability to our work. Several authors of other technical papers prepared under the AWRS program also developed specific information and are cited in the paper.

## FOREWORD

Fundamental and far reaching problems arise as the demands on a nation's water resources approach the limit of the resources available. Indeed, the increasing population density and expanding industrialization are imposing pollution loads on surface and groundwaters that are, in effect, causing substantial further reductions in the quantities suitable for most uses. No less than the economic well being of society and the health of its surrounding environment are vulnerable to the water resources management decisions made by the nation under these conditions.

The effectiveness of the response to this situation depends directly on the capacity and appropriateness of the nation's institutions: (its form of government, the body of legislation, the organizational structure, the role of government, the private sector and the individuals, and the broader framework within which society functions). This factor is even more important than the relative quantity of the water resources available. Increasing expenditures are no substitute. And unfortunately, time does not allow for experimentation or procrastination under the prevailing conditions.

This paper presents some institutional principles found to be effective for the successful management of water resources. These principles are drawn from a range of physical and institutional settings where countries have shown positive results in addressing difficult water management issues. The paper is not intended as an indepth treatment of the subject, but rather constitute a synopsis that can serve as background for consideration by individuals and agencies grappling with this complex matter.



Daniel Ritchie  
Director  
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## I. INTRODUCTION

A nation's institutions (laws, customs, organizations and all that is associated) comprise the framework within which society functions. They constitute the framework for every action from group relations to commercial activities. This framework is, by its very nature, constantly subjected to pressures for change as a country's economic and social demands change.

This is a time of rapid and dramatic institutional adjustment in the world. Yet institutional change, even within a limited field, is not always recognized as a positive opportunity or rational pursuit. Instead, many changes are incidental and sometimes result as a compromise based on an inadequate assessment.

Today, aspects of the water resources institutions in many countries are under examination by non-government and government groups alike. Environmental concerns have brought intense and continuous public scrutiny of water development relating to both existing and new facilities to meet the needs of the future. The public is questioning many existing laws, regulations and practices involving water allocations. And water shortages, exacerbated by rapid population and economic growth is forcing governments to seek new directions in water management.

The conflicts between environmental objectives and water-use demands are complicating the modernization of water resources institutions. The severity of these conflicts in a given country depends on the physical and economic factors including total resource availability, water use and growth in demand, user priorities and the institutions that deal with these matters.

Customary and constitutional rights and legislation are the foundation of today's institutions. Many arrangements for the use of water evolved over centuries, particularly at the local level for community supply, drainage and irrigation, while broader water institutions developed along with country's civil government. The more recent institutions have developed to address water quality/pollution concerns and protection of the environment.

Institutional evolution in many countries, nevertheless, has not kept pace with the new impositions on their resources. Special interests and long established customs are powerful constraints. Single-purpose agencies sometimes delay needed cross-sectorial actions. As a result, institutional changes often have been reactions to narrow concerns.

Institutional change can only be made by the people and their government. Only they can decide what measures best meet their needs. The experience of other countries and advice of people who have actively directed institutional change, however, can provide practical information for use in these internal efforts.

This paper presents the situation confronting countries, identifies important institutional issues, and examines, by way of example, the principles followed by many countries in dealing with them.

## **II. THE WATER SITUATION AND INSTITUTIONAL DEFICIENCIES**

### **THE SITUATION**

Newspapers, magazines, radio and television constantly bring the more spectacular water related problems to the world's attention -- floods in Bangladesh, droughts in the Sahel and oil spills in Alaska. As a result, the general public has become much more aware and actively engaged in efforts to halt water related environmental deterioration. International water shortages as found in the Mid East, however, receive limited coverage. And the growing regional shortages in water supply and ever more pervasive pollution of groundwaters, though more serious, receive less attention. Few in the public understand the serious consequences that these less dramatic conditions foretell.

It is not generally known that few of the cities in India with over one million inhabitants have 24 hour, seven-day-a-week water service today; or that greater Beijing's current groundwater overdraft is lowering the water table and will force relocation of large farm populations or immediate diversions from other basins. Even the discussions of the critical Mid East shortages are couched in euphoric terms of "--- technology to make the desert bloom," while a fundamental obstacle to stability of inter-country water allocation remains unsolved.

These are only a few examples of the pervasive water related conditions that must be addressed through basic institutional changes. Once better institutional arrangements are achieved, physical and funding possibilities exist.

### **INSTITUTIONAL DEFICIENCIES**

The conditions generic to most countries testify to the problems requiring institutional actions. Most countries have general water allocation priorities: domestic use, agriculture, industry and electricity generation, in declining order. Some place industry ahead of agriculture. But these general priority statements neither clarify the allocations among specific users nor set priorities under long-term and emergency shortages. The linkages to land-use objectives and geographic location within basins are not defined, resulting in inconsistencies. Water quality considerations are absent in criteria governing use of an allocation.

The lack of specificity precludes selecting effective allocative mechanisms to enforce the objectives and water rights systems to record actions for the investors and the public affected. Indeed, few effective allocation mechanisms are in place in the developing countries other than what government does or does not construct. Few of these define firm project rights even though the undertaking should have a fifty-year economic life and, may form a much longer base for the affected region. Water conditions generated by scarcity, and pollution of remaining flows on numerous Interstate and international water bodies, are deteriorating with little success in remedying riparian conflicts.

"Safe" drinking water is available to only portions of the population. Unfortunately, much of that is not safe either. Though goals for expanding service exist, funding constraints prevent meeting them. The quality of surface supplies is deteriorating due to urban and industrial waste discharged into waterways. Remedial programs are slow in execution and adequate measures to promote effective waste management, such as pollution charges or standards enforcement, are not in place.

Flood events are believed by many to be increasing because of runoff changes on deforested watersheds. The primary reason for increased flood damage, however, is that habitation and economic activities are expanding on to flood-prone lands. Land-use zoning and construction

of flood water by-passes are effective alternatives. These require joint land/water resource management plans backed by project formulation guidelines and facilities operations different from those followed under the established institutions.

Sites for future facilities, essential to managing a nation's waters efficiently, are being permanently lost to other uses. Enormous costs will accrue to society by not reserving these specific lands now when disruptions are relatively more manageable. People may have to be displaced if solutions to a region's water shortage are to be changed; moving from reservoir lands so stored water may serve cities; from farms so irrigation water can be diverted to municipal use; or from cities if water is not made available.

The electricity companies commonly own and operate large reservoir facilities as essentially single-purpose projects. Without basin-wide multi-purpose operations rules, maximum energy benefits cannot be realized. Neither can water supply and flood protection be optimized.

Most local water agencies do not apply sound business practices. Deficiencies in mid- and long-term planning, budgeting, accounting and financial control preclude them from becoming effective, self-sufficient entities that can maintain their assets.

Operation and Maintenance (O&M) efforts to sustain the irrigation service have not kept pace with the programs for expanding irrigated area. The rehabilitation needed to overcome widespread construction deficiencies and neglected maintenance overwhelm national budgets, while water-user groups contribute minimally to financing and maintenance.

Financial responsibilities are integral to a country's institutions. What aspects of resources development and management should society pay for? To what extent should activities be subsidized? If the beneficiaries should pay, what facilities and responsibilities should government relinquish to them? Can for-profit privatization, as applied in some developed countries, be adopted by developing countries?

These examples of problems are but a few of those confronting governments in managing their water resources. Only a continuing and objective assessment with a fresh perspective can ensure that a country's institutions are equipped to meet the ever evolving requirements in addressing them.

### **III. SOME PRINCIPLES FOR SOUND WATER RESOURCES INSTITUTIONS**

#### **CONSIDERATIONS WHEN EXAMINING INSTITUTIONAL PRINCIPLES**

##### **General**

A nation's institutions and the manner in which they are applied, determine how the nation manages its water resources. And the existing institutions together with the condition of the resources and the economy combine to create the important issues confronting a country. Most issues that warrant changing institutions, however, are generic to the sector. Countries throughout the world have confronted the same issues and many have devised solutions that give insight into principles that another country might adopt.

This paper outlines the principles believed to be essential in formulating broad water resources institutional modifications. It is not intended as a comprehensive treatment of the subject, but as a synopsis for guiding more specific actions.

The principles set forth in this paper draw from several sources, mostly from extensive direct observation of government and private entities in the performance of their assigned responsibilities. Four papers completed under the World Bank Asia Water Resources Study July 1992 compiled additional information from selected countries for this specific purpose. They are Topic Paper No.7, "Water Resources Institutions of Selected Countries" by Mr. Barber and Ms. Scheierling; Topic Paper No. 3, "Water Allocation Methods and Water Rights in the Western States, USA" by Mr. Teerink; Topic Paper No. 6, "Water Pricing in California" by Mr. Teerink; and Topic Paper No. 8, "Water Allocation Methods and Water Rights in Japan" by Mr. Masahiro Nakashima. A more extended bibliography is provided at the end of this paper.

##### **The Dominant Role of the Political Process**

Often water resources institutions are discussed as though they are a technical subject. Careful analysis should yield uncontroversial conclusions. Perhaps fortunately, this is not the case. Goals, resource allocation and programs are formulated through the political process. This process is basic under most governments; certainly fundamental to democracies with active public participation. After all, the use and management of this basic resource should be for the purposes judged best by society.

The role of the "experts" is to offer specific expertise to the political bodies by presenting realistic, unbiased assessments of the consequences of proposed actions. The bureaucracies' role, in addition to being one source of expertise, is to implement the political decisions. But it should be clearly recognized that the effectiveness of resources management and the involved institutions are determined by the political process. The conditions encountered in a country's water sector reflect the political demands and the wisdom and leadership in these matters far more than any other factor.

##### **The Nature of Water Institutions**

One would intuitively expect that institutions devised specifically for the development and management of a nation's water resources are essentially the same in all countries. After all, it involves a substance of given physical characteristics, obtained from similar sources and applied to similar uses for the same economic and social purposes. Indeed, though institutions differ from country to country, fundamental institutional principles are common under good water management, particularly if one examines countries nearing full utilization of their resources. Three general principles apply when modifying institutions:

1. *Continuing evaluation:* Water resources institutions should be dynamic and must continuously change if they are to best match the evolving conditions. Proposals for institutional change of any type, at any point in time, should be viewed in that context.

2. *Comprehensive review:* Institutional modifications to any aspect of water resources development and management should be comprehensive and made in the context of devising effective management of all government and non-government functions in the entire water resources sector.

3. *Consistency among actions:* Deficiencies arise from inconsistencies in the inter-linked legislation, the organizational structure, the rules and procedures and the exercise of public/governmental responsibilities. Partial measures, no matter how sound, do not suffice. The first step is to formulate an overall framework to guide all reform proposals.

### **Reasons for Differences Among Countries**

An examination of the institutional principles common to most successful institutional arrangements might best begin by noting the reasons for the differences encountered.

First, the relative availability of water has a predominant influence. A variety of institutions may be found in countries with ample water, particularly if the country is still in a "development" phase. Loose arrangements suffice under conditions of surplus when conflicts and environmental concerns are minimal. As countries mature, however, problems of scarcity or quality force institutional modifications that follow similar paths.

A second influence on the institutions is the rate at which the related resources problems have arisen. Has it been a rate to which the institutions could adjust in an orderly manner or one that occurs at such a pace that institutional changes are made in response to crises?

A third influence is the relative population density. In well managed, densely populated areas -- or at least relative to the resources -- many management decisions reside in local units where people readily cooperate and work together to solve conflicts and maximize mutual benefits. Problems are found where central or state governments have usurped these long-established arrangements.

A fourth influence is the climate (amount, pattern and nature of precipitation). This variable largely determines the extent of major commitments to irrigation, drainage and flood control; often entailing large-scale programs.

Lastly, the form of the government and the legal system create the basic structure for water- and land-use legislation, particularly in such matters as delegation of government responsibilities. Unitary republics and federated republics display major differences, primarily due to the extent of state/provincial autonomy in resources ownership and management.

### **Primary Areas of Government Action**

Before discussing institutions, it is important to identify the three areas of pertinent government actions: legislative, operational and regulatory. It is in these areas where efforts must be applied to improve resource management capability (including institutional).

1. The legislative area creates the legal basis for all activities, and its history reflects the country's response to changing conditions. It includes: legislated policies, regulations and authorization and funding of basic programs and projects. The identified need for many of these may originate in the government bureaucracy, and much of their content may be formulated there as well. But ultimately, the fate of programs is determined through the legislative process, and hence, the political process.

2. The operational area includes data collection, planning, design, construction and O&M. The primary actions are carried out in accordance with authorization invoked by the legislative body. All actions deal with phases of programs to utilize and manage the resources. In most developing countries, governmental line agencies at various levels dominate the operational area. In others, the non-governmental entities play roles that expand as the actions move towards the O&M phase.

3. The regulatory area constitutes the framework for guiding program actions and measuring results in conformity with certain objectives (often expressed as standards) particularly in the environmental area. It includes monitoring activities and conditions and enforcement of established laws, regulations and specific-purpose agreements bearing on resource use. Those commonly enacted pertain to rights to the resources; real-time allocation; appropriateness of resource use; quality effects of any use; facilities configuration; safety of facilities and environmental impacts. All users are responsible for complying with regulations, but government agencies carry the regulatory responsibility to assure adherence.

Another regulatory function pertains to the financial aspects of water service entities. Since funds are inevitably involved in the operation, there is usually an oversight entity that reviews the cost recovery scheme, the application of charges and fiscal operations. In many countries a public utilities commission oversees non-government utilities and approves the financing and repayment plan before the action may proceed. This step is particularly important where financial instruments are offered on the market. A ministry such as "home affairs," "interior," or "finance" has this function for government entities, and in some countries for customer-owned entities.

Project and O&M financing may or may not be a government action. Where provided, it reflects the funding responsibilities seen by government and the priorities given to various programs through budgetary support and subsidies. Financing, of course, bears directly on the viability and sustainability of the programs and constructed facilities, an increasing concern given the demands on government budgets. As this paper discusses, beneficiary-financing of water services is increasingly seen as but one virtue of establishing "utilities" for providing all water related services. This is true whether these "utilities" are sub-units of government entities or wholly non-government; for-profit or non-profit entities.

## **A Basis for Change**

Many countries must make significant changes in their institutions if they are to maintain a healthy environment and sustain their economic and social well-being. But neither time nor funds exist to experiment with untried approaches, a luxury that the developing countries in particular cannot afford. The unknown, real or perceived, is not a reason to "pilot" yet another concept without thoroughly researching and understanding what others have tried in a like situation. Institutional innovation should be considered, but if introduced, it is likely best if introduced in conformance with proven principles.

As stated earlier, the increasing complexity of resources management has forced most countries to modify old and devise new institutions to cope. The similarities of the resources and the peoples' aspirations have lead to the evolution of several principles proven sound as measured by the health and sustainability of the country's economic and environmental conditions. Many, of course, apply to all sectors of government.

The principles of sound water resources institutions are presented in this paper under four groupings: (1) resources ownership, allocation and rights; (2) standards, regulations and administrative rules; (3) government and non-governmental responsibilities and organization; and (4) financial.



## **RESOURCE OWNERSHIP, ALLOCATION AND RIGHTS**

### **General**

The relationships among water resources allocation objectives, water allocation mechanisms and water rights are often misunderstood. Allocation mechanisms are proposed without a clear statement of national allocation objectives or an understanding of how the mechanisms effect national objectives. And water rights systems are formulated without deciding which combination of allocation mechanisms to adopt.

### **Water Allocation Objectives**

Water allocation among categories of uses is a political decision reflecting broader social, economic and environmental objectives. This statement is true in every country. Water, after all, is only one resource whose availability and cost affects broader growth and well-being. Since objectives are a political decision, the only principles that can be cited pertain to form.

Water allocations should support long-term goals and investments, optimize overall benefits by mixing complimentary uses, have geographical bounds that facilitate administration, guide real-time operations to meet annual and inter-annual variations, and incorporate a review/renewal mechanism for future generations. They must satisfy general priorities at the national level while being specific at the regional or basin level to accommodate local conditions and objectives. The allocation objectives must be presented in terms that allow factual evaluation of the appropriateness and effectiveness of proposed allocation mechanisms and the related water rights. As allocation objectives change, allocation mechanisms may also have to change.

The specific economic objectives (economic efficiency, equity, directed sector development, regional strengthening, poverty alleviation or efficiency of returns on unit of water) that bear on water allocation should be stated in terms linked to the overall allocation objectives. Linkages to other resource allocations, such as meeting land-use objectives, should be explicit, particularly when controlling pollution or meeting environmental objectives. Environmental objectives may dictate choices among the options. Too often the interdependencies of water allocation with other resource use is only vaguely inferred or ignored completely in devising allocation mechanisms.

The principle to remember is to formulate national and regional allocation objectives with sufficient detail to subsequently devise practical allocation mechanisms and rights systems to permit the country to meet those objectives.

### **Water Allocation Mechanisms**

Water allocation mechanisms are a major focus of debate in water resources management. Too often the debate on mechanisms proceeds without clear allocation objectives in place. Some mechanisms are proposed for the purpose of altering the country's allocation objectives. This concept is contrary to the principle of explicitly setting the allocation objectives first in an open process to consider all factors and then tailoring the mechanisms in a manner to attain those objectives.

Specific water allocation objectives generally limit the mechanisms. For example, society may wish to govern land use to meet various objectives (environmental, rural economic development, poverty alleviation, agricultural production or reduction in migration to urban areas). This then becomes a water allocation objective and the water allocation mechanism becomes a process of committing water to defined land uses precluding an overall "free market." Indeed, most countries allocate under combinations of mechanisms with their applications linked to both broader non-water objectives and to the hydrologic conditions. And many proposed allocation mechanisms fail to satisfy the stated objectives in a fair, easily administered manner under all hydrologic conditions.

The most common water allocation mechanism in arid countries is through legislative authorization of major developments, which is also becoming true in the humid zones where allocation to environmental purposes may be substantial compared to other uses. Indeed, project legislation contains the allocation objective and serves as the allocation mechanism. This constitutes the more focused allocation mechanism available through the political process.

A limited number of formal water allocation mechanisms dominate in the world. As stated, a common objective when water is abundant is to allocate water to develop a region's lands and other resources. Simply granting and administering formal water rights for uses meeting the general measures of "beneficial purposes" is a common mechanism to attain the allocation objective. The type of rights involved include riparian, designated use by legislation and "first-in-time and first-in-right" (appropriative). The administration of limited duration/specific use licenses is gaining appeal as it facilitates reallocation as objectives change. An over-riding priority of use usually dictates in all cases during critical drought shortages though many governments have not detailed the priorities of the environmental allocations.

Less formal allocation mechanisms, not linked to firm individual rights, are common in developing countries. Some simply set priorities for whatever water is available at a given time. Others may dedicate a proportion of water for each category of use (agricultural, urban, industrial, etc.) with more elaborate allocation mechanisms for the users within each of the categories. Or there may be a changing share among users as resource deficiencies occur -- long term, annually and seasonally. Usually a regional or basin entity administers the real-time distribution.

Water's role in attaining social and economic objectives has dictated much water development. The large infrastructure investments and parallel private dependence on the water service necessitate long-term allocations. The situation in many developing countries, coupled with the size of farms and villages and their near subsistence conditions, precludes any type of allocation other than guided development. In these cases, the allocation mechanism is the project authorization, and modifying these allocations is extremely difficult and of questionable benefit.

Very limited use has been made of an allocation mechanism applying restrained free market for existing "appropriative" rights in developed countries. One allows a free market of water shares and the rental of the associated rights among irrigators and village users within the system service area boundary. But it retains the resource within the system bounds following a policy to allocate water to sustain the area's economic activities. Another is similar but stipulates a difficult criteria: No third party injuries may result. Many urban areas administer allocation limits on individual use regardless of willingness to purchase, even at elevated prices. Some have removed basic supply allotments to public uses forcing parks and golf courses to secure reclaimed water. One large jurisdiction does allow internal sales of appropriative rights among systems, though only recently have substantial movements occurred, and the consequences in the public's view is not clear.

Environmental allocations are made through legislative appropriation in developed countries, often independent of the allocation mechanisms applied to the traditional users. Usually flow and quality levels are set. Allocation to this purpose does not have to meet economic criteria and often does not compete in a priority ranking with other uses for the water. Nevertheless, the mechanism for determining their allocation during shortages should be clarified.

Several other mechanisms are under trial in developed countries to improve management under scarcity conditions. "Water banking," which allows water rights holders who have stored water within a basin to exchange water during droughts, is under trial in the western United States. Exchanges are limited to systems in jointly owned reservoirs. One government, serving as a broker, has set a firm price for all sellers and buyers under a short-term trial instigated because of a drought emergency.

A free-market mechanism is proposed by some for allocating water, but the major direct impacts on third parties (rural versus urban growth and land-use objectives) continue to restrict its application. To date, no large scale free markets with bidding among "systems" or any scarcity pricing mechanisms have evolved in the developed countries. Again, these and other mechanisms only prove appropriate if the results satisfy all the country's water allocation objectives.

In summary, the over-riding principle is to establish water resource allocation mechanisms carefully tailored to attain the established national, regional and local resources allocation objectives. The features of the mechanisms should assure transparency in their effect in meeting the allocation objectives in the three areas: social, economic and environmental. They should make obvious any linkages to non-water matters such as third-party rights and land use. Administrative practicality, a means to establish rights of the investor/user/third parties and a provision for future change should be inherent in provisions of the combined group of mechanisms.

### **Water Rights Systems**

Most countries set forth water resource ownership in their constitution or in primary legislation. Nevertheless, the situation may be vague, particularly as it pertains to groundwater, and often there is little guidance in its administration. Lacking a detailed rights system, new government projects compete with established projects for the same water, and prior commitments are often ignored. Farmers dependent on a given supply may lose it to new lands in the same project.

National water resources allocation objectives can be attained only if practical allocation mechanisms and an effective system of water rights exist. The right may be permanent or licenses of limited duration and use. But protecting the investments of government, water utilities and individuals and fair real-time water allocation under actual hydrologic events requires definitive rights and effective administration of those rights.

The water rights system should apply to surface, groundwater and coastal waters and stipulate the following: category of use (agricultural, urban, industrial, and environmental, etc.); class of use (consumptive, non-consumptive and polluting); quantity and quality implications; priority, time and duration; and administrative procedures. It should define source of water, geographical restrictions on use (including linkages to land use), limitations on class of use, quality restrictions on source and return flows, and rules for any transfer of rights by the holder, if permitted. The economic and social development commitments based on existing rights, including those of third parties, influences how rapidly changes can be introduced in the allocation objectives, the allocation mechanisms and the rights.

### **Interstate Water Rights Agreements in Federal Systems**

Resources ownership in many federal systems of government resides with the states/provinces. This even arises in unitary governments where the broad resources management responsibility is delegated to provinces established for purposes of civil government.

Each state may have a comprehensive water rights code, but has not formulated detailed rights agreements with their fellow riparians on jointly owned resources. Though many developing countries, including the most populous, have made general allocations, they lack comprehensive interstate/provincial agreements for all aspects of water management. As a result, several confront internal economic and stability concerns due to uncertainty with their long-term water resources development. The advantages of reliable data exchange and joint real-time basin operations by riparian states are lost. No means exist for effective long-term planning and management, nor are the complex measures in place to manage drought disasters and sudden toxic spills.

As a principle of some urgency, states/provinces in federal systems should enter into comprehensive interstate water rights agreements on all interstate bodies of water (surface and groundwater). These agreements should provide for resource allocation, data exchange, resource planning and long-term management, and real-time operations under normal and emergency conditions of flood, drought and pollution spills. The agreements should specify the institutional and physical means to facilitate resources management, monitor compliance and resolve disputes.

### **International Water Rights Agreements**

The same resources management and development constraints encountered on interstate/provincial waters in the absence of riparian agreements arise on international waters. Without comprehensive agreements, many riparians have serious difficulties with resources allocation, economic development and international relations. They cannot devise solutions to these problems with confidence, nor can they rationally commit their internal resources without knowing their share of the international body. Effective management for environmental protection suffers. And the conflicts under the next severe drought could extend far beyond economic considerations to issues of national security.

Most developed countries have agreements with their riparian neighbors. Countries most successful in their resources management reached comprehensive agreements early in the development phase. Resource allocations and real-time operations (quantity and quality) are detailed with permanent management entities in place. Jointly directed entities established under the agreements have authority to resolve operations situations as they arise, often using permanent expert panels for advice and oversight.

Riparian countries should negotiate comprehensive international water rights agreements on bordering bodies of water (surface and groundwater) with the same level of detail as noted for the interstate situations. They should cover data exchange, resource planning and long-term management and real-time operations under normal and emergency conditions of flood, drought and pollution spills and the implementation mechanism.

### **Land-use Rights**

Land ownership and legal restrictions on its use varies from country to country. In developed and many developing countries the local government, and to a lesser extent the state and central government, has limited powers to control private land use. Regulations may exclude industrial and commercial developments from residential areas and retain limited agricultural and forests areas to provide open space near urban centers. Control to meet environmental objectives is widespread.

A rapidly growing trend is to impose land-use restrictions to control water pollution. Example actions are restrictions on the application of agricultural chemicals, the density of livestock feeder/fattening operations, mineral extraction, siting of industries and power plants and urban configuration as affecting the drainage quality and quantity. Regulators and the public realize that these are the only effective means to control major pollution sources, and public support for them is growing.

A second land-use restriction proposed helps assure water availability to meet regional priority purposes during periods of scarcity. When high priority demands approach total supply under normal hydrologic conditions, the volume of low priority allocation to transfer to priority needs during droughts shrinks. Indeed, the full use of a region's normal water supplies by domestic users and critical industries, particularly if all the "efficiency" measures are in place, assures economic disaster during prolonged shortages. Some regions are already to the point where serious human welfare problems will occur under the next drought.

One solution is to retain a mix of low and high priority uses drawing on a given supply to assure the flexibility to manage water allocations in times of drought. It is prudent to limit total high priority water use, and hence related land use, to the water supply level available under a prolonged drought. The water supplies above the critical drought supply quantities should, thus, be allocated only to lower priority uses. Annual field cropping and park lands are examples of the lower priority land uses.

Several countries have social and regional development objectives that require a level of land use that will support a healthy agriculture. Rainfed agriculture suffices under some climatic conditions. But under others, irrigation is essential for adequate farmer income and the supporting, processing and supply industry that employs the non-farmers. Land use to meet such economic and social objectives may dictate water allocation.

Experience has proven that countries should conjunctively formulate land-use objectives and land-use rights in parallel with water allocation objectives and water rights. The land-use rights should contain explicit statements concerning any reserved water rights or conditions of surface and groundwater use or of land uses that affect water resources management. They should address aspects from quality impacts to flood plain reservation. The rights statements must be in terms easily understood by the public and readily enforceable by government.

### **Acquisition of Key Sites**

Conflicts are forcing countries to reallocate water among users and construct storage and long distance transfer facilities to develop the remaining resources. Dam sites, reservoir areas, groundwater recharge areas, channels, flood plains, wastewater reuse areas, drainage by-passes and large pipelines are essential to these efforts. The topographical, geological and geographical characteristics of the key sites for these facilities restricts substitution. Unfortunately, these essential sites are under conflicting pressures, too. And the costs of relocating the growing population on needed sites is rising dramatically, as are the related emotional and political consequences.

Some may not view these conflicts as an institutional matter. Yet, they should be considered in the same context due to their influence on resources allocations and water- and land-use rights and their dependence on political actions.

Sites for key features are known already or are readily identified. Traditionally, however, sites are not acquired until authorized projects are funded. Meanwhile, public and private investments in infrastructure, industry and urbanization and intensification of agriculture usually continue on these sites. And acquisition costs become immense.

Resettlement is proving the greatest obstacle to site acquisition. Water developments may displace people, but water scarcities just as effectively displace people together with economic loss and degraded social welfare.

Both developed and developing countries confront this issue. But there the similarity stops. Most developed countries encountered the need for major sites for flood control and water supply long before the sites become congested. They met their primary needs early. And rural population densities remain a fraction of many developing nations. Today, and in the foreseeable future, they have far less urgent water shortages than the developing countries. With a stable population, economic tradeoffs dominate debate rather than human health concerns. They also can afford very costly substitutes.

Developing countries, particularly with growing populations and expanding urban regions, should adopt the principle of acquiring sites for facilities that are key to efficient water management as soon as they are identified. Each acquisition should provide reasonable boundaries to accommodate the configuration that finally may be adopted. The type of ownership acquired

should match the situation and may include: Fee title and vacating the seller, fee title with lease-back to existing owners for restricted use until needed and/or land-use zoning with compensation for restricted use imposed on existing owners.

## **STANDARDS, REGULATIONS AND ADMINISTRATIVE RULES**

### **General**

Too often either the standards to guide resources management or the rules for their administration are lacking. Most countries have water quality standards, for example. But the rules and procedures for administration (reporting, penalties, and specific enforcement actions) are loose, at best. It does little good to set standard without clear rules and procedures for enforcement. It is for this reason enforcement is treated separately in this paper from the nature of the standards themselves.

### **Rules for Administering Water- and Land-use Rights**

Even when countries have detailed water rights legislation, the rules and regulations for administering the rights may be absent or unduly delaying. The means to monitor users, the triggering values signifying non-compliance and the enforcement actions are not promulgated. Usually, no positive means links groundwater with the surface water regulation.

A system of land-use rights is inherent in land-use zoning used to control development in the most large urban centers. The administration falls under the municipal government, usually part of the construction and property approval and evaluation programs. The issuance and administration of land-use rights for purposes of water resources management, however, remains a vague concept in the same countries.

Countries with inadequate rights management should prepare comprehensive rules and procedures for administering the adopted system of rights/licenses. There should be a clear, unerring mechanism assuring consistency of and timeliness in administering both the individual resources rights and rights where inter-linked (water and land). Means for recording rights and making the records easily available to the public at the local or regional level is essential to public trust and fair administration. The affected public, locally in the case of land and project or basin-wide in the case of water, should be notified when rights administrative actions may impact them. Real-time administration of water rights entails monitoring and enforcement of rights among diverters, particularly on fully committed streams. This warrants special attention as local entities assume responsibility for services. Practicality of monitoring and enforcement and openness to public scrutiny is essential and requires a range of measures from clarifying legislation to preparation of manuals.

### **Environmental Quality Standards and Regulations and Rules for their Administration**

Comprehensive standards for measuring compliance with environmental objectives are essential for resources management, but again, without effective administration do little other than clutter documents and lead to false confidence. Water quality standards for health objectives exist in all countries, though many are incomplete for purposes of administration. Standards for groundwater, instream flow and effluent standards for pollution control are less common. Misuse of fertilizers and pesticides has prompted a few countries to enact standards and enforcement measures.

The formulation of regulations and rules to administer the standards entails a range of actions from clarifying legislation to preparing manuals. To assure practicality of objectives and approaches, local entities and the public should actively participate in this task. What constitutes a violation and the associated penalties must be clearly stated, known to all, particularly the public,

and enforced promptly and uniformly. The triggering conditions should be set forth at locations where real-time conditions, particularly water quality, are measured. Conditions should be published or results made readily available to enquires. An essential principle to effective administration of standards is to detail the specific responsibilities and powers of all government agencies, non-government entities and individuals. Interim rules and regulations may be effective to address serious conditions allowing time to refine details for broader application. They can be useful, but a firm schedule for implementing country-wide rules and regulations must be set.

### **Dam Safety Standards and Regulations and Rules for Administration**

The government is responsible to assure the safety of government and non-government dams for protection of its citizens. Most have adopted the general approach developed by the International Commission on Large Dams. Almost all have enacted some legislation. However, too many developing countries have not effected a comprehensive dam safety assurance program. Regulations and rules may cover technical aspects, but only minimal rules exist for administering the standards.

The need for government to exercise its responsibility cannot be argued. It has been demonstrated by government and court decisions where the owner's actions were judged inadequate. Countries should prepare detailed regulations and rules for dam safety assurance and the associated rules for administering the standards stating measurable conditions of acceptability and owner reporting, agency monitoring and enforcement provisions. Agency and owner training is an essential part. Owner responsibility for adequate maintenance should be obvious under law, but liability for remedial work and conditions under which the government can assume control help emphasize the seriousness of this matter.

### **Service Quality Standards and Regulations and Rules for Administration**

Effective service standards and regulations, promptly administered are as essential to sustaining water service systems as the physical facilities. The quality of water services greatly influences the economic potential for customers, and in the case of domestic use, their well-being. It is a proven principle that where comprehensive service standards are enforced, service quality is high and the beneficiaries are more able and willing to pay. Where service standards are not met by the operating entity, beneficiaries refuse charges even to meet O&M costs. This applies equally to government owned, user owned and private operations and explains why satisfactory service quality is more usual in the latter two. This bears heavily in any efforts to transfer system responsibilities from government to beneficiaries. The system must be capable of providing an acceptable service under reasonable O&M costs.

Standards for urban water service quality are well proven and numerous examples are available from international agencies. Standards for irrigation delivery and farmer actions are peculiar to each scheme. Indeed, standards are rarely set forth. The generic service problems caused by illegal canal breaches and off-takes and the excessive "head-ender" diversions demonstrate that neither the standards nor the rules to administer the scheme regulations exist. And there is no system design that can overcome actions of undisciplined farmers. Though drainage and flood control services are not as easily defined, there also should be standards for performance, beneficiary actions and rules to enforce them.

Countries should place high priority on this entire area so they may realize the potential economic and social benefits. Guidelines and example ranges of services should be developed and maintained at the national or state levels with the procedures for their application by system designers, operators and customers. Detailed service standards should be set out for each scheme in terms understandable by the customers and measurable at various points in the system. A compilation of services provided at such points made available to the beneficiaries accomplishes more in the administration of the service standards than any other action. But procedures must allow customers to seek action from regulatory offices outside of the system operations office so both the customer and the O&M staff have access to an independent authority.

## **Financial and Management Standards and Regulations for Administration**

Usually, beneficiary-owned and local government service entities are created under legislation with legal provisions for their management and financing. They are responsible to the customers and lenders for operational efficiency and fiscal integrity. Unfortunately, many agencies are reluctant to establish such organizations. (The advantages of this form of organization is discussed in a later section.) At the same time, most failures of such entities, where established, result from unsound financial decisions either in the day-to-day operation or in system expansion.

Governments should devise detailed performance standards and regulations for management and accounting and audit rules for fiscal activities specific to service entities. Procedures for monitoring operations, reviewing proposed actions and approving major acts are routine. Those applicable to government entities most likely constitute amplification of standing government procedures. Those procedures for the beneficiary-owned will incorporate principles adopted for private sector entities. Effectiveness with simplicity of application are key together with ease of beneficiary enquiry. Independent oversight units should administer the program with strong enforcement powers and the staff and means to match the task.

## **GOVERNMENT AND NON-GOVERNMENTAL RESPONSIBILITIES AND ORGANIZATION**

### **General**

Having set the goals for resources utilization, management and standards with procedures for their administration, a country can more rationally organize and assign responsibilities for their execution. Of course, every country has arrangements in place, and what can be changed depends on a great many factors. However, institutional change occurs as conditions change and the public becomes more knowledgeable and capable of assuming an increased role. A thorough understanding of proven organizational principles helps to attain the best results.

### **Participants in the Resources Area**

There are three main participants in resources development and management: government, non-government entities and the individual. The government controls overall exploitation and management of the resources for the benefit of society, undertakes programs in all phases and through sub-divisions provides public services in the sector. Non-government entities (beneficiary owned or for-profit utilities) develop and manage resources for their members' or customers' benefits within bounds established by government. Individuals' activities parallel those of the non-governmental entities except for scale. Advocacy organizations, particularly in the environmental and the customer protection fields and the longer established professional organizations, constitute an expanding group of non-governmental entities. But regardless of what level one examines water resources management activities, government capability is critical to the end result.

### **Government Functions to Meet its Responsibilities**

Government participates in water development and management through six primary functions, and its success invariably depends on the capability in these areas. These functions are:

- (1) data collection and dissemination
- (2) planning
- (3) design
- (4) construction



- (5) operation and maintenance
- (6) regulatory

The evident scope of each function is adequate for purposes of discussing government organizational structure and agency responsibilities.

### **Structure and Flexibility**

Government must adjust to the changing stages of its resources development and to the advancing technology available in the field if it is to manage resources effectively. A dominant force against government's change, however, is the accompanying staff adjustments. Indeed, it is the private sector's flexibility, particularly in personnel actions, that allows it to rapidly adjust and thus remain effective in its field.

Several principles apply to government organization for it to best perform its functions. Variations exist, particularly due to the form of civil government. And there are advantages to variations if limited modifications to the existing structure yield satisfactory results. However, as resource limits are reached and more sophisticated management becomes necessary, cross-sectorial resource planning and regulatory agencies, and to a lesser degree operation and maintenance (O&M), evolve to serve in parallel with the traditional development agencies. Ultimately, they replace many.

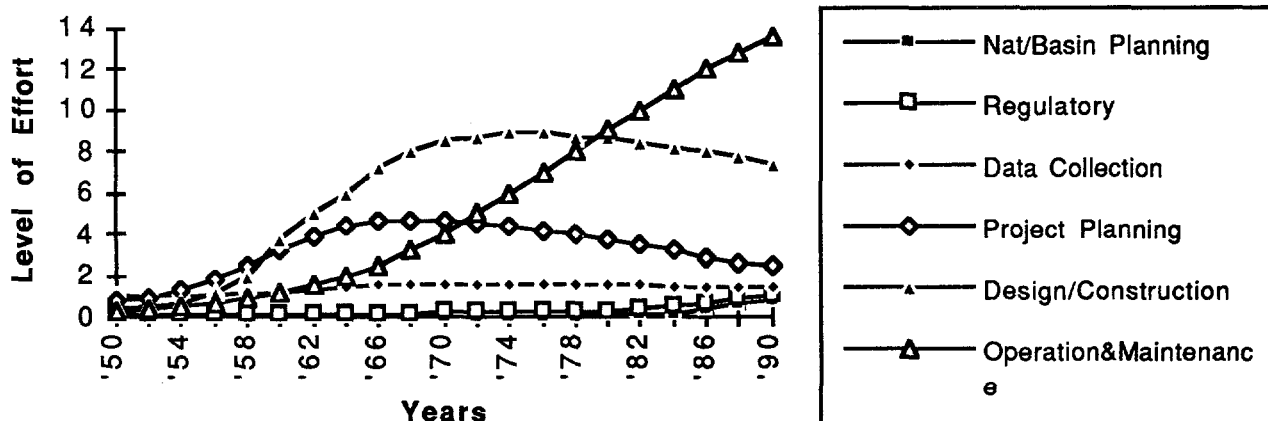
Though rarely addressed directly, the future workload should be a major concern in structuring and staffing agencies with flexibility to accommodate an announced objective. Figure 1 illustrates the relative changes in effort required of a hypothetical group of government agencies during a given development period.

The situation varies, but many countries are now closing out their development stage; a time when organizational and staffing flexibility is essential. Natural attrition reduces staff rapidly, if allowed, and eases the difficulties of consolidation. The employment of consultants for peak loads and highly specialized tasks has been used effectively. Some apply limited term employment to staff temporary units.

### **Organization**

The strengthening of government's capability should commence by carefully clarifying the present and future purpose and scope of activities, resolving conflicts and removing overlapping responsibilities among agencies in the functional areas. Then the assignment of specific responsibilities and authority, internal structuring, staffing, specialization, procedures, work and support fall in place. Principles in this area are presented with the recognition of these tasks.

**Figure 1: RELATIVE GOVERNMENT EFFORT BY FUNCTION**



### Linkage of Water- and Land-use Management

The interdependence of water rights and land-use rights has been discussed. The need for and the mechanics of linking rights can be debated, but the need to reflect this linkage in organizational structure, in assigning responsibilities and in government programs should not await resolution of rights legislation. Governments should move forward in the broader application of this principle.

Many countries still manage water in isolation of land-use impacts. Plans committing the resources are made by different agencies; often by several different entities. Some effect local land use through water allocation as they judge wisely instead of addressing both in the context of the broader ramifications of proposed actions.

Countries should integrate all land use and water use in their planning and in their regulatory functions and, as appropriate, in the management and operations functions through appropriate assignment of organizational responsibilities. The resources rights, regulatory controls and enforcement of water and land use should conform to the resource plans and be administered by or overseen by one agency. The owning/operating entities, government and private, should be held accountable for compliance.

### Linkage of Water Quantity and Quality Management

Governments still assign responsibilities for water quality planning, management and operations to units separate from those responsible for the water quantity (reservoirs, groundwater, surface water conveyance and water supply). National investment policies and programs and their priorities do not reflect the inter-relationship. They do not take advantage of the cost trade-offs between pollution control/prevention and water supply treatment in the same watershed.

Efficient water management requires that water quality and quantity be dealt with conjunctively. The options for using a given water source depends directly on its quality and the maintenance of that quality. In turn, the specific use of a water source determines the quality of return flows, and hence, the potential for subsequent use. The quantity of instream flow required

to meet quality objectives is dictated in large part by waste discharges that must be diluted. The potential for toxic waste entering prime water supplies arises unless management focuses on both.

It has proven most effective to consolidate responsibilities for water quality and quantity in the same functional units in the areas of planning, operations/services and regulatory, particularly in water supply and waste treatment. The service functions may be combined in the local "utility" and in any governmental agency providing wholesale services to local entities. Formal coordination and review/approval procedures among existing single purpose entities may be suitable during a transition period.

### **Linkage of Surface and Groundwater Management**

Another much espoused, but seldom applied concept is the conjunctive planning, management and regulation of surface and groundwater. The separation of responsibilities for these two water resources gives rise to overly optimistic resource availability projections, conflicting exploitation projects, ineffective control of groundwater build-up and inefficient investments. The increased resources potential from short-term and long-term conjunctive management is not realized.

Countries should consolidate responsibilities for surface and groundwater and assign to the same functional units in the areas of planning, operations/services and regulatory with equal attention to this principle at all levels of government. This consolidation is usually easier and yields more immediate benefits than many other institutional changes attempted.

### **Linkage of Agency Jurisdiction to Geographical and Political Bounds**

The organizational arrangements of some water management functions, primarily at the basin and local levels, may influence management efficiency. Political and hydrologic boundary inconsistencies present few disadvantages for broad planning, data collection and regulatory activities. On the other hand, the detailed planning and the regulation of water and land use at the local level may warrant greater emphasis on the selection of the responsible agency's boundaries. Violating hydrologic boundaries at the operational levels of services (water supply, water distribution, waste collection, drainage and flood protection) presents difficulties. Problems arise where water services, particularly irrigation, are a function of a local civil unit established long before irrigation facilities are constructed.

The function critical to sustainability (sound O&M) dictates that beneficiaries of a given system be included within the bounds of the responsible entity. The service area of large schemes can be subdivided in a manner so the sub-areas constitute hydrologic units. The user schemes on the same river can function as separate units while receiving wholesale supply from the basin operating entity that has boundaries compatible with the watershed and its customers, the user schemes.

This principle presents no difficulties for non-governmental service entities. Government line agencies, such as irrigation and public works departments, and civil government units, such as villages, counties and municipal governments, can readily meet this principle by creating single purpose service utilities complying with hydrologic boundaries for the services under their responsibility. Political jurisdictions should join in forming service entities where the service area overlaps more than one. (Basin entities are discussed later in this paper.) And as possible, the boundaries of local resource planning responsibilities should also conform to hydrologic boundaries.

### **Separation of Line (Operations) and Regulatory Functions**

Many governments in developing countries do not separate responsibilities for providing services from the responsibilities for regulating actions pertaining to the services. This lack of division creates adversarial relationships between sub-units and conflicting objectives for

managers. Some government water agencies determine the allocation of water among projects -- their own and others -- with resulting over-commitment and over-construction. Water supply agencies may be responsible for enforcing water quality. Industry ministries with powers to promote industrial development regulate land use and siting, and sometimes even act as the regulators to control industrial waste disposal. Owners of major water facilities are the sole judge of their safety and the adequacy of maintenance. Environmental protection activities, which are regulatory, are inconsistently assigned to executing agencies. The public, the private sector, academia and non-governmental organizations (NGOs) have mixed impacts on agency performance, using political influence rather than participating, perhaps in an oversight role, with established regulatory units.

The principle of explicitly keeping agencies responsible for operating functions independent of those with regulatory responsibilities is perhaps one of the most essential principles in government. It is evident in the countries having greatest success in managing their water resources. To assume that service organizations will administer regulatory standards consistently and unbiased without independent oversight is not realistic.

Countries should clearly separate responsibilities for the service/operations functions from the regulatory functions. The use of oversight commissions composed of government and non-government individuals to oversee the execution of the various regulatory functions is an amplification of this principle that has been widely adopted.

### **Separation of Functions in the Environmental Area**

The institutional principles that apply to the broad regulatory functions apply in the environmental area. Consistent with these principles, some traditional water related regulatory activities, particularly water quality (and air quality), are increasingly grouped in "environmental" regulatory agencies. Indeed, "environmental" agencies in developed countries are regulatory. Yet, even in some of these countries the established resources agencies still retain seemingly dual functions that should be examined more closely to understand the reasons and the risks.

Typically, the environmental units set general standards and provide oversight while the established agencies such as fisheries refine the standards and regulations and perform the enforcement function. This procedure is particularly common where management controls over resource use are the primary means to protect the environment. Many management actions cannot be easily defined in terms of standards alone. Agencies that promote development such as industrial development or energy development, however, inevitably encounter conflicts if they retain both regulatory and promotional responsibilities.

The separation of these functions has long been a problem. And today the principle is often ignored in new "environmental" programs instituted in developing countries. The responsibilities may be inter-mixed under a fuzzily defined program, often under a single unit. This occurrence suggests that institutional principles, as they relate to the environmental field, should be clarified more explicitly because some do not understand that government should separate the regulatory and the action functions -- principles sometimes already adopted by the developing countries.

Indeed, the indiscriminate application of the term "environmental activities" complicates effective treatment of environmental problems and issues. Urban waste treatment, land drainage, watershed management and groundwater management should be called by the traditional, more descriptive terms rather than "environmental" projects. The institutional arrangements and responsibilities to set criteria and standards, monitor conditions, introduce improved operational procedures, enforce regulations and execute remedial programs associated with protecting the environment could then be set forth in these same terms. They would be clearly understood by the public and the agencies. And the established line units can execute those tasks within their functional areas while the appropriate regulatory units can assure compliance.

Another concept inconsistent with sound institutional principles is to define resettlement of people as an "environmental" area of government activity. Of course, the governments in developing countries are responsible for resettlement. But incorporating the social/political orientated activities of resettlement into the already confusing "environmental" field confounds sensible structuring of government agencies for managing its resources and its environment.

Governments should apply the principles of separating operations from regulatory responsibilities in the environmental area, and it should retain long used descriptive terminology to facilitate assignment of execution and regulatory functions. This principle is essential to productive public and political debate of activities and for devising clearly understood improvements.

### **Separation of the Line Functions**

Comprehensive data collection and dissemination, planning, design, construction and O&M are the five primary line functions in the water sector. Many levels of government have specialized units in each functional area to provide expertise and establish performance accountability.

Nevertheless, some countries still retain all-purpose units that handle several functions with whatever staff is available, shifting work as budgets dictate. Some separate project operations from project maintenance -- a step that assures failure of an O&M program. Others have parallel units in the same function. It is almost impossible to develop true centers of expertise under such arrangements. Program continuity, staff currency with evolving technology, program quality and performance accountability are sacrificed.

The principle of organizing along functional lines is probably the second most important, yet often violated principle for effective formulation and execution of water resources programs. Planning requires considerable knowledge of country and sector policies, government-wide programs and budgets. It requires a multi-disciplinary team and, of course, planning like design must directly engage O&M staff. Design entails higher technology, knowledge of latest materials and methods and experience in specifying the work. Construction must oversee the field work and assure quality, being intimately familiar with standards and methods. While O&M entails service operations, maintenance of the facilities, exchanges with the customers and, more than any other government function, the expertise and discipline of managing a responsive, self-sufficient permanent "business". (And system operation and its maintenance must for reasons of their direct inter-dependencies be within one unit.) Functional separation in the operating area fosters specialization and provides accountability. (Staff policies must be adjusted accordingly.)

Quality assurance also requires clear separation of work so units can be held accountable for performance. This is most evident in the design, construction and O&M phases of a project. For example, the transfer from construction responsibility to O&M responsibility requires a quality warranty if affordable and sustainable systems are to be built. Any deficiencies must be remedied by the construction organization from their capital construction budget and not passed on to the inevitably inadequate O&M budget.

Thus, each functional area should be assigned to a specialized unit of a size and capacity to match the technology and work load. As discussed, government should not staff to match all needs, particularly those of short duration or those requiring extremely specialized staff. The unit officials, however, should be capable of programing the work, selecting the means to do the tasks and overseeing all tasks in that field. Staff tenure, training and compensation policies should encourage retention of capable, experienced personnel, which such structuring facilitates.

### **Public Participation in Advice and Oversight**

Participation of non-governmental individuals in advice and oversight roles is a tradition in the water resources sector. Beneficiaries serve on agency boards; experts serve on

technical committees; and public figures serve on policy and oversight commissions. The latter is particularly effective concerning regulatory and resources allocation matters. They provide a timely reaction from an outside perspective. Greater public understanding and support of government actions are an important result; essential to instituting changes.

External oversight entities are rarely used in developing countries. Leaders may be wary of public participation and direct influence. Bureaucracies may oppose sharing management decisions or be subject to oversight. Yet, the outcry from the public and NGOs with resulting delays must be recognized and be turned to productive participation. And the expertise available through professional associations should be tapped.

Countries would be wise to adopt the principle of external oversight. It should evolve a means for non-governmental oversight, assuring that all segments are represented: recognized community leaders, advocacy and the professions. This principle could begin at the national and regional levels with technical advisory committees and oversight commissions in the policy, planning and regulatory areas. It should be encouraged at the local level in planning, enforcement and operations. And at every level, an ongoing public education program should engage the public in the discussion and gain their support for the adopted programs.

### **Basin Water Entities**

Countries have created various special purpose agencies to develop and manage the waters of large river basins. A few have broad charters to foster balanced development of all the basin's resources with authority to undertake most government responsibilities and services. The Tennessee Valley Authority (TVA) in the United States and similar agencies in Colombia, Iran, Japan and India established during the period from 1930 to 1960 brought together the needed talents not available in the existing entities. Water services to support economic development in the rural and urban areas (power generation and flood control with navigation, water supply and irrigation as appropriate) were the common thread. Aspects of agriculture, distribution of electricity, forestry, watershed management, education and public health were involved to varying degrees.

The federally authorized TVA (1932) was highly successful in improving the region's economy within its multi-state jurisdiction. However, the jurisdictional conflicts with state governments and established state and federal line agencies have prevented the creation of other such authorities in the United States. With the increasing desire for local control and the increasing capability of agencies at every level, this concept for interstate basins has limited application today. Even multi-purpose basin authorities within one state encounter similar problems.

Strong, more narrowly focused river entities have been established to operate main-stream facilities to maximize power generation and water supply. A limited number have assumed water quality management responsibilities. Typically, these have permanent operating staff with substantial power to make real-time decisions on operational matters. A board of directors composed of high officials from the involved jurisdictions oversee the entity. Under these forms, user facilities are operated by the principle owners of the resources or by entities under their direction.

The most common type of inter-jurisdictional basin entity found now is a commission or committee to coordinate basin planning, operating and regulatory activities of the political jurisdictions involved. These less powerful basin entities are also governed by high officials from the affected jurisdictions serving as a board of directors while staff assigned by the jurisdictions conduct the day-to-day commission work. Both mainstream and user facilities are under the respective owner's direct management.

No single basin resources management structure satisfies all situations, though the last type cited seems most adaptable. While basin specific factors influence the choice, recent trends in basin management should be examined closely before new agencies are established.

Certainly, the principles of giving management responsibility to the resource owner or its delegated unit, placing control as close to the local people as reasonable and strengthening existing management agencies apply without question. It makes accountability more transparent and the units more responsive. A small basin coordinating unit under the direction of the responsible jurisdictions can help provide the means to attain maximum efficiency of the real-time operations. Different operating agencies can coordinate readily using well proven procedures and supporting communications equipment and software now available. And building on the individual operating entities already functioning in the basin avoids serious political and administrative complications.

### **Water Services as Utilities**

Power generation and distribution, water supply, waste disposal, irrigation supply, and to a lesser extent, navigation, drainage and flood protection services are measurable. The first four are almost always operated as utilities in developed and in many developing countries. The entity provides a readily defined service to the customer; no peripheral support. It owns assets, conducts O&M, procures new facilities and equipment, finances capital improvements and charges for services. Where beneficiary organizations own the system, the management board consists of customers. Where a unit of government, usual at the local level, it functions as an independent service "utility" within government. The budgeting and accounting is carefully isolated from the parent organization.

The utility form assures greatest operational efficiency, accountability for quality of services, response to the beneficiaries and cost recovery from the beneficiaries. The objective of "sustainability" requires that the service function be managed as a business, isolated from other influences or activities that divert attention or create a maze within which accountability is lost.

As a utility, it isolates a function that a general line government agency is ill-suited to perform unless the activity is organizationally separate. The water services entities in urban areas of developing countries follow this principle to varying extent. But, often budgeting and receipts are not separated from general government operations and subsidies cloud the situation.

Water services in the agricultural area vary. Those constructed by farmers are operated with all the cited characteristics of an independent utility at no expense to government. Those constructed by governments in developing countries usually remain government operations; blended into the array of agency programs, susceptible to the priority dictates of the agency's overall budget. Drainage and flood control, which could be defined adequately for identifying beneficiaries, are rarely other than government operations in developing countries without cost recovery. And many are not satisfactorily operated or maintained.

The adoption of the "utility" form of organization to provide water services is one of the most important principles found in effective water management. Countries should apply the principle to structure all government water service entities as self-sufficient utilities with rigid programing, budgeting, financing and public accountability. Services should be easily defined and measured. They should have clearly defined, unquestioned rights to the resources involved. The "utility" should have no other responsibilities. Beneficiaries should participate as appropriate in project formulation, contribute to the investment and pay the cost of services through a combination of fees and taxes. Any subsidies to government entities should be public and transparent. Urban supply and waste management systems are more complex, but are already close to the customers. Government should make every effort to turnover to farmers the ownership and O&M of government-built irrigation systems. This can begin with small schemes

and service area facilities and progress to the larger through formation of a federated entity responsible to the member entities.

### **Assigning Planning Responsibilities**

Water resources planning should be assigned to the appropriate levels in government, reflecting the purpose of planning and the decisions to be taken. Unfortunately, aspects of water resources planning is often scattered among several line agencies with only minimal coordination by the finance ministry through the budgeting process. The relative powers of the individual line agencies determine the government's thrust. Some countries have national plans, but these also may suffer from the dominant agency syndrome or are one-time efforts by consultants with limited budgets, inadequate dialog with government leaders and insufficient data.

The degree of planning detail depends on the maturity of resources development and the management mechanisms adopted by the government. Water- and land-use framework planning should be conducted at the level where resource ownership resides and allocation is made. These include national, state and basin plans for large rivers. Local government should prepare detailed plans to guide water- and land-use. Line agencies and service entities must plan in the detail required for long-term development scheduling to meet their responsibilities and for the project specific programs.

Ideally, the national/state general water- and land-use plan units should reside in the economic planning or budgeting/financing agencies. This would maintain impartiality; free from the pressures of any line agency. It would place economic, resources and financial planning together. One option is to assign it administratively to the "water resource" entity, but guided by a "Board" comprised of representatives from involved ministries. The unit should act to: (1) maintain the document reflecting decisions and (2) offer advice to the legislative body and policy makers on the consequences of proposed actions; keeping these two different roles clearly in mind. It should not play an advocacy role.

The local jurisdictions' planning unit should report to the local administrative head. This is where external oversight can play an important role. Local planning responsibilities should match management and enforcement responsibilities in the entire resources area, particularly land-use, waste management and water utilization. Line agencies with development and project responsibilities should conduct development and project planning in their respective geographical and subject areas of operation. This requires coordination among all agencies, but the national/state and local plans should be the primary reference for the line agencies' programs, if these plans are properly maintained.

### **Assigning Line Agency Responsibilities**

Success in meeting responsibilities depends on a nation's management capability at each level of government and communications between the responsible units, the activity site and those affected. Historically, regional all-purpose infrastructure development units were replaced by central agencies as project complexity grew. The central agencies independently determined their programs and carried out design and dispatched units to execute the works. The subsequent O&M often became an orphan of the development agency and the national budget. Regulatory functions did not exist. Local government had little influence.

Certain skills can only be sustained in central units. Sound quality control demands a central programming together with technical and budget review. But excessive centralized direction can frustrate local input in tailoring the program to the need.

As a principle, governments should locate activities in the affected area consistent with sound government. It should decentralize as appropriate by assigning line responsibilities to units at the lowest level where quality work can be attained; incorporating measures to facilitate any necessary higher level guidance for consistency among all functional areas. Some functions may



necessitate that central line agencies retain responsibilities. Then deconcentration of central units by assigning sub-units to the locality may be appropriate, particularly where a few highly skilled staff are required or the local government units lack the necessary ability. Deconcentration is common in the regulatory function. Except for central oversight and guidance, O&M of government facilities should be assigned locally.

### **Assigning Service Functions to Beneficiary Entities**

An extension of the argument to establish water service "utilities" is to place the utility under the direction and responsibility of the beneficiaries. This would shift line agency service responsibilities down to elected officials of local government or directly to the beneficiaries themselves.

Almost all water services in developed countries are under direct or indirect beneficiary control. Municipal water supply, waste collection and treatment are typically sub-units of local government; but under local government they report to the local people. The local political process allows direct influence on both long-term and daily operations. In all countries, some or all irrigation schemes are under farmer ownership and operation. Agricultural drainage and flood control on smaller streams has long been a beneficiary responsibility in many countries and one finds user entities in charge of O&M.

Beneficiary organizations will have to assume O&M responsibilities as central governments trim budgets to meet broader demands of society. For new water service projects outside of local government, beneficiaries should be required to organize as a public corporation with specified legal and taxing powers before the project is finalized or any construction initiated. The turn-over of existing facilities to local entities can proceed in parallel under a program of system repair and management advice. Beneficiaries under both approaches should actively participate in project formulation and assume a significant part of the financing so they are satisfied with concepts and quality in line with their acceptance of O&M responsibility while restraining excessive construction.

Though they exist, it is questionable that private for-profit water service entities are widely applicable in developing countries. They are found in few countries and focus on narrow services in settings where all the inter-related infrastructure is well maintained and effective coordination with government agencies is assured. Strong, unbiased, independent government regulatory units oversee every aspect of such undertakings, an absolute essential.

The proposed build-operate-transfer (BOT) undertakings for urban water and waste systems are no less difficult. Implementation would be extremely difficult, and the skills to specify and control the operation and define the final constructed product under situations typical in the developing countries have not evolved to a level suitable for wide application. The area's population growth and deteriorating infrastructure are but two uncertainties. Site compatibility of all urban facilities construction complicates such programs for the city and the entity. In most countries, the BOT entity would lack the essential close coordination and prompt support of administrative, infrastructure and regulatory agencies due to limited staffing and budgets that, indeed, are the cause for needing improved capability though outside assistance. The programing, budgetary and accounting fuzziness in large urban and national governments create further risks. Until new approaches are fully proven, countries should not reduce efforts to introduce traditional approaches to organize their water service.

### **Assigning Regulatory Functions**

The regulatory provisions and the government's enforcement capacity determine the country's effectiveness in meeting resources management and environmental quality objectives. In many developing countries, sound standards have been enacted, but the enforcement remains ineffective leaving the dangerously false sense that a process exists. Several reasons may be cited; however, inadequate funding and insufficient political will to enforce dominate.

As stated earlier, effective regulatory administration requires that the responsibility for compliance with the standards is assigned to the operating entities, whether public or private. They must be held accountable. Special purpose units should not be created to remedy a given "environmental" problem. Indeed, negligent agencies must remedy problems and apply their resources to such work so they do not believe a clean-up effort by an "environmental" unit will rectify their errors or even willful omissions.

The government should assign regulatory tasks in accordance with the principle of separating line and regulatory responsibilities with monitoring and enforcement of all water quality regulations, water quantity allocation, and environmental regulations assigned at the level of resource ownership. Some powers are properly delegated to lower levels if capacity exists, but the level of government that owns the resource still retains prime responsibility. Responsibility for matters on land use usually reside at the same level as the related planning. And administrative and financial regulation of service entities should be assigned to the level of government responsible for entity formation and registration.

There are two exceptions: Central government should have jurisdiction where states have inadequate capability and on matters where national objectives dictate a uniform application of standards. All regulatory units should be staffed with highly skilled technicians with permanent status using current investigative procedures and equipment, ideally, reporting to the government's senior civil service official. A responsible central office should assure that all affected entities and the public are knowledgeable of their respective regulations and enforcement.

### **Assigning Data Collection Functions**

The inadequacy of information for water development and management stems in part from the dispersed responsibilities. Development agencies collect a minimal amount for use in project formulation. This is terminated upon completion, except those features continued by the operating unit. Regulatory agencies have limited funds. Data quality suffers from the use of inexperienced personnel, and records are lost or not processed for storage. Line agencies and financing entities do not wish to hold up projects while data collection is completed, but ignore the potential created for unacceptable results. As a consequence, data programs remain unsupported while government moves forward with uncertain investments and unreliable operations. And no information is available to non-government entities and individuals, key players in water management.

Sound resources management requires that comprehensive information is collected, processed and available in a prompt manner. Many countries have adopted the principle that this is a specialty field justifying a separate entity serving all government agencies in the sector (and making information available to the private sector.). The service includes daily, monthly and annual reports presenting analysis of historic conditions and trends of all pertinent parameters. It entails direct and remote sensing supported by comprehensive laboratory and computer facilities. Planning, design, operating and regulatory entities select the level of detail desired of the agency. Access may be through conventional communications or computers.

Line units may augment the information. Design units conduct site specific programs. Operations always need detailed flow data within their system and perhaps more frequent information on surface water conditions in their immediate vicinity. Indeed, the data entity should cooperate closely with operating units so that an effective exchange of information, with minimum duplication, is assured.

Thus, governments should assign overall resources information collection, processing and dissemination responsibilities to a support unit independent of other line agencies. Existing surface and groundwater entities, including water quality, should be consolidated under one head. The unit should have powers to coordinate data collection standards and to review collection programs of others to assure quality information. In federal systems, a central entity sets the

standards and collects and compiles information of national and international interest and conducts a more comprehensive program within those states lacking capability. States conduct a program tailored to their specific management needs, supplementing the federal program. The data users including the regulatory agencies, should still retain responsibility to set their requirements and, of course, the use of the data.

## **FINANCIAL**

### **General**

Financing water resources activities is not entirely an institutional subject. However, since it is linked to the institutional issues of allocation mechanisms, pricing services and structuring agencies, selected aspects are addressed. Principles are described that have evolved for calculating and allocating project costs; financing project investment, and O&M and subsidies, cost recovery and service pricing.

### **Project Cost and Allocation Among Purposes**

Most countries successfully apply standard principles for project costing and allocation among project purposes. Categories of uses and direct and indirect benefits are identified and associated costs (e.g., capital, interest, operation, replacement and maintenance) are assigned. Yet, many borrowers do not apply consistent cost allocation rules to their projects, and some have no rules. This practice prevents proper analysis of potential benefits during project formulation and the correct costing for setting service charges.

Governments should adopt formal cost allocation procedures and apply them consistently in their planning and management. Allocation categories should include all services (urban and irrigation supply, waste collection and treatment, flood control, drainage, navigation and hydro) and the non-service purposes such as recreation and any environmental enhancement; but not mitigation. Allocation should be made in full to all purposes with any subsidies identified and applied through the subsequent pricing/funding decisions.

### **Service Cost Components**

There is debate over what should be included in costing services in the water sector. Typically, developed countries apply the principle that service costs comprise all costs of the single purpose service facilities and the same categories of costs allocated from multi-purpose projects serving the individual scheme. These costs are measurable and can be judged as fair by beneficiaries and the public alike. Differing from system to system, it better matches the services the beneficiaries receive and what they decide they want to invest in capital and O&M for a given service in each situation. Recovery of most of these costs allows governments to continue future undertakings without sacrificing other obligations. This principle is straight forward, obvious to the public, which has a direct interest, and is easily examined.

Recently, water quality degradation has been charged as an operating cost, since downstream users incur direct expenses by the polluters' action. This most obviously applies to urban and industrial dischargers. Theoretically, it could apply to agricultural wastes when caused by chemicals or livestock operations.

"Opportunity cost" has been suggested as the basis for charging customers of water supply services, even where the water use, and hence water allocated, was authorized under legislative action. The concept replaces the cost of facilities as the basis. But the mechanics of calculating this cost and the rate of change in this component as affecting investor plans, and deciding how to free it of political influence are not resolved. How this method applies to other water use such as navigation or environmental protection/enhancement is not clear either. This, of course, as "free market" pricing would function as an allocation mechanism.

Foregone opportunities are one of a great many "costs" of a society's decisions in allocating land, water and its other resources. Since opportunity cost pricing is not yet applied in the developed countries, it should remain under study for application in the developing countries. Even if a practical application method is devised, this can only be considered after a country's society has set its allocation objectives and undertakes selecting its allocation mechanisms. And it is appropriate only if the over-riding national allocation objective is to allocate water to the highest calculated direct economic use. (This, however, does not preclude the calculation of opportunity costs as one item to consider in the initial resource allocation.)

Marginal costs has also been suggested as the basis for charging customers for water services. This method is not found in the water sector for reasons related to the nature of the activity. Most important, non-profit beneficiary owned utility type entities have proven to be the most successful vehicle for providing a service. Their financial objective is to cover O&M replacement and modernization costs; nothing more. Their functional objectives (area and services) are determined by the member owners. Usually, expansion costs are incorporated into the total costs and all share, however, some use the mechanism of hook-up fees and surcharges to pass higher marginal costs on to those demanding the expansion. (A more detailed presentation on pricing is provided in The World Bank's July 1992 Asia Water Resources Study, Topic Paper No. 6 "Water Supply Pricing in California" by John Teerink.)

In summary, the most practical principle for developing countries to apply when introducing financial responsibility is to calculate costs for all water related services (supply, waste collection and treatment, flood control, drainage, navigation and hydro) by totaling capital investment, including any remedial actions, interest during construction, operations including direct administrative expenses and maintenance expenses including routine, emergency and replacement. These should include all such costs incurred in the single purpose service facilities and costs allocated from multi-purpose facilities serving the scheme. Environmental mitigation is an appropriate cost, but enhancement is not. The calculation of service costs should be kept independent of the subsequent decisions on setting service charges, subsidies and general cost recovery mechanisms.

## **Cost Recovery**

The linkage of O&M funding to cost recovery that in turn has been inadequate, has served to justify underfunding O&M. (One cause of deteriorating systems is governments' unwillingness to plan in their budget their obligations to maintain the facilities, though construction deficiencies have created much of the excessive level of maintenance now encountered.) The first principle related to cost recovery is that government should fully budget system O&M and separate it from the effort to institute cost recovery. (This concept is discussed further under O&M Funding.)

Recovery from the beneficiaries of full costs of government to provide water services is seldom accomplished in the developing countries, though some countries are moving aggressively in that direction. Flood control, navigation, drainage, most irrigation, some large urban water supply systems and essentially all waste treatment are subsidized. The primary exception is the hydro sector where subsidies are not as common. Yet, private and farmer-owned irrigation systems are financially self-sufficient in these same countries. These unsubsidized schemes serve the majority of irrigated lands in many countries. Some municipal and local government water supply schemes are essentially self-sufficient. In a few countries, small government-built irrigation systems are turned over to the farmers to operate and maintain, but usually no capital costs are recovered.

Private and water-user owned systems, some of which have existed for decades and even centuries, prove that water supply and irrigation schemes can be physically and financially self-sustaining. They follow common principles that are important to their success. The system is designed as an affordable facility consistent with the benefits; the construction is of a type and

quality that results in affordable maintenance; the beneficiaries invest in the facilities; government does not guarantee rehabilitation when deficiencies or failures occur; the service is reliable as measured by the rules and a disciplined operation is supported by strong beneficiary enforcement of rules. Cultural and economic conditions in most developing countries justify the fact that the beneficiaries pay for services, unless government has undertaken costly or unsuitable projects or is not providing a reliable service. Unfortunately, this condition is too common and must first be rectified.

Governments should institute a system of direct and indirect charges to recover costs of most services in the water sector including: urban supply and waste removal; irrigation and drainage for agriculture; flood control (to the extent it is not a national benefit); hydro and navigation (to the extent that it is not a national benefit such as with rural ports for fishing and transport). Project investment subsidies may be justified so that a country can meet adopted objectives through construction of expensive schemes. This method has aided nations to settle new lands and is now used to control urban and industrial pollution. Flood control of major urban areas commonly receive such subsidies. However, no O&M subsidies should be warranted, except for delayed collection during a start-up period. The only exception more easily justified is where abnormally high O&M costs occur due to poor construction by government or commodity prices restrained by government. Under these circumstances, the government should directly augment the O&M agency budget as required to sustain the system. Indeed, the government should never force the O&M entity to assess charge below full cost recovery unless it also augments the O&M budget to fully meet all needs to sustain the facilities.

### **Service Charge Mechanisms**

Several direct and indirect factors influence the selection of service charge mechanisms. They are: the service, conservation incentives, subsidies, poverty alleviation, equity and ability to pay. But recovery of costs is not only a question of paying for a service. It is also a necessity as government budgets tighten.

A variety of customer service charges are used. Examples are: delivery charges for urban and irrigation, stand-by charges for service that enhances the property value or for fire protection and zoned property tax assessments to beneficiaries and, at a different rate, the adjacent public reflecting the level of flood control and drainage protection. Usually, a mix of mechanisms best suit irrigation O&M financing. A component property tax carries a water supply service through low delivery years of drought while delivery charges reflect actual benefits derived by the customer. A tiered or escalating rate structure encourages water conservation in municipal systems. Minimal rates apply to the system's low income group. Experience shows that drainage and flood control costs are most effectively and equitably charged through zoned property taxes. Several countries are experimenting with new waste charge mechanisms. These should be viewed from the standpoint of adequacy of recovery, equity and effectiveness, if serving as a pollution management tool.

Service charges should be calculated on each specific system to reflect its peculiarities, the level of services by the beneficiaries and the basic principle of no cross-subsidizing by beneficiaries among different systems. All should apply in an open, easily monitored manner. The collected funds should be rigorously accounted for and dedicated to their purpose, isolated from other funds.

### **Funding Capital Expenditures**

Funding capital expenditures concerns countries at every stage of development, particularly those with limited means. Their growing demands today exceed outside funding assistance, forcing attention to other sources for future undertakings. The most obvious is substantial or full payment of all capital costs by the beneficiaries. This provides funding and improves agency performance through customer pressures.

Some governments finance, at fair interest rates, their local governments' and user entities' needs as a condition for pursuing new projects. In limited instances, government loans are replacing grants for rehabilitation and emergency repairs. Service entities use a variety of charge mechanisms for reimbursing the government. The goal of financing local works through revenue or obligation bonds on the open market is pursued in many countries. And hydro and urban systems offer opportunities for such means as do larger irrigation schemes where backed by government.

### **Funding O&M Expenditures and Government Guarantee of Full O&M Funding**

Governments have long assumed responsibility for water development. They have allocated the resources, planned the developments and executed the work, usually without considering funding options. Indeed, not even the beneficiaries have been engaged in devising the program. With the development and construction of infrastructure is the responsibility to maintain the facilities. Though not necessarily stated, this is as obvious an obligation as any component of the program. Unfortunately, the O&M situation today confirms the continuing neglect.

Governments should guarantee O&M funding of government owned facilities at a level to sustain the facilities in a condition to fully provide the design services on into the future. As a part of this, a reserve fund for emergency repair should be incorporated in the O&M budget. The O&M funding needs must over-ride all other agency budget demands. The principle followed in bond financing of such facilities should be rigorously applied by the government and any lending agencies that support construction of such facilities. This principle is that the first call on any revenues produced by the scheme is to fully fund O&M to the level that permanently sustains the facilities. The adequacy of the O&M effort should be verified by an outside review unit. Any revenues surplus to O&M may be applied to other budget items. Simultaneously, the government should introduce, as part of a facilities rehabilitation program, if necessary, full payment of O&M by the beneficiaries to relieve general budget funding as possible. (The justification and mechanisms were discussed under service charges.) Any shortfall should be made up by the owner from its other budget categories, including construction. This principle should never be violated, even in the short-term. There is no other way that a country can reconcile its wishes with its means. Nor is there any other action that assures sound, affordable investment in resources development.

## IV. THE APPLICATION OF PRINCIPLES

### GENERAL

One way to assess the validity of institutional principles in the water field is to examine several countries' laws, government programs and their execution. The legislative history and current conditions indicate their responsiveness to meet change. The sampling of existing institutions used in this paper has focused on areas judged most important in managing water resources and serves as an overview of country experience to confirm generic principles in the field. A more in-depth study of existing institutions is suggested when formulating specific proposals.

### COUNTRIES SURVEYED

The water resources institutions of several countries are cited in the following pages as part of the World Bank Asia water resources study. The countries reported on by Mr. William Barber and Ms. Susanne Scheierling in Topic Paper No. 7 are indicative of the range of settings represented in the larger review. Topic Paper No. 7 covers Australia (the state of Victoria), Canada (the two provinces of Ontario in the east and Saskatchewan in the west), Japan, New Zealand, South Africa, Germany (North-Rhine Westphalia), France, the Netherlands, the United Kingdom (England and Wales), and the United States (California and Colorado). In Topic Papers No. 3 and No. 6 titled "Water Allocation Methods and Water Rights in the Western States, U.S.A.," and "Water Supply Pricing in California," Mr. Teerink reports on pricing and rights in the Western United States.

These countries represent both federal and unitary forms of government. The climates range from temperate humid to hot arid. Agriculture is important in all countries, but the extent of irrigation and industrial use varies greatly as does population density. The government organization differs in terms of the geographical jurisdiction and authority of civil government and the type of functional entities -- from planning through O&M. The role of the non-government entities, non-profit and for profit, differs. And the period during which their water is essentially developed also differs widely. Thus, the main common attribute of these countries is the objective of effective management of their resources.

### RESOURCES OWNERSHIP AND ALLOCATION

#### Ownership

In almost all instances, surface waters are owned by the nation or, in federal systems, by the state. The exceptions are countries that only recently nationalized waters under new constitutions that recognize earlier established individual ownership.

Fewer countries assign like status to groundwater. Some European countries, South Africa and U.S. states like California treat groundwater in part as private ownership, usually retained by the overlying land-owner. In the countries intimately linked to surface water bodies, groundwater is treated as surface water. But groundwater laws are changing. The countries with more recent constitutions, common in the developing countries, do assign groundwater ownership to the nation.

#### Water Allocation

National or state water allocation objectives may be explicit or implicitly reflected in the water rights systems and the allocation mechanisms established through the political process. The usual broad goals are public well being, national economic development, regional economic

development and a quality environment. In many countries, general allocation is reflected in national legislation with refinement at the local level. However, most legislate specific allocations.

Indeed, examination shows that governments allocate most water resources in the course of project or development program authorization. Thus, the allocation objective and the allocation are combined in the same enactment with the law serving as the allocation mechanism. Whether it is regional development, expansion of urban infrastructure, irrigation facilities construction or environmental set-aside lands, the legislation commits water to the area and the use.

Universally, highest allocation priority is given to domestic use. Urban, industrial or agricultural use usually follow. However, other objectives often influence the assignment. For example, Israel places high priority on irrigation, forcing desalination and intensive recycling for urban and industrial uses instead of reducing agriculture. Japan places agriculture ahead of urban and industrial uses for allocation of surface water, necessitating urban and industrial dependence on groundwater, except as farm lands convert to urban/industrial purposes.

Federal and state legislation has allocated large amounts of water to environmental purposes in several U.S. basins. Several million acre-feet in the northern California rivers are withheld, even from urban use elsewhere in the state, with the result that the total environmental allocations now equals 85 percent of the total surface and groundwater used for irrigation. Regional economic development objectives underpinned allocations in the arid areas of Canada, Australia, South Africa and the United States.

One state in the United States has a system in which rights can be purchased if no adverse impacts on others result, a condition difficult to meet. Recent U.S. Bureau of Reclamation (USBR) policies allow temporary or permanent transfer of delivery rights providing no third parties are impacted adversely and water contract obligations are met. These policies have seen limited use and their broader application is not clear.

As countries approach the limit of their water resources, some see a need to formally accommodate future generations. Australia typifies a trend by including in its broader allocation objectives sustainable management to satisfy current needs in a manner to meet the needs of future generations.

## **Water Allocation and Land-use Rights**

Many countries link water allocation and land-use restrictions. Some higher populated countries, where resources are essentially fully committed, formalize basin water resource plans (use, quantity and quality) to serve as legally binding documents for decision-makers to follow in development and regulatory actions pertaining also to land use. These linked allocations, as most other allocations by developed countries, typically over-ride any single objective such as economic efficiency.

Example linkages include the large allocations for environmental purposes through river set-aside, restricting watershed development to certain purposes and prohibiting export of surface and groundwater resources from their general area of origin. Balanced regional development is the objective that has determined allocation and the associated allocation mechanisms applied by many arid countries. New Zealand incorporates this objective into their basin planning and, in turn, the resulting infrastructure and development programs. Watershed management, channel stabilization, irrigation schemes, flood plain zoning and selective drainage are successfully overseen by all powerful basin boards.

The Netherlands issues national plans at four-to-eight year intervals that the provinces must follow in allocating and managing water and land. Spain links water resources, land-use and forest plans and, through local government, is effecting both water allocations in the basins and pollution control. Some California cities retain surrounding lands in irrigated cropping for esthetic and environmental benefits of their citizens. That state's "County of Origins Act" allocates water



for reasonable purposes in the mountain areas when demands develop, even though downstream users already may be utilizing all waters that leave the region. This is to preclude urban centers from buying permanent rights and exporting all waters to the detriment of local rural residents as Los Angeles' action did to Owens valley. Some in Australia seek to give land-use management power to the River Murray Commission so it may control flood plain development and have greater influence on water quality management. But state jurisdiction will likely prevent granting such powers, though pressures on the individual states through this entity are effective.

### **Surface Water Rights Systems**

Every developed country examined has a clearly articulated, effectively administered water rights system for surface waters, though not always for the groundwater. The systems vary from granting users permanent rights to specifying a use under limited duration licenses. As an example, German states own the water resources, issuing either revocable permits for use with minimal investigation or non-revocable fixed duration permits following extensive public hearings. Licensing is used in many Mid East countries, though Iran recognizes rights established before water was nationalized. Indefinite rights are issued in the name of individual irrigation districts in Canada, Australia and the United States. California grants permanent rights to service entities and individuals stipulating nature, time and priority of holder, though pressures for change are mounting. Other states grant use permits on both surface and groundwater to industry and irrigated agriculture that are subject to renewal hearings at fixed intervals.

### **Groundwater Rights Systems**

In Germany and the Netherlands, local entities operating under central oversight issue licences for extraction and use of groundwater with close monitoring. Japan has introduced licensing for industries. Spain and England regulate use through a central licensing system. California requires registration and standards for well construction and limits use in some basins where extractions are controlled under court adjudication. And no rights are granted to export water to the detriment of any basin users. Imported water for groundwater recharge, however, remains the property of the importer, including export use. Arizona is replacing existing irrigation pumping with surface imports, prohibiting any new extractions for those purposes. Egypt licenses all wells as a means of controlling overdraft in the Nile and selected adjacent lands.

## **INTERSTATE AND INTERNATIONAL WATER AGREEMENTS**

Comprehensive agreements are in place on most interstate and international waters of the developed countries examined. Typically, they address water quantity allocations, real-time operations and pollution management.

Agreements between Canada and the United States and Mexico and the United States cover all bodies of water forming boundaries or crossing from one country into the other. The interstate Colorado River Compact sets forth the allocation among the U.S. states, while the Mexico-U.S. agreement formalizes the Colorado and Rio Grande arrangements between Mexico and the United States. In the case of Canada and the United States (the agreement covers 90 significant streams, including the Colombia and the St. Lawrence Rivers and the Great Lakes) addressing urban, industrial and irrigation supplies, power, navigation, flood control and environmental aspects. Permanent joint commissions of the involved countries, through various boards, administer the agreements, which have allowed the countries to efficiently incorporate their share of international resources into their national and state resources management.

Interstate agreements are in place on all major bodies in Australia, Canada and the United States. The agreements on rivers and lakes refer to the international treaties as appropriate, dealing with the quantity allocations and quality and quantity real-time operations. Some efforts are underway to allow deviations during emergency drought conditions that would not disturb arrangements for normal operations.

Water quality management issues dominate agreements among the European riparian countries, though flood and low water flow conditions are also addressed. Comprehensive agreements exist on the Rhine while less effective treaties are in place on the Baltic, the North and the Mediterranean Seas. The downstream cities' dependence on river supplies dictates not only quality standards, but notification and coordinated operations during emergency spills. Other activities covered include gravel removal from the river bed and groundwater extraction that may affect river discharge.

### **Regulatory Water Quality and Pollution Control Standards**

Every country has water quality standards governing domestic/urban use and effluent disposal. Recommendations of international bodies are met or surpassed by most, though some do not diligently enforce the more restrictive. The standards for protection against pathogens and heavy metals are reflected in the established operating and enforcement programs. But most European Economic Community (EEC) countries cannot meet their own restrictions on some exotic compounds, several that only recently could be detected. Laboratory capabilities have advanced faster than has knowledge of the potential health impacts. Public officials now seek to introduce the concept of "risks," as inherent in daily life (injury from walking down the street), to the public for consideration. The public will have to decide what to spend from the ever-tightening government budgets. The U.S. federal Environmental Protection Agency (EPA) has set rigid standards applying to all states, a few of which have more restrictive laws. But the issue on regulating the compounds and introduction of risk analysis are also debated there.

### **Land-use Regulation to Control Pollution**

Now, several countries apply land-use zoning to meet environmental considerations, primarily to control water pollution. The European countries and the United States require storm water runoff retention features to be incorporated in land uses as one means to reduce pollution from urban areas. High investments in land set-aside are justified by the even more costly alternative construction of facilities. Germany, the Netherlands, Denmark and the United Kingdom have limiting land-use regulations on the use of pesticides and livestock densities to prevent pollution of urban surface and groundwaters. Both federal and state laws govern land use adjacent to waters of the United States. For example, one state requires retention of native vegetation near stream banks and has limited building densities within one kilometer of all its rivers.

### **Pollution Fees**

The principle that the polluter pays -- where he can be identified -- is well established in several countries. Many European countries and U.S. states now apply pollution fees and effluent licensing as a primary mechanism in their efforts to control point-source pollution. This limits application to urban, industrial and mining dischargers. Belgium is one exception with laws to assess farmers for excessive application of manure. Several U.S. states require licensed pesticide specialists to advise on appropriate controls. Some countries have gone a step further and are attacking air pollution to reduce soil acidification that causes release into the groundwater of heavy metals attached to the soil particles.

## **ORGANIZATION AND RESPONSIBILITIES**

### **Resource Ownership Responsibilities**

Uniformly, governmental units at the level of resource ownership (national or provincial/state in a federation) directly or indirectly, carry responsibility for broad resource planning, allocation, regulatory and oversight functions. The execution of these functions is often decentralized or delegated by central agencies to lower level organizations; the established civil or

special purpose governmental units. This is true in developed and many developing countries as well. Small, highly skilled staff and facilities provide comprehensive, timely, yet, low cost execution of the involved tasks. But the operating service entities, government and non-government, are accountable to take whatever measures and organizational steps necessary to assure that their day-to-day operations comply with the government regulations and directives.

### **Linking Quality and Quantity**

Recent trends are to place responsibilities for pollution management and water supply together in one agency within the functional areas of planning, regulatory and services. Water quality and pollution impacts already outweigh the water supply concerns in an increasing number of countries, and the interdependencies of addressing quality and quantity force the consolidation. This is particularly true in countries that have or are anticipating substantial pollution problems, as is true in several European countries. Most major urban governments have long joined these within their organizational units. California places state water rights and quality control under the same regulatory board.

### **Linking Water and Land Use**

Essentially all countries have adopted the river basin as the basis for detailed resources planning and management. This is furthering comprehensive water and land-use planning and the associated land-use zoning/licensing regulatory measures to better manage for quality and efficiency objectives in the water area. German states prepare basin plans that define their water resources development and management goals and the means to attain them, which, subsequently, are binding on all local water entities. Japan has legislated water quality/quantity, surface and groundwater and water and land-use planning under a central ministry.

### **Separating Operating from Regulatory Entities**

Essentially all developed countries examined assign regulatory responsibility to non-operating entities that report to a minister or equivalent. The State of Victoria in Australia placed all regulatory responsibilities, (water rights, water quality and dam safety) in the Ministry of Water Resources, which has no service responsibilities. France placed them in the central ministries, again none with service responsibilities. Enforcement of water rights permits and pollution and construction standards is in turn delegated to the local civil government departments. The U.S. federal EPA administer most resource standards under federal jurisdiction, though the Public Health Service and the Fish and Wildlife Service have important roles in water quality. State regulatory units, separate from the operating entities, administer water rights, safety of non-federal dams and the water and waste standards, including some more stringent than EPA. Today, the regulatory function for water quality, both health standards for use and standards for waste discharge, are increasingly found in environmental regulatory (protection) agencies; removing it from or replacing the earlier established public health units.

### **Basin Agencies**

Several European countries have basin agencies. All serve as umbrella organizations for planning and coordination. France's well known basin authorities plan, coordinate development and assist the entities to arrange funding, but do not participate in the affairs, including operations, of the local water agencies.

In 1950 Japan created several basin development agencies with planning and management responsibilities. Unfortunately, this has proven ineffective as single-purpose agencies in Japan still independently manage facilities for power, flood control and water supply within the same river. Australia's Murray-Darling River Commission was empowered and staffed to implement the 1915 interstate agreement on sharing the basin's waters. Today, the states continue to carry out a broader scope of activities within their boundaries under the oversight of the

Commission, now composed of the key ministers. But the individual states retain final approval authority through the requirement for unanimous agreement on proposed measures.

The U.S. TVA, a federal agency granted wide land and water development and operating responsibilities in a multi-state basin, remains with a diminished role in the non-water areas as state capabilities have expanded. No other basin entity with such powers has been created in the United States. The state-federal Delaware River Commission, directed by equal representatives from five basin states and the federal government, has substantial coordination, review and operating powers over the river system. Standards, rules and developments related to water are subject to Commission approval. Its staff directs real-time operations for supply and water quality in this highly industrialized basin.

### **Service Entities Structured as Utilities**

Another fundamental principle found in all developed countries is the evolution of special-purpose governmental, customer-owned and for-profit "utilities" to render water services. Beneficiary owned single purpose entities dominate irrigation, drainage and flood control. In humid countries, drainage and flood control are usually combined in one entity that may be part of local government or may be independent. Both urban supply and waste treatment services are generally under one sub-unit of local government, though for-profit entities provide such services in much of France and are now being established in England. Except for the national and state level agencies, the boundaries of the local service and the wholesale entities often differ from those of mid-level civil governmental units. The water utilities follow the system's "hydrologic" boundaries.

Australia, South Africa, the United States, and Canada offer examples where the government retains some 'whole sale' systems to serve water to urban entities. "Super" districts, outside of government, exist in several countries to provide such services to their district owners, and in some cases, to local governmental units.

Performance and cost accountability to the customer is the most effective way to attain efficient services and is universally practiced by all entities. Beneficiaries effect control of local governmental sub-units through their elected representatives and through the board of directors for the non-governmental districts. Rules for customer behavior are known by all and enforced. Operation and maintenance costs are paid by the beneficiaries. Capital expenditures are partially or fully covered by the beneficiaries. In the United States, investments are paid through agency taxes and service charges, except for federal grants to urban entities for waste treatment and pollution control measures, grants for construction of flood control works and, earlier, no interest loans for federally constructed irrigation facilities. Essentially all European countries place construction, management and all financing of water systems at the local level, with only planning and limited technical assistance by basin authorities in the case of France and state government in the case of Germany. The exceptions in these and other countries are in the pollution control and irrigation areas.

Though such non-governmental irrigation entities have long existed in almost every country in the world, Mexico, South Africa, Australia and others have or are now converting large government-owned systems to non-governmental districts, while countries like Indonesia are turning over smaller service areas to farmers as a first step.

### **Bulk Water Services**

Major water sources increasingly are developed and managed by governments as a bulk or "wholesale" delivery to the various local entities for distribution rather than developed independently by individual user entities. Several were cited above. Society can thereby better reach their regional objectives (including environmental) through coordination of all infrastructure investments and land use. It captures the advantages of large undertakings while retaining local

control and responsibility for services through a utilities type of organization with local entities executing the local water facilities work.

## **WATER CHARGES AND FINANCING**

### **Utilities Independent of Government Budgets**

Most countries have a national policy, with exceptions, as will be discussed under subsidies, to assign service entities the responsibility for funding construction of facilities and all O&M, including replacement costs. A combination of obligation bonds, revenue bonds, and taxes, augment dedicated components of service charges to fund capital investment. Operation and maintenance costs are recovered by annual taxes and service charges. This relieves the government of vast budgetary demands. But perhaps equally important, it frees the O&M entity from competing with the education, defence, highway and social programs for funds from limited government budgets -- a serious constraint on sustaining systems today. The local urban supply and most urban waste treatment and irrigation are fully covered by the beneficiaries now. And the trend is to remove any remaining subsidies as rapidly as possible, though major subsidies to clean up urban and industrial pollution continue in all countries.

### **Cost of Service**

Every country defines the cost of water as comprising investment, O&M and replacement costs. The purchase of water from higher level entities is included as operating costs. No examples of the application of "opportunity costs" were found in the water field.

### **Water Service Pricing**

Entities in all countries examined follow the world-wide practice of pricing water services based on the actual cost of providing the service less any subsidies. None use charge mechanisms for any purposes other than recovery of investment and O&M costs with internal modification to encourage conservation. The internal rate structure may be adjusted to encourage water savings and support to low income customers. One exception uses a market to determine water charges. A very old Spanish irrigation system holds weekly auctions of available supplies to its system users, but retains the river water allocation for the irrigation district's farmers. Only two countries, France with about 60 percent of its water and less of its sewerage and England with essentially all water and sewerage, have substantial for-profit entities in the field, which do include profit in their charges. The public to private transformation in England is recent and its future remains uncertain.

### **Service Subsidies**

Subsidies in the water sector are handled quite consistently in the countries. The construction and O&M costs of water storage, treatment and distribution by local entities usually are not subsidized by state or national government. But low income and low quantity users may receive subsidies through internal rate structure adjustments by the service entity.

Most governments, however, now heavily subsidize construction of major urban pollution control facilities. The European countries are pursuing a range of programs to comply with dated EEC regulations. Most U.S. urban areas received substantial grants for construction of urban waste treatment and some collection facilities. The current toxic waste clean-up program constitutes a massive subsidy to metropolitan agencies and industries. These programs were instituted to accelerate remedy of serious environmental conditions that had been allowed to develop. Operation and maintenance, however, is paid by the beneficiaries through agency taxes and service fees.

Throughout the world, farmer-constructed and owned irrigation systems remain fully self-sufficient. This constitutes the majority of irrigation in countries from Nepal to the United States. The many farmer-owned drainage districts in Europe and the Mid West and eastern parts of the United States have long been self-sufficient, receiving no government subsidies. Costs for the drainage services are collected through property taxes with assessment rates dependent on the relative benefits within the affected area.

A majority of countries with substantial irrigation including Canada, New Zealand, Australia, South Africa and Israel subsidize government "wholesale" deliveries to some farmer-owned systems, government operated distribution systems, as well as local towns in the areas. Australia and South Africa similarly subsidize rural municipal water supplies in their dry zones. These systems were constructed to meet regional development objectives as rapidly as possible with service agreements incorporated into the enacting legislation.

The U.S. subsidized water development by the USBR to meet the same regional objectives cited above by using interest-free funding of facilities construction. Farmer districts, required by the Reclamation Act to be created before work could commence, assumed obligations to repay these funds under forty-year contracts and all the O&M costs for the distribution facilities. These charges were modified on some projects by "ability to pay" tests. Power revenues from the involved reservoirs were also used in part to reduce the charges for the primary supply features serving these districts. Under the same rules, the USBR subsidizes deliveries to some metropolitan customers within the irrigated regions. Thus, Las Vegas and the Metropolitan Water District of Southern California (MWD), which serves the greater metropolitan area of Southern California (61 percent of the region's total supply is provided at less than \$1.00 per acre foot at MWD's Colorado River diversion point) and cities and rural towns within the Bureau's service areas, benefit similarly. Upon renewal of the forty-year service contracts, provisions likely will be included to recover a portion of foregone interest on construction and possibly remove some of the power support where that still applies.

Several governments are assessing the practice of subsidies to water supplies, however, the power of regional politics holds sway in irrigation as it does in urban waste and transportation subsidy programs.

Most countries subsidize flood control to a varying extent. In the United States, cities, towns and lands along smaller streams in every state in the nation until recently received full subsidy of construction, with state and local entities funding rights-of-way costs. Local entities fund flood facilities O&M through local taxes. Construction and much of the O&M costs on the major river systems are largely funded by the national or state government general revenues. The agricultural lands and cities along such rivers as the Mississippi, Ohio, Missouri, Sacramento and Columbia Rivers benefit from massive flood control facilities built, and to a large extent, maintained by the federal government. In the case of the lower Mississippi, the largest U.S. concentration of petro-chemical industries receive both flood control and navigation subsidies through federal river projects. However, lockage fees are collected to partially cover the annual O&M costs. New federal legislation requires much greater local contribution, though substantial subsidies remain for flood control.

Agricultural polluters in every country in the world receive large subsidies, in the sense that there are no charges for the treatment costs of downstream water users. This will likely continue until government devises a means for measuring discharge and identifying polluters. The Netherlands is now considering legislation to levy special regional taxes to provide control and treatment measures as dictated by the region's impact on water quality deterioration. Ironically, government agricultural production/pricing policy, as exemplified in the EEC, can be a primary cause of increased surface and groundwater pollution by agricultural chemicals.

## **Business Principles**

Efficient operations require discipline and accountability. And water service operations is a business that must comply with these principles. To further the "utility" concept and introduce rigorous business management principles, Australia now requires local government service entities to prepare annual business plans setting out proposed activities, budgets and cost-recovery programs to be approved by the responsible minister. The "utilities" commissions or equivalent unit in other countries -- Canada, Europe and the United States -- overseeing non-governmental entities do not necessarily require detailed plans, except when an entity is preparing to secure financing or is still repaying financing instruments placed on the financial markets. This was expanded greatly after the public bond failures incurred by service utilities during the depression years of the 1930s. Most governments also have oversight units on primary business operations for entities receiving grants and repaying government loans.

## **OBSERVATIONS FROM DEVELOPING COUNTRIES**

A basic question may remain as to the applicability to developing countries of institutions found in developed countries, particularly those built on European traditions? The information readily available from developing countries is not as detailed as that from the countries presented in the foregoing sections. Important principles can be extracted from observations, however, that will help allay skepticism of using experiences from developed countries.

Studies show that the principles of organization and participant responsibilities found among farmer-owned irrigation entities in existence for several hundred to two thousand years, in Nepal, southern India, Sri Lanka and Bali, are the same as described in the preceding sections.

The principles basic to sustainable, fair services and affordable to the beneficiaries and government alike, are evident in all schemes. Water rights among farmers in sub-areas receiving water under scheme expansions and among entities on the same stream are established by priority and are honored by the farmers. Equity ownership of facilities by the farmers is universal. The beneficiaries meet all O&M costs and, through representatives, manage the enterprise. Farmers usually share O&M tasks at the immediate neighborhood (tertiary or higher) level, but often the entity employs operators who route water and assure distribution in the primary and secondary facilities following the entity's rules. All farmers know the rules and violators are promptly penalized. Operation and maintenance costs are shared in proportion to service. The maintenance objective is, unquestionably, to sustain a reliable system on into the future. Government provided little assistance in the past and, only in rare instances, provides technical advice now.

These examples are not isolated entities. They serve over 70 percent of irrigated land in Nepal, still dominate in Bali and, at pre-independence, served most land area in southern India and Sri Lanka where many thousands small schemes remain active. The principles are the same as found in Europe where local drainage districts were formed in Germany, the Netherlands and England beginning in the 12th to the 14th Centuries, and for that matter, water undertakings in North Africa and North and South America.

Water supply and waste disposal for large metropolitan areas in almost all countries are provided by institutions common throughout the world. These institutions and those for hydro and those for rail and air travel are based on recent institutional inventions tailored for the specific function to be carried out. The physical operations and the human activities to be managed, as with the earlier irrigation that preceded any of today's endeavors, determines the institutional arrangements.

In summary, a consistent set of institutional principles is found in entities exhibiting successful resources management. This is true whether at the country level or at the level of the local organization. And where performance deficiencies are found, whether pervasive in a country or isolated to a sub-sector, a careful analysis usually brings out the causative institutional short-

comings. Sound legislation or operating rules alone do little to improve results. If any one serious flaw exists in laws, policies, procedures, staffing or funding for a function, that function will fail to meet its objectives. Today, the complexities of the water resources situation in all countries and regions of the world demand that sound, comprehensive institutions are in place.



## BIBLIOGRAPHY

- Barber, W. and S. Scheierling. "Water Resources of the Developed Countries." World Bank Topic Paper No. 7, Asia Water Resources Study. Washington, D.C.: World Bank, June 1992.
- Barth, Roy, James F. Eagan and Francis E. Borcalli. "The Yolo County Flood Control and Water Conservation District - Its Development and Operation." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.
- Burchi, Stefano. "Current Developments and Trends in Water Resources Legislation and Administration." Paper presented at the 3rd Conference of the International Association for Water Law (AIDA). Alicante, Spain: AIDA, December 11-14, 1989.
- Water Resources Working Group, East Asia Country Department 3. "Indonesia - Water Resources Institutions: Issues and Opportunities." Report No. 9565-IND. Washington, D.C.: World Bank, June 17, 1991.
- Frederiksen, Harald D. "Irrigation and Drainage on Irrigation and Drainage Systems - Public Utilities that are too often Improperly Oriented and in need of Strengthened Capability." Paper presented at the XIIIth International Congress. Casablanca, Morocco: World Bank, September 14-26, 1987.
- \_\_\_\_\_. "Water Resources Institutions - Background Discussion." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.
- \_\_\_\_\_. "Planning for Droughts : An Essential Action." Topic Paper No. 1, Asia Water Resources Study. Washington, D.C.: World Bank, July 1992.
- Hancock, Lawrence F. "Role of U.S. Bureau of Reclamation in Sacramento Water Basin Development and Management." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.
- Hansler, Gerald M. "Policies and Practices of the Delaware River Basin Commission." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.
- Klostermeyer, William C. "Evolution of the U.S. Bureau of Reclamation from 1906 to the Present." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.
- Nakashima, Masahiro. "Water Allocation Methods and Water Rights in Japan." Topic Paper No. 8, Asia Water Resources Study. Washington, D.C.: World Bank, July 1992.
- Paul, Samuel. "Institutional Development in World Bank Projects - A Cross-Sectoral Review." Working Papers Series WPS 392. Washington, D.C.: World Bank.
- Reynolds, Robin R. "Agencies Involved in California Water Resources Development and Management." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.

Steiner, Wesley E. "Arizona's Institutions to Manage its Water Resources." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.

Teerink, John R. "Overview of California Water Resources Development and Management." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.

\_\_\_\_\_. "California Department of Water Resources' Role in Sacramento Water Basin Development and Management." Paper presented at the Water Resources Institutions Workshop. Washington, D.C.: World Bank, April 4-5, 1989.

\_\_\_\_\_. "Water Supply Pricing in California." Topic Paper No. 6, Asia Water Resources Study. Washington, D.C.: World Bank, July 1992.

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